Pluto LNG DEVELOPMENT

Public Environment Report / Public Environmental Review

Supplement and Response to Submissions

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Assessment No. 1632

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WOODSIDE

PLUTO LNG DEVELOPMENT
PUBLIC ENVIRONMENT REPORT/ PUBLIC ENVIRONMENTAL REVIEW – SUPPLEMENT AND RESPONSE TO SUBMISSIONS

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1. Introduction

The purpose of this document is to respond to public and government submissions on the Pluto LNG Development Draft Public Environment Report/ Public Environmental Review (Draft PER). The Draft PER was published by Woodside Energy Ltd. (Woodside), as proponent (owner and operator) of the proposed Pluto LNG Development, for public review for a period of ten weeks from 11 December 06 through to 19 February 07.

The Draft PER and PER Supplement and Response to Submissions (this document) make up the Final PER and will be provided to the Western Australian Environmental Protection Authority and Commonwealth Department of the Environment and Water Resources (formerly the Department of the Environment and Heritage) for assessment.

The PER Supplement and Response to Submissions consists of two sections which outline:

- modifications to the development concept since the Draft PER was published
- list of public and government submissions, comments and Woodside's responses.

2. Development Update

Section 4 of the Draft PER describes each of the key infrastructure elements of the proposal. Since the publication of the Draft PER in December 2006 front end engineering and design (FEED) has advanced, resulting in some modifications to the development concept. The following sections describe the key changes to the development scope.

2.1 Disturbance Footprint

As described in Section 4.7.2 of the Draft PER the gas processing facility will be located at Site B (approx. 130 ha in size) in an area gazetted by the State of Western Australia for industrial use. Since the publication of the Draft PER further engineering studies have indicated a need to change the Site B disturbance footprint due to:

- incorporation of 3D site digital terrain model (DTM) data in cut-to-fill estimates
- allowance for domestic gas (Domgas) pipeline corridor linkup to the gas processing facility
- revision of access required for transportation of plant modules from the Dampier Port Authority Material Offloading Facility to Site B.

Further changes to that footprint may be necessary as engineering studies progress.

These changes to the Site B disturbance footprint result in an increase in vegetation clearing from approximately 66 ha, as presented in the Draft PER, to approximately 90 ha. The difference between the disturbance footprints is shown in **Figure 1**.

The change in the Site B disturbance footprint results in changes to both the regional vegetation analysis and the local vegetation analysis presented in Section 9.3.1 of the Draft PER.

The resultant increase in impacts on significant regional vegetation associations is presented in **Table 1**, which is a revised version of Table 9-6 of the Draft PER. As shown in **Table 1**, the increase in clearing of vegetation associations recorded by Trudgen (2002) are generally less then 30%, with the exception of the following:

- vegetation association TeRm increases by 38.6% to 0.14 ha to be cleared
- vegetation association TeCa increases by 42.3% to 2.40 ha to be cleared
- vegetation association AcCaTe increases by 72.7% to 0.45 ha to be cleared

Note these percentages represent the extent of clearing of these vegetation associations within Site B. Despite the change in disturbance footprint, most vegetation associations of regional

conservation significance will have more than approximately 75% of their regional extent remaining on the Burrup Peninsula. Three vegetation associations will have less then 75% of their regional extent remaining after clearing for the Pluto LNG Development:

- vegetation association AbCc'Te - 19.3% remaining compared to 35.2% remaining in Table 9-6 of the Draft PER
- vegetation association AcImTe/TeCa - 16.4% remaining compared to 14.4% remaining in Table 9-6 of the Draft PER
- vegetation association TeEtSg - 74.4% remaining compared to 89.6% remaining in Table 9-6 of the Draft PER.

The changes in the Site B disturbance footprint also affect potentially locally restricted vegetation associations. **Table 2** is a revised version of Table 9-7 in Section 9.3.1 of the Draft PER and demonstrates the changes in clearing requirements of potentially locally restricted vegetation associations (as described in Section 8.3.2.3 and 9.3.1 of the Draft PER). Local vegetation associations are considered potentially locally restricted when they cannot be easily compared to regional vegetation associations mapped by Trudgen (2002).

As demonstrated in **Table 2**, the change in disturbance footprint in the northern half of Site B is minor, resulting in slight increases to the clearing of vegetation associations recorded in Site B North by ENV (2006) (2 to 4% increase in clearing).

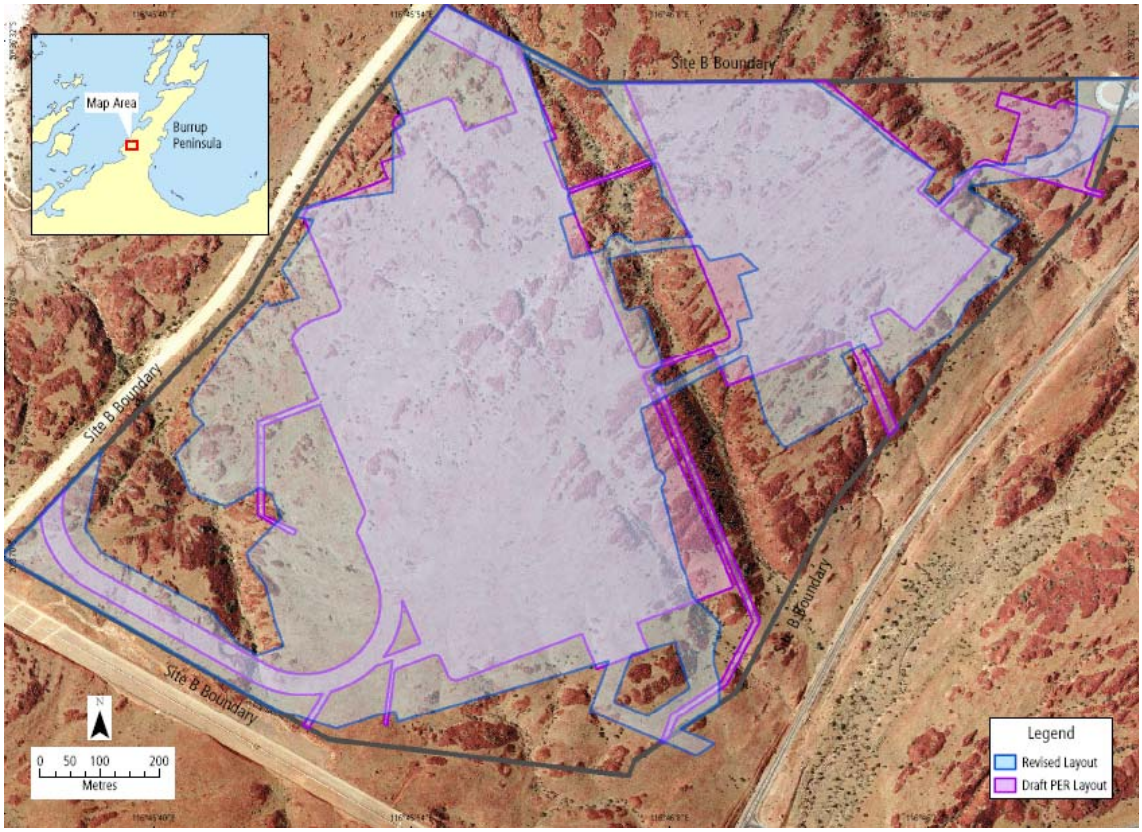


Figure 1: Draft PER and Revised Disturbance Footprint at Site B

Table 1 Changes in Disturbance to Site B Vegetation Associations Recorded by Trudgen (2002)

Conservation Significant Vegetation Associations	Total Area in Burrup Peninsula (ha)	Area in Conservation Zone (ha)	Area in Conservation Zone (%)	Total Area in Pluto LNG Development (Prior to Clearing)			Area to be cleared for Pluto LNG Development				
				Site B (ha)	Site A (ha)	Site A laydown (ha)	Site B Draft PER (ha)	Site B 2007 Disturbance Footprint (ha)	Site A (ha)	Site A laydown (ha)	% Change in Site B Clearing from Draft PER to 2007 Disturbance Footprint
AbCc'Te	0.68	0.13	19.0	0.55	0	0	0.44	0.55	0	0	20.4
AbCwTe	64.52	3.31	5.1	0.0043	0	0.11	0	0.00	0	0.11	0.00
AcCaTe	3.48	0	0	0.52	0	0	0.066	0.45	0	0	72.7
AcImTe/TeCa	0.90	0	0	0.9	0	0	0.77	0.75	0	0	-1.5
AiFdTe	16.8	2.00	11.9	0.33	0	0	0.02	0.06	0	0	13.0
R^2	2068.25	1716.59	83.0	36.01	18.77	0.97	11.35	15.21	0.18	10.7	11.6
TcCvSe	0.95	0.23	23.7	0.014	0	0	0	0.00	0	0	0.0
TeCa	36.09	1.54	4.3	4.33	6.17	0.96	0.57	2.40	0.16	42.3	42.5
TeEtSg	1.16	0	0	0.58	0	0	0.12	0.30	0	0	30.4
TeRm	51.74	10.36	20.0	0.14	0.18	0	0.08	0.14	0	0	38.6

Conservation Significant Vegetation Associations	Draft PER Total Area to be cleared for Pluto LNG Development (ha)	2007 Disturbance Footprint Total Area to be cleared for Pluto LNG Development (ha)	Previous Clearing in Site A[1] (ha)	Cumulative Area to be cleared in Burrup Peninsula based on 2007 Disturbance Footprint (ha)	Cumulative Area to be cleared in Burrup Peninsula based on 2007 Disturbance Footprint (%)	Area remaining in Burrup Peninsula after clearing based on 2007 Disturbance Footprint (%)
AbCc'Te	0.44	0.55	0	0.55	80.7	19.3
AbCwTe	0.11	0.11	0	0.11	0.2	99.8
AcCaTe	0.07	0.45	0	0.45	12.8	87.2
AcImTe/TeCa	0.77	0.75	0	0.75	83.6	16.4
AiFdTe	0.02	0.06	0	0.06	0.4	99.6
R^2	12.50	16.36	2.57	18.92	0.9	99.1
TcCvSe	0.00	0.00	0	0.00	0	100
TeCa	1.69	3.53	4.08	7.61	21.1	78.9
TeEtSg	0.12	0.30	0	0.30	25.6	74.4
TeRm	0.08	0.14	0	0.14	0.3	99.7

Most of the requirements for additional land are in the southern half of Site B, resulting in increases (greater then 50% increase) for two potentially locally restricted vegetation associations (TcBaTeCa and TsBaCpTe), as recorded in Site B South by Astron Environmental (2005).

Site	Vegetation Association	Area Within Site (ha)	Draft PER Area to be Cleared (ha)	Draft PER % to be Cleared	2007 Disturbance Footprint Area to be Cleared (ha)	2007 Disturbance Footprint % Area to be Cleared	% Change from Draft PER to 2007
Site B South	BaTsFv	6.13	0.77	12.5	2.55	41.5	29
	ChCwTe	0.15	0.06	42.7	0.10	69	26.3
	CpTaCv	0.10	0.10	100	0.10	100	0
	SgTaCv	0.17	0.05	28.7	0.08	44.4	15.6
	TcFvAc	3.42	2.16	63.3	2.32	68	4.7
	TcBaTeCa	4.13	1.24	30.0	3.12	75.6	46
	TsBaCpTe	1.53	0.16	10.2	1.53	99.7	89.5
Site B North	BaTcAcPtTe	27.96	9.72	34.8	10.84	38.8	4
	TcBaRmPtTa	0.76	0.01	1.2	0.02	3.2	2
	TcRmTe	1.43	0.46	32.4	0.51	35.8	3.4
Site A	AcAeTe	0.162	0.13	82.0	N/A	N/A	N/A
	AcIcRm	0.599	0.08	12.8	N/A	N/A	N/A
	BaTsAc	16.77	2.5	14.9	N/A	N/A	N/A
	TapTe	0.078	0	0	N/A	N/A	N/A
	TsAcAe	1.696	0.33	19.2	N/A	N/A	N/A
	Ab*AjSfTe	3.56	3.56	100	N/A	N/A	N/A
	EvAcTa	0.07	0.07	100	N/A	N/A	N/A
	IcTa'Te	0.24	0.23	95.5	N/A	N/A	N/A

Note: N/A = Not Applicable, the Site A Disturbance Footprint has not altered from that presented in the Draft PER

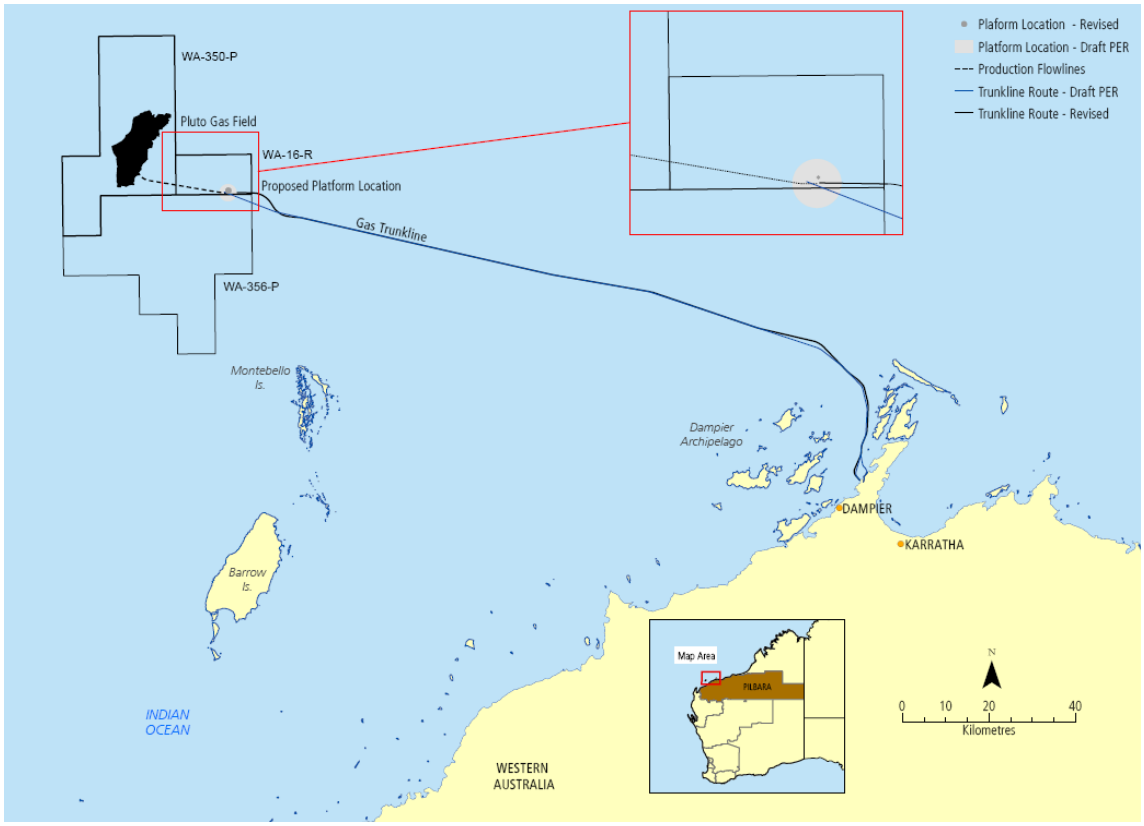
2.2 Offshore Trunkline Route

As described in Section 3.4 of the Draft PER the preferred gas trunkline route between the offshore platform and Site B comprises landfall at Holden Point (Site A) via Mermaid Sound (Option A). Engineering work is no longer progressing on Option B which would have reached landfall along the north-eastern coastline of West Intercourse Island via Mermaid Strait.

Option B has been discounted as the preferred trunkline route as a result of the significant additional onshore footprint required for this option (20 km additional onshore pipeline corridor) and the associated environmental and cultural heritage impacts. The seabed along the route through Mermaid Strait is also comprised of harder substrate which would have resulted in potentially more rock dumping requirements for pipeline stabilisation.

Woodside is not progressing environmental or cultural heritage assessments and approvals for trunkline Option B.

The preferred trunkline route (Option A) from the offshore platform to the gas processing facility at Site B on the Burrup Peninsula is illustrated in **Figure 2**.



- **Figure 2: Revised Platform Location and Trunkline Route**

2.3 Wastewater Treatment and Disposal

The reference case for treatment and discharge of wastewater described in the Draft PER involved discharge of approximately 6 000 bpd of wastewater to Mermaid Sound via a short ocean outfall located at the end of the export jetty. The Draft PER also stated that all potable and plant service water would be sourced from Water Corporation's Harding Dam or Millstream supplies.

Although this option formed the reference case, alternatives to discharging treated wastewater to Mermaid Sound were being investigated and considered in the context of the Environmental Quality Management Framework for Mermaid Sound (DOE 2006a). Produced water has traditionally been considered a waste product of hydrocarbon production; however, given the scarcity of fresh water in the Pilbara region, options to re-use water are preferred by Woodside over disposal to sea.

Since publication of the Draft PER Woodside has revised the reference case for wastewater treatment and disposal to allow for extensive treatment of all wastewater streams to meet plant service water specifications. This will result in a high level of wastewater treatment and substantially reduced discharge volumes to Mermaid Sound. Woodside is continuing to investigate options to provide the remainder of treated wastewater to a third party, thereby negating the need to routinely discharge wastewater to Mermaid Sound. A discharge line to Mermaid Sound and ability to source service water needs from Water Corporation will need to be retained in the event of treatment system upsets and/or low produced water/runoff rates.

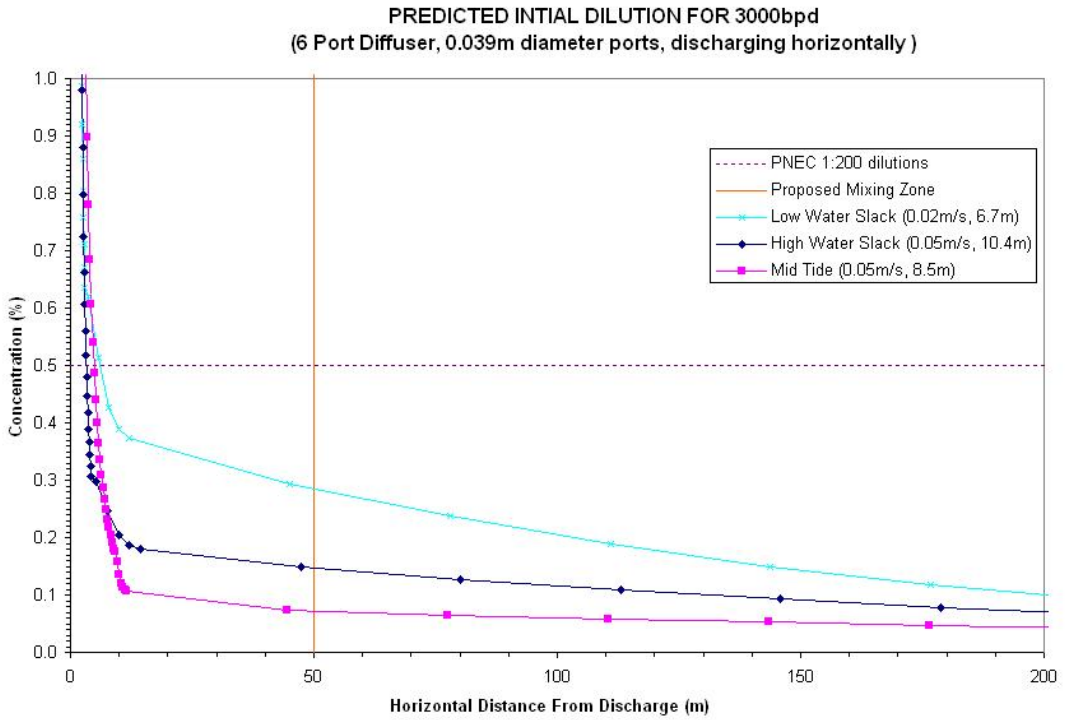
The wastewater discharge location has also been moved approximately 135 m to the east. This has resulted in decreased water depth at the discharge location from 8.7 to 6.7 m (relative to Lowest Astronomic Tide). Further wastewater dispersion modelling has been undertaken by Rob Phillips Consulting to reflect the revised discharge volume and change in discharge location.

As per the original results presented in the Draft PER, the revised modelling indicates that periods of low water depths and weak ambient current speeds are worse case conditions for mixing (**Figure 3**). Revised near-field modelling during slack water with current speeds of 0.02 m/s predicts initial dilutions of 1:256 (0.39% wastewater) at 10 m from the discharge location and 1:345 (0.29% wastewater) at 50 m from the discharge location (that is, the edge of the proposed mixing zone). This is an improvement on the 6000 bpd case discussed in the Draft PER which showed dilutions of 1:200 (0.50% wastewater) and 1:300 (0.33% wastewater) at 10 m and 50 m from the discharge location respectively.

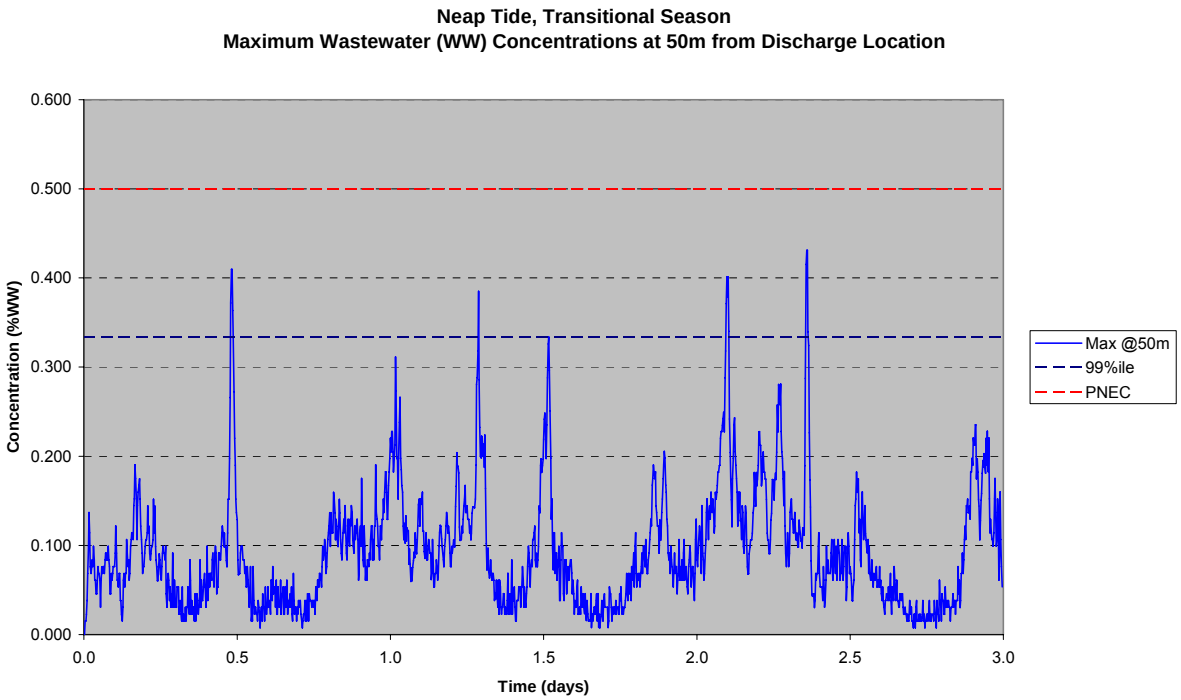
Far-field modelling has also been revised to take into consideration the potential for recirculation of the plume over the discharge location. **Figure 4** presents the predicted wastewater concentration at the edge of the proposed 50 m mixing zone for the duration of the worse case model scenario (neap tide and low wind speeds). Concentrations peak at just over 0.4% wastewater; however, for 99% of the time concentrations remain below 0.4% wastewater. The spatial distribution of maximum instantaneous concentrations recorded over the duration of the three day simulation is shown in **Figure 5**. The 0.4% wastewater contour limit extends just beyond the 50 m mixing zone (denoted by red ring); however, as shown in **Figure 4**, these peak concentrations occur for a short duration.

Worse case mixing conditions (low wind and current speeds) occur for only a small percentage of time, and for prevailing conditions it is likely that concentrations at the edge of the mixing zone will be less than 0.1% wastewater (1:1000 dilutions) for the majority of the time.

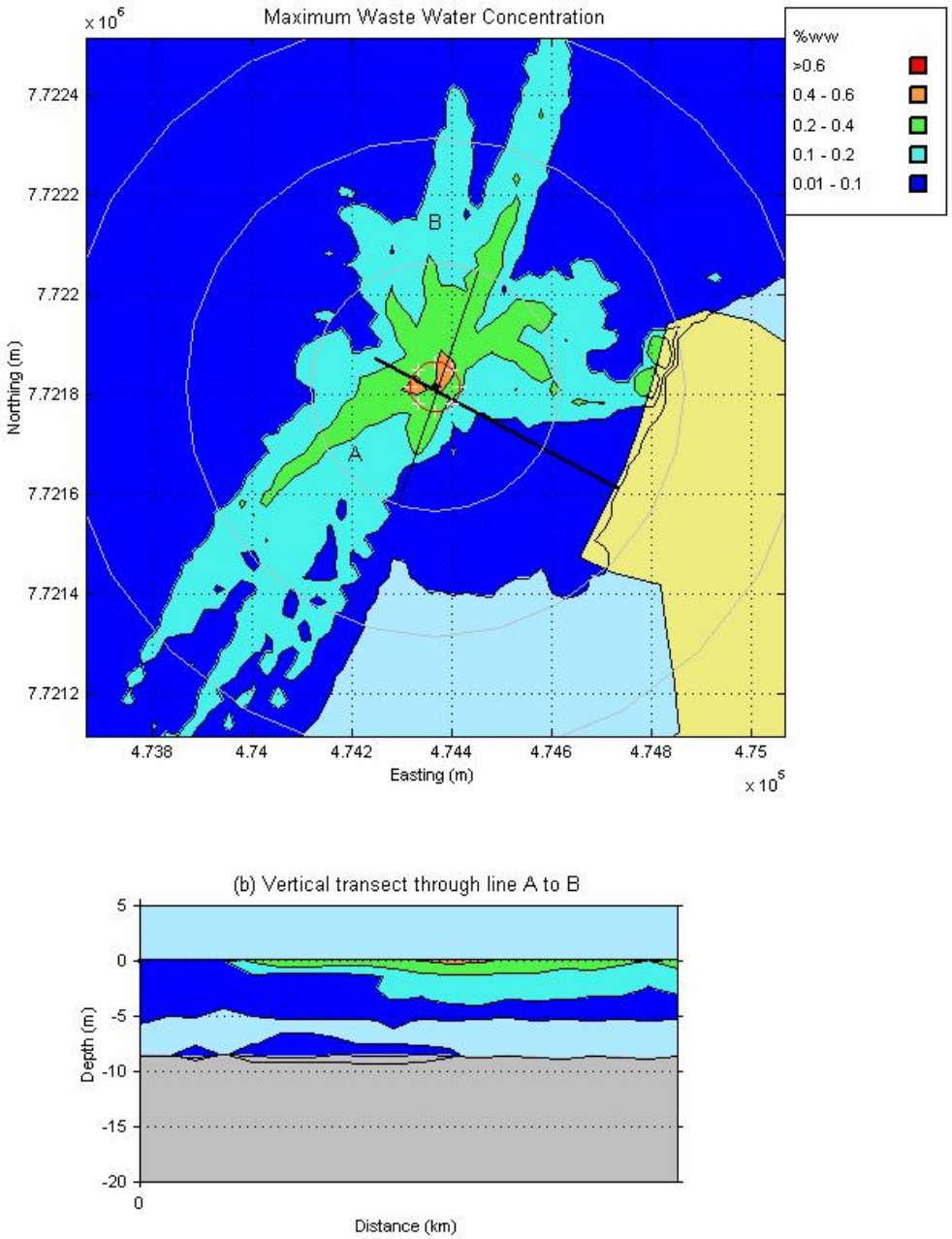
Revised modelling concludes that the reduction in wastewater discharge volume will result in improved dilution in the near-field.



- **Figure 3: Comparison Between Near Field Dilution for Various Discharge Options**



- **Figure 4: Predicted Maximum Wastewater Concentrations for Typical Conditions During the Transition Season for a Neap Tide (Worse Case Scenario)**



- **Figure 5: Time Series of Maximum Wastewater Concentration at 50 m from the Discharge Location for a Neap Tide During the Transition Simulation**

Note: range rings are 250 m apart; red ring denotes the proposed 50 m mixing zone; white crosses are locations where time series are extracted.

3. Response to Submissions

Thirteen government and public submissions have been received on the Draft PER for the proposed Pluto LNG Development (**Table 2**). This section contains Woodside's formal responses to the issues raised in these submissions.

- **Table 2: Public and Government Submissions on the Draft PER**

No.	Submission
1	International Federation of Rock Art Organisations (Robert Bednarik)
2	Russell Clemens
3	Conservation Council of Western Australia
4	Department of Fisheries
5	Dampier Port Authority
6	Western Australian Museum
7	Anna Vitenbergs
8	GetUp! (Brett Solomon)
9	EPA Service Unit
10	Department of Environment and Conservation
11	Ngarluma Aboriginal Corporation
12	Department of Health
13	Jeannine Gan and Christopher Malcolm

Environmental Approvals Process

5.11 It is noted a supply base has not been included for assessment in this document, although the DPA is aware that Woodside are considering establishing a base in the port area.

Woodside is currently assessing options for a supply base to service the Pluto LNG Development and potentially other Woodside operations in the North West Shelf region. This includes the option of potentially expanding the existing King Bay Supply Base or development of a stand-alone supply base elsewhere within King Bay area. The preferred supply base option will be subject to an additional environmental assessment and approval process.

Stakeholder Engagement

1.8 Item 2.1, Consultation of Stakeholders to Date: Numerous false claims are made. For instance the consultation of Traditional Custodians has been a farce in every possible respect. In Table 2-1, we, the International Federation of Rock Art Organisations, are listed as having been consulted. We have never, in any form or fashion, been consulted by Woodside.

Woodside has been in contact with IFRAO both via written correspondence and telephone discussions, and is aware of IFRAO's concerns regarding development on the Burrup

Peninsula. These concerns have been addressed in the Draft PER. In particular a description of the potential impacts to and management of Aboriginal cultural heritage within the proposed development area is provided in Section 10.3 and Section 11.4 of the Draft PER.

Comprehensive consultation has been undertaken with the Traditional Custodians in regards to cultural heritage.

11.1 Woodside has not consulted at all with us [the Ngarluma Aboriginal Corporation] about the Pluto project, despite its comments in the draft PER, its policies and obligations to us under the BAMIEA, the Burrup Agreement that we made with the State government.

11.2 Woodside [has failed to] involve us in any heritage site surveys, sharing of information in survey reports and not providing us with any documentation about the proposed Pluto project nor the Pluto Site A and B section 18 Aboriginal Heritage Act (AHA) applications.

11.4 Woodside's decision makers have refused to meet with us [the Ngarluma Aboriginal Corporation] as Traditional Owner decision makers.

11.14 Table 2.1 lists 'Ngarluma people' as 'stakeholders contacted by Woodside'. NAC is the corporate spokesperson for the Ngarluma people and our Country and we have not been 'contacted.'

11.12 we have not been involved in 'cultural heritage induction' nor any heritage surveys nor monitoring

11.13 we have not been involved in any development of 'Environmental Management Plans' nor any 'Cultural Heritage Management Plan'

Woodside has consulted with representatives nominated by the Ngarluma, Yindjibarndi, Yaburarra, Mardudhunera and Wong-Goo-Tt-Oo groups. The Ngarluma Aboriginal Corporation is a Prescribed Body Corporate established under the Native Title Act to hold and manage Native Title interests for the Ngarluma native title claimant group. Native Title has been found not to exist over the Burrup Peninsula.

Woodside has offered to discuss the Pluto LNG Development with the Ngarluma Aboriginal Corporation. The Ngarluma Aboriginal Corporation has declined to meet with Woodside for that purpose. Further, in June 2006 at a meeting attended by the Aboriginal Cultural Material Committee, representatives from Woodside and representatives from each of the Indigenous groups who participated on the heritage surveys, the Ngarluma elders clearly said that Ngarluma representation on heritage surveys is a matter for the Ngarluma community to agree and resolve. As such, the Chairperson of the Ngarluma Aboriginal Corporation, who was present at this meeting, was asked to organise a Ngarluma community meeting at which the community would discuss and conclude Ngarluma heritage survey representation. Woodside, until advised otherwise by the Ngarluma community and elders, will not change the way that it conducts heritage surveys including who participates on those surveys.

Comprehensive heritage surveys have been conducted over the Pluto LNG Development leases. These surveys involved archaeologists, anthropologists and senior members of the Indigenous community who have been identified by the community. This included senior Ngarluma elders.

11.3 All aboriginal groups oppose the proposal.

11.15 Woodside acknowledges that "none of the Indigenous groups of the area are supportive of the development on the Burrup Peninsula". Yet Woodside wishes to proceed anyway, flying in the face of its own publicly declared 'Indigenous Community Policy'

1.14 [We recommend that the EPA request the following from Woodside]…To provide written evidence that the senior Traditional Custodians of the local Indigenous groups agree to the placing of this plant on their traditional land.

1.2 The further destruction of the Dampier monument is strenuously opposed by the Wong-Goo-Tt-Oo, the Ngarluma and the Mardudhunera-Yaburrara.

In 2003 the Ngarluma/Yindjibarndi, Yaburarra/Mardudhunera and Wong-Goo-Tt-Oo groups agreed with the State Government of Western Australia, under the Burrup and Maitland Industrial Estates Agreement, to the establishment of an industrial estate on the Burrup Peninsula. The Burrup LNG Park, the onshore component of the Pluto LNG Development, is proposed to be constructed within this agreed industrial estate.

Woodside understands that the Indigenous groups of the area do not support further development on the Burrup Peninsula and that in the event that development is to occur, the groups wish to be involved in heritage management consultations and surveys so as to influence how development proceeds with a view to minimising impact and protecting their interests.

Woodside's approach to heritage management is one of heritage site avoidance where practicable which is not inconsistent with any of the Company's policies or the requirements of any State or Commonwealth legislation. Woodside has applied for relevant approvals to progress the proposed Pluto LNG Development on that basis.

Development Alternatives

1.7 The most suitable site for the Pluto Project is at Onslow, where even construction costs would be significantly lower.

1.18 [We recommend that the EPA request the following from Woodside]…To explain in detail why Onslow is not a realistic option for the siting of the Pluto plant.

The site selection process and the factors that led to the selection of the Burrup Peninsula as the preferred onshore location for the Pluto LNG Development are described in detail in Section 3 of the Draft PER.

As described in the Draft PER, the site selection process included investigation of 12 potential development locations, including Onslow. Onslow and the Burrup Industrial Estate option were carried as alternative locations after other sites had been discounted. Significant engineering work and assessment of cost, technical, environmental and socio-economic factors was undertaken for these development options.

Onslow currently carries a range of uncertainties that are considered to present a significant risk to Woodside's development timeframe for the Pluto LNG Development. Onslow presents technical and cost challenges for the Development particularly with regard to capital and operational costs associated with marine facilities (length of jetty and shipping channel) and marine operability (sea-state) off Onslow. Other uncertainties include the unresolved status of industrial sites south of Onslow, existing Native Title claims which have not yet been determined, limited existing community infrastructure and lack of government support for a development of this size in this area and timeframe.

8.4 The economic grounds for this proposed site [Burrup Peninsula] have always been weak. The Council of the Shire of Roebourne, where the majority of the area's North-West Shelf workers reside, has previously stated in 2002: 'There are only limited areas for further expansion on the Burrup...It is a false economy to squeeze developments into relatively small, disconnected valleys...The Shire of Roebourne urges the State government, in conjunction with the Federal Government, to encourage relocation of these industries, through the provision of common use infrastructure'.

The industrial land allocated to Woodside for the Pluto LNG Development provides sufficient space suitable for development. The Pluto LNG Development site is located in the proximity of significant industrial and community infrastructure and existing public port facilities and shipping channels. Significant common user infrastructure has been installed in the Burrup Industrial Estate by the Government of Western Australia to support industrial development.

3.1 In response to this PER the Conservation Council of WA reiterates our extreme disappointment in Woodside's decision not to use previously cleared industrial land, existing port facilities and existing dredged channel at the NWS Joint Venture facility. This disappointment has been made clear to the proponent during a number of public consultation meetings. Relocating the project to the JV site would avoid all of the significant damage to very high conservation value terrestrial and marine flora and fauna as well as the internationally significant Burrup rock art. It appears the only barrier to using the existing facility is an unwillingness to engage with other Joint Venture partners to negotiate a suitable arrangement. This is completely unacceptable given the sensitivity of the receiving terrestrial, marine and cultural environments.

8.5 It makes far more, long-term economic sense to capitilise on the newly discovered natural gas fields from one of two locations: in the already destroyed and flattened land on the Burrup, close to the North-West Shelf Joint Venture, or further down the coast, around Onslow – where flat expanses of featureless spinifex, devoid of any obstacles to industrial construction, abound. Each of the Joint-Venture partners have stated a willingness to negotiate the inclusion of the Pluto plant on the already destroyed land – letters to this effect have been included at the end of this submission.

The North West Shelf Venture (NWSV) site is not leased by Woodside alone but by a joint venture of which Woodside is a one-sixth participant. In 2006 Woodside put forward a proposal to the joint venture participants to construct the Pluto LNG Development onshore facilities within the NWSV lease area. The joint venture chose not to accept this proposal.

Consequently, Woodside has proceeded with its own development proposal on alternative industrial sites. Given the progress already made with the detailed engineering and design studies, the current proposal at Site A and Site B represents the only option that can satisfy customer requirements for LNG supply from late 2010.

As described in the Draft PER the site selection process included investigation of 12 potential development locations, including Onslow. The site selection process and the factors that led to the selection of the Burrup Peninsula as the preferred onshore location for the Pluto LNG Development are described in detail in Section 3 of the Draft PER.

11.8 We [Ngarluma Aboriginal Corporation] note that alternative sites were primarily considered only 'from an engineering feasibility perspective'. Woodside clearly prioritises this purely technical perspective above more important social and cultural perspectives, perspectives that would say the proposal should not occur where Woodside wants it to.

The site selection process and the factors which led to the selection of the Burrup Peninsula as the preferred onshore location for the Pluto LNG Development are described in detail in Section 3 of the Draft PER.

Woodside has applied a range of environmental and socio-economic considerations to site selection and these supported the decision to locate the Pluto LNG Development on the Burrup Peninsula. Detailed environmental and socio-economic criteria were developed in consultation with stakeholders, and are presented in Table 3-4 of the Draft PER.

5.13 Trunkline route Option B is not supported by the DPA, as it is considered a sub-optimal use of the area in relation to future development of the port.

10.5 Given that the gas trunkline is a key component of the Pluto LNG Development the proponent should provide supplementary data and discussion on the potential terrestrial and marine environmental impacts of route Option B if this option is to be considered for impact assessment and/or possible approval.

Trunkline route Option B is no longer being carried as an alternative trunkline route and Woodside is not progressing environmental or cultural heritage assessments and approvals for this option.

Emissions Discharges and Waste

8.2 We are also still unaware of the effect CO_2 emissions from the new Pluto plant will have on surrounding petroglyphs in the long-term – no scientific evidence can conclusively say what will happen either way.

1.6 The high concentration of acidic atmospheric emissions is destroying the rock art, further acidic emissions (a doubling of current 12000 t/yr NOx plus others) need to be located elsewhere.

1.16 [We recommend that the EPA request the following from Woodside]…To provide technical details of the effects of the acidic pollution on the ferruginous rock accretion, bearing in mind that Woodside has already lowered ambient pH from 7.2 to 4.6 causing acidic precipitation 50 weeks in the year.

1.17 [We recommend that the EPA request the following from Woodside]…To provide a documented and reliable prediction of how much further the precipitation pH will be lowered by the Pluto plant.

13.3 This section [Emissions, Discharges and Waste] to include the significance and the effect of any emissions on the Indigenous rock art in the vicinity of the Pluto plant.

13.16 There is a lack of correlation between the field studies outcomes and Woodside's assertions that there is no clear evidence of change in condition of the rock art as the field studies were not done where the emissions suitably simulated either the current baseline (based on Karratha gas plant or similar) or forecasted air quality as stated in other sections of the PER.

13.17 Why have no international standards been identified and applied to assess the impact of emissions on the rock art? Why is there inconclusive evidence from the analysis undertaken, and was additional assessment and monitoring not undertaken until conclusive evidence had been established?

13.24 Similarly, if Woodside is operating in accordance with its Environmental Policy, why has it not published the impact of NO2 and CO2 emissions on the rainfall pH, and why has it not advised the affect of this on the rock art?

The potential impacts of atmospheric emissions on rock art are discussed in Section 11.4 of the Draft PER.

As discussed in the Draft PER, the presence of heavy industry on the Burrup Peninsula has generated concerns that industrial emissions may lead to an accelerated deterioration of rock art. These concerns centre on the issue of potential acid deposition which can occur when

sulphur dioxide (SO_2), carbon dioxide (CO_2) or nitrogen dioxide (NO_2) react with water, oxygen and other oxidants in the atmosphere to form acidic compounds.

In 2002 the Government of Western Australia appointed the Burrup Rock Art Monitoring Management Committee to assess whether there has been any change to the petroglyphs over and above that due to natural weathering. The Committee has commissioned CSIRO Atmospheric Research to conduct an air pollution monitoring programme. The Committee has also commissioned several studies into rock art appearance, with the work primarily done by CSIRO Manufacturing and Infrastructure Technology and some input from CSIRO Exploration and Mining.

Interim results from this work indicates that current levels of air pollution on the Burrup Peninsula are low (well below national and international environmental and health standards and at least one-tenth of what is found in Perth) and are not resulting in accelerated rock art weathering or damage to the rock art.

All known sources of air emissions on the Burrup Peninsula have been included in a cumulative air quality assessment for the Pluto LNG Development. The results of this work are presented in Section 5.1.2 and Section 9.5 of the Draft PER.

1.13 [We recommend that the EPA request the following from Woodside]…To provide firm estimates of the quantities of CO_2, NOx, SOx and benzene to be emitted by the Pluto plant once operational.

Estimates for the quantities of CO_2, NOx, SOx and benzene emissions from the operation of the gas processing facility are provided in the Draft PER. Estimated emissions of CO_2 and other greenhouse gases are described in Section 5.1.1 and estimates for NOx, SOx, benzene and other combustion products are provided in Section 5.1.2.

4.7 The proponent should be encouraged to adopt one of the land-based options for the discharge of waste water.

5.3 The DPA does not support discharge of any wastewater to Mermaid Sound and would encourage Woodside to consider reuse opportunities such as freshwater requirements of offshore exploration drilling programs.

Since publication of the Draft PER Woodside has revised the reference case for wastewater treatment and disposal to allow for extensive treatment of all wastewater streams to meet plant service water specifications. This will result in a high level of wastewater treatment and substantially reduced discharge volumes to Mermaid Sound. This strategy would also reduce consumption of regional potable water that would otherwise be provided by Water Corporation.

Woodside is continuing to investigate options to provide the remainder of treated wastewater to a third party, thereby negating the need to routinely discharge wastewater to Mermaid Sound. A discharge line to Mermaid Sound and ability to source service water needs from Water Corporation will need to be retained in the event of treatment system upsets and/or low produced water/runoff rates.

5.5 Prior consultation with the DPA is required should there be a need to discharge pipeline hydrotest water within port limits.

This comment is acknowledged. Woodside will consult with all relevant stakeholders, including the Dampier Port Authority, prior to disposal of hydrotest water.

12.3 An Air Quality Management Plan (AQMP) is recommended to address air emission issues that could arise from the commissioning and the operation of the LNG plant. Specifically the AQMP should include a program of stack emission monitoring to verify current emission estimates. The AQMP should also include compliance monitoring and reporting requirements to be undertaken.

Air emissions from the Pluto LNG Development will occur during commissioning and normal operations of the gas processing facility and for some hours over the course of a year during non-routine operations. The most significant emissions are generated by the combustion of fuel gases from gas turbines and by flaring associated with the gas processing facility. Air emissions have been estimated through an air quality assessment and are presented in Section 5.1 of the Draft PER.

Where applicable, emissions may be further managed by works approvals and licence conditions set by the DEC under the *Environmental Protection Act 1986*.

12.4 It is the preferred option that all human sewage waste generated by onshore activity is treated by a packaged wastewater treatment plant with associated land based disposal area that complies with the requirements of the Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974, and that application to construct or install this system is made to the local government.

During operations, Woodside plans to treat sewage generated by onshore activity in a packaged wastewater treatment plant. Woodside intends to use the treated effluent onsite, and plans to dispose of treated sludge at a licensed landfill. Woodside will seek relevant approvals to undertake those activities.

12.8 To ensure appropriate protection of people during recreational use of natural estuarine and ocean waters, water quality should be assessed against the National Health and Medical Research Council's Guidelines for Managing Risks in Recreational Waters.

The primary objective of the *National Health and Medical Research Council's Guidelines for Managing Risks in Recreational Waters* is to protect human health from threats posed by the recreational use of coastal, estuarine and fresh waters including natural hazards such as surf, rip currents and aquatic organisms, and those with an artificial aspect, such as discharges of wastewater. The guidelines are not mandatory; rather, they have been developed as a tool for state and territory governments to develop legislation and standards appropriate for local conditions and circumstances.

The relevant characteristics of the guidelines in relation to the Pluto LNG Development are *Chemical Hazards* and *Aesthetic Aspects* and are discussed below:

Chemical Hazards: Current recreational activity levels within the area of the proposed wastewater discharge location are not significant and will be limited as a result of the presence of the proposed jetty. As stated in the Draft PER (Section 11.11 p. 404), public access to Holden Point via road is currently prohibited and the beach is visited by few recreational visitors. Public access by boat will be restricted (as described in Section 5.2.15 of the Draft PER) in the interests of health and safety.

In areas where significant recreational activity takes place, (for example, around Conzinc Island and at Conzinc Bay) it is considered highly unlikely, based on wastewater dispersion modelling, that chemical hazards from treated wastewater will be an issue (refer to response to **Comment 9.3** for details on chemical constituents and their concentrations and to Section 7.8.13 of the Draft PER for discussion on potential impacts from treated wastewater discharge). Water quality monitoring at the boundaries of a localised mixing zone, which is proposed as part of the Pluto LNG Development Wastewater Management Plan, will confirm that contaminants are within the Pilbara Environmental Quality Management Framework guidelines for recreational waters.

Aesthetic Aspects: Aesthetic issues associated with dredging induced turbidity (reduction in water clarity) will be assessed in accordance with the Pilbara Environmental Quality Management Framework. The 'National Health and Medical Research Council's Guidelines for Managing Risks in Recreational Waters' states that 'No guideline values have been established for aesthetic aspects' .

Refer to the response to **Comment 9.11** for further discussion of dredging impacts on recreation and aesthetic values and for proposed criteria for assessing turbidity impacts.

Impacts associated with water clarity will be managed according to **Section 7.9.15** of the Draft PER and the Framework Dredging and Spoil Disposal Management Plan (**Appendix I**).

12.9 Management Plans for the discharge of the produced water will also need to meet the requirements of the Radiological Council and, as appropriate, the Petroleum Division of the Department of Industry and Resources and/or the National Offshore Petroleum Safety Authority.

The requirements of the Western Australia Radiological Council and the Petroleum Division of the Department of Industry and Resources will be considered in the finalisation of a comprehensive Wastewater Management Plan.

13.6 What monitoring will be included in the forthcoming Management Plans both during construction and for the normal operation phases?

Regular monitoring of stack emissions will be carried out in compliance with Works Approval and Operating Licence Conditions under Part V of the *Environmental Protection Act 1986* (WA).

Dust emissions during construction will be minimised through the development and implementation of a Dust Management Plan. A Framework Dust Management Plan was provided in Appendix G of the Draft PER.

13.19 What avenues for recourse and restitution will the community and the custodians of the rock art have once the plant has been constructed and is found to be causing direct and irreparable damage to the rock art?

Woodside has provided its assessment of the likely impacts of the proposed Pluto LNG Development in the Draft PER.

The plant will be designed, built and operated in accordance with the environmental approval conditions established by the Western Australian and Australian Governments. Air-borne emissions will be managed within licence limits and exceedences will be reported to authorities. Woodside is supporting the work currently being undertaken by the Burrup Rock Art Monitoring Management Committee.

Woodside's approach is to avoid impact and our performance will be monitored by government regulators.

13.23 What records can Woodside provide of data associated with the pH of natural rainfall from the area surrounding the Karratha LNG facility as an indication of the likely atmospheric changes in the Dampier area?

Wet deposition is not believed to be a significant exposure pathway for acidic emissions on the Burrup Peninsula (CSIRO 2006). The Burrup Rock Art Study currently being conducted by CSIRO for the Department of Industry and Resources has found to date that the local

vegetation and land surfaces (including rock art) are not considered sensitive to the acid deposition impacts. Consequently Woodside does not anticipate monitoring of rainfall pH to be separately undertaken for the Pluto LNG Development.

Marine Impacts and Management

3.2 The Council also recommends to the EPA that any approval for this project (in either location) be coupled with a condition that Woodside engage an appropriate independent consultant to fully assess the cumulative impacts of their operations on the marine and terrestrial environments of the Burrup before any development is commenced.

Woodside is currently conducting a cumulative environmental impact assessment of its operations in the North West Shelf region. This study is being undertaken with the participation of the Department of Environment and Conservation and independent scientists.

3.3 Woodside should be required to conduct a full baseline survey of any areas likely to be affected by Woodside's operations on the Burrup and permanent monitoring sites should be established to ensure the protection of the Burrup's rich biodiversity.

In line with the Environmental Scoping document for the Draft PER, baseline studies have been planned and undertaken for both onshore and offshore environments in which development activities are proposed. The results of field surveys are described in the Draft PER and supporting technical appendices and form the basis for assessment and management of predicted environmental impacts of the proposed Development.

Environmental management plans that outline specific environmental monitoring requirements will be developed in consultation with relevant regulatory authorities. In some cases further surveys and studies will be undertaken as part of Woodside's commitment to manage the likely environmental impacts of the proposed Pluto LNG Development identified by this impact assessment process. For example, a regional-scale marine environmental baseline of fixed monitoring stations was established and implemented in 2006 and will provide physical and biological data to support management and monitoring of effects of marine construction activities. It is expected that the findings of this baseline study will contribute significantly to a better understanding of local and regional physical processes as well as to various aspects of the biological communities in Mermaid Sound.

4.2 The PER should contain a comprehensive NIMS [non-indigenous marine species] risk assessment that, at a minimum, should examine the type of vessel/equipment, where and when the vessel/equipment has come from (i.e. last port of call) and the type of surfaces on the vessel/equipment that may be at risk from carrying NIMS. For example, all vessels should be examined for their risk profile in relation to NIMS including tending vessels, blast barges, structures and equipment such as floating docks, platforms etc. The Department of Fisheries can be contacted to provide advice on developing a comprehensive risk management plan.

4.3 Inspection requirements should include examination of internal systems, including internal strainers. Precautionary treatment of these systems prior to arrival should also be considered. This may include freshwater treatment of dredge ballast tanks, although this is not mentioned within the PER.

4.4 The Quarantine Act 1908 *and Regulations 2000 (Cwth) mentioned in the PER (Table 13-1) only apply to ballast water management requirements. Hull and internal fouling should also be identified as issues within the PER.*

4.6 Reference is made in relation to the preparation and implementation of a Marine Pest Management Plan. Current management strategies in relation to external and internal hull fouling are insufficient. Such a plan should include both prevention and response

provisions. Prevention requirements such as pre-arrival inspection and treatment option[s] should include incident response plans that would be implemented if any non-endemic or pest species were identified on any project vessels, structures or equipment.

Woodside will comply with all relevant legislation and regulations in respect of managing the risk of introducing non-indigenous marine species (NIMS) associated with the proposed Development.

The risks and potential impacts associated with marine pest species, including those associated with vessel ballast water, hull fouling and residual sediments contained on dredges and in ballast tanks were identified and discussed in Section 7.7 of the Draft PER along with a summary of mitigation and control measures.

Woodside recognises the importance of having a robust management plan in place to manage risks of introducing non-indigenous marine species. As outlined in the Draft PER, the focus of environmental management will be on prevention, with proposed management measures as outlined in the context of the Framework Management Plan (Appendix G of the Draft PER). This framework is the basis for development of a detailed management plan that will be developed in consultation with the Department of Fisheries and other relevant stakeholders.

4.5 Impacts to be avoided or minimised in relation to NIMS also relates to the introduction of exotic parasites and diseases that may affect endemic species. This is currently not identified in the PER (Table ES-1 or section 7.7).

Woodside would expect to have to satisfy the same requirements that apply to other regional port users in respect of managing risks of introducing exotic parasites and diseases. Woodside is not aware of evidence showing that diseases and parasites have been introduced and impacted endemic species through the types of construction activities proposed.

5.1 A recent survey of the spoil grounds has confirmed there has been a substantial loss of dredged material from the Northern Spoil Ground. This highlights the incompatibility of disposing fine material at this location. This spoil ground has more capacity for coarse material than estimated during the initial discussions with Woodside and hence it is unlikely there is a need to extend the existing spoil ground to the north. The disposal of fine material at this location is not supported. Further consultation with the Dampier Spoil Management Committee is required.

This comment is acknowledged. Woodside will consult with the DPA and the Dampier Spoil Management Committee in relation to appropriate means of disposing material generated from marine construction and dredging work. Woodside is investigating the feasibility of locating more material to the deep water spoil ground (i.e. spoil disposal ground 2B).

5.6 It is DPA's preference that dredged material of engineering quality be disposed at a location from where it can be readily retrieved and reused.

5.7 For backfill of trenches in port limits, it is DPA's preference to utilise dredge material of engineering standard stored in the southern spoil ground rather than sourcing from land or dredging a borrow area that is outside the footprint of the dredge program.

This comment is acknowledged. Woodside's preference, wherever practicable, is to dispose of spoil material at sites in reasonable proximity to construction works as this avoids additional environmental and operational constraints associated with long haulage distances and additional vessel movements.

Woodside is investigating options to re-use some of the coarser clean spoil material located in the existing Northern Spoil Ground and similar materials generated during the proposed inshore dredging of the turning basin and shipping channel. The spoil and dredged material from these

locations is considered suitable fill for stabilising sections of the proposed trunkline. The use of pre-existing, clean spoil is viewed as, overall, a more attractive option environmentally as it eliminates risks and impacts associated with the alternative option of sourcing large quantities of rock from onshore sites that would require additional blasting and quarrying and with the attendant impacts associated with removal, transport and offloading of material to site.

6.1 In this section [4.6.5 Dredging], a maritime archaeological survey is required for areas proposed for dredging and blasting.

Woodside is required to notify the Aboriginal Cultural Material Committee if the company believes that its activities will damage Aboriginal heritage sites and to seek consent to use land for a required purpose in that instance. Woodside has no reason to believe that it will disturb Aboriginal heritage sites during maritime operations associated with the Pluto LNG Development.

5.2 Where relevant, the DPA expects Woodside to comply with DPAs existing and planned port wide environmental management control measures such as the DPA Environmental Management System, Contractors Handbook, Dampier Cargo Wharf Terminal Handbook, local Marine Notices etc. These are available on the DPA website (www.dpa.wa.gov.au).

In undertaking its activities, Woodside will comply with all relevant laws and regulations, including those that fall under the jurisdiction and responsibility of the DPA in administering and enforcing its legal obligations and requirements on port users.

5.9 The DPA encourages research in the region to support improved environmental management. Any planned research in the marine environment should be undertaken in consultation with the DPA who maintains a coordinated approach.

5.10 The DPA is currently investigating the potential for a port wide common marine monitoring program. It would be expected that Woodside contribute to this program.

Woodside supports the DPA position of taking a coordinated approach to marine research and will consult with DPA and other relevant regional stakeholders in relation to proposed research it may be considering where this has potential mutual benefits in managing areas of common environmental risk. In that regard, Woodside has recently engaged in preliminary discussions with other regional users, including DPA, with the purpose of seeking to identify potential opportunities for coordinating aspects of marine environmental monitoring.

5.12 The DPA would expect Woodside to consult with DEC regarding design of lighting to minimise impacts to turtles.

This comment is acknowledged. The DEC will be consulted regarding strategies to minimise impacts on turtles during the development of detailed Environmental Management Plans.

7.1 This Pluto report makes specific mention of turtle safety during construction (i.e. dredging etc.) however, I am unable to find any specific plan, future strategy, or research programme that addresses the long-term potential impacts of this project on the marine reptile species classified as endangered and vulnerable (see 6.3.8 Table 6-5) and, to date, largely ignored in the Dampier Archipelago.

A Framework Sea Turtle Management Plan was provided in Appendix G of the Draft PER, and a Framework Dredging and Spoil Disposal Management Plan was provided in Appendix I of the

Draft PER. Both of these management plans will be further developed in consultation with the DEC and other relevant government agencies to minimise potential impacts on turtles.

7.2 Recommendation: that Pluto commits to a long-term, appropriately structured turtle research programme in the Dampier Archipelago addressing, inter alia, the impacts of:

- *artificial lighting (onshore and offshore)*
- *flare towers*
- *construction activities (spoil dumping, dredging, blasting etc)*
- *habitat destruction (nesting and foraging)*
- *vessel impacts*
- *waste disposal*
- *increased recreational impacts.*

Additional research to identify:

- *definitive turtle habitat mapping of the Dampier Archipelago including:*
  - *mating and nesting sites*
  - *nesting beaches and nest success rates*
  - *aggregation sites*
  - *migratory routes*
  - *feeding and internesting grounds*
  - *population numbers and trends*
  - *hatchling orientation.*

Potential impacts to sea turtles will be managed through engineering design where required (for example, design of lighting to reduce light spill) and management plans including a Sea Turtle Management Plan, a Dredging and Spoil Disposal Management Plan and a Waste Management Plan. Management plans will be developed in consultation with the DEC and other relevant authorities.

Woodside is supportive of research programs, and will consider funding appropriate investigations into sea turtle ecology.

9.1 No information on the toxicity of the hydrotest fluids and consequently the concentration threshold in marine waters considered to be safe to biota has been provided. This information is essential for assessing the potential risk to marine ecosystem and should be provided along with any necessary management strategies that will be implemented to prevent any impacts in the response to submissions(e.g. method of discharge, flow rate and calculated zone of effect (if any)).

Hydrotest fluids from the trunkline, flowlines and services lines will be discharged near the offshore platform, in water depths of approximately 80 to 85 m. Seawater is likely to be used to hydrotest the onshore storage tanks and it is likely that this will be discharged nearshore.

Offshore Discharge of Hydrotest Fluids: The trunkline, flow lines and service lines will be hydrotested with filtered seawater containing leak detection dye and treated with oxygen scavengers and biocides. The dosage rates for oxygen scavenger, biocide and leak detection dye shall be sufficient to prevent internal corrosion and bacterial attack for the entire period that the water will be resident in the pipelines.

To ensure these chemicals do not present a significant threat to the offshore marine environment, only those chemical brands with a minimum Hazard Quotient (HQ) category of 'Silver' or 'Gold' or Categories D or E (for non-CHARM assessed chemicals) under the United Kingdom Offshore Chemical Notification Scheme will be used. All chemicals will either be included on the CEFAS List of Notified Chemicals in accordance with the HOCNF format and the above categories, or Woodside will ensure that sufficient information exists to support an HOCNF application in line with the above categories.

The OCNS conducts hazard assessments on chemical products that are used offshore. Products not applicable to the CHARM model (that is, inorganic substances, hydraulic fluids or chemicals used only in pipelines) are assigned an OCNS grouping A – E, with A being the greatest potential environmental hazard and E having the least potential for environmental harm.

Products that only contain substances termed PLONORs (Pose Little or No Risk) are given the OCNS E grouping (LINK to PLONOR list). The United Kingdom Offshore Chemical Notification Scheme requires toxicity data from three trophic levels (Algae, Crustacea and Fish) to predict the potential ecosystem risk, and in turn, rank the product by Hazard Quotient (HQ).

The exact chemicals to be used for offshore hydrotesting have not yet been determined as the Pluto LNG Development is still in the design phase and chemical selection will take place during selection of a trunkline installation contractor. However, **Table 3** indicates chemicals which would typically be used for hydrotesting as an example of the types of additives that may be used. The data and OCNS categorisation is preliminary at this stage.

- **Table 3: Typical Chemicals for Offshore Hydrotesting**

Chemical	Primary Constituent	Typical OCNS Category[1]
Oxygen scavenger	Ammonium bisulphite	D
Biocide	Phosphonium salts	D
Dye	Fluorescein	E

Note 1: OCNS - Onshore Chemical Notification System. Category E chemicals are low toxicity, readily biodegradable and non-bioaccumulative.

Glycol slugs will be used during dewatering of the trunkline and pipelines to condition the pipelines and suppress hydrate formation during the introduction of hydrocarbons. Monoethylene glycol (MEG) is on the OSPAR List of Substances / Preparations Used and Discharged Offshore which are Considered to Pose Little or No Risk to the Environment (PLONOR).

All Hydrotesting and pre-commissioning chemical additives will be listed in the Pipeline Flooding and Hydrotesting Procedure and referenced within the Pipelay Environment Plan. This plan will be submitted to the Department of Industry and Resources, in accordance with the Petroleum (Submerged Lands) (Management of Environment) Regulations 1999. The Environment Plan will include the:

- chemicals selected
- dose rates
- a risk assessment of the discharge to the marine environment.

The Environment Plan must be approved by the regulator prior to pipelay commencing.
It is important to note that disposal of treated hydrotest water and MEG slugs to the offshore marine environment is standard industry practice, as there are both few alternatives and the operation presents a negligible risk to biota in deeper water.

Nearshore Discharge of Hydrotest Fluids*:* Woodside is nearing selection of a contractor to build and test the onshore storage tanks. It is currently planned to test the onshore LNG and other storage tanks using seawater. A short residence time in each vessel is planned to ensure low internal corrosion from using this source. Using seawater has both environmental and economic benefits, as it reduces demand on the local potable water system, presents little risk of marine impact on discharge and enables faster completion of the hydrotest activities. An active or passive cathodic protection system may be employed on selected elements of the tanks to aid in reducing corrosion. On the completion of hydrotesting this water will be returned to the sea, via a discharge line located on the jetty. As the water used is untreated (that is, no chemicals will be added), biological effects from this operation will be negligible, although it is likely that a diffuser or energy dissipation device will be added to the end of the discharge line to ensure physical impacts of discharge (for example, stirring up sediments) is minimised.

In the event that the planned hydrotest methodology for the onshore storage tanks is modified and treatment to hydrotest water (potable or seawater) is required, a risk assessment will be undertaken to ensure discharge presents a low risk to the nearshore marine environment. Selection of low toxicity chemicals will be a pre-requisite for any treatment additives. As discharge of tank hydrotest water will be in shallower water, if chemicals are added, discharge will require careful control to ensure adequate dilution (matched to the concentration, biodegradability and toxicity of chemicals selected) is achieved within a small area of influence around the jetty structure.

9.2 The reasons for not utilising the Burrup multi-user brine disposal pipeline for the discharge are not well argued and do not appear to be sufficient reason for dismissing the option. Introducing this additional outfall into Mermaid Sound will result in another mixing zone within a high ecological protection area that is likely to require a low level of ecological protection. There is a strong argument on environmental protection grounds to discharge the waste water from this proposal through the multi-user pipeline.

As discussed in Section 3.6 of the Draft PER, the concept of using the multi-user brine disposal pipeline has been considered by Woodside, but was not the favoured approach for managing and disposing of wastewater generated by the Development.

Modeling demonstrates that, based on a high level of treatment, treated wastewater discharge into Mermaid Sound will result in a localised mixing zone (as discussed in Section 7.8.13 of the Draft PER). Woodside remains committed to undertaking both ecological testing of treated wastewater and operational monitoring of the discharge location as outlined in the Framework Wastewater Management Plan (Table G-3, Appendix G of the Draft PER and the revised version presented in response to **Comment 9.12**), which will ensure that impacts on the marine environment, outside of a localised mixing zone, are negligible and acceptable within this mixing zone.

It is envisaged that in the vicinity of proposed nearshore marine infrastructure (including jetty, turning basin and berth pocket) a moderate level of ecological protection will be allocated, commensurate with the level allocated to existing industrial development areas in Mermaid Sound, as per the approach outlined in the *Pilbara Coastal Water Quality Consultation Outcomes* report (March 2006). Siting of the wastewater disposal line adjacent to the turning basin (from a diffuser system located at the end of the jetty) already presents synergies with this area of proposed lower environmental protection (refer to **Figure 6** in the response to **Comment 9.12** which shows low LEP mixing zone area located within the moderate LEP surrounding the nearshore infrastructure). Whilst it is recognised that the multi-user brine outfall area is categorised as an area of 'low' environmental protection, compared with inner port areas, which may be considered either 'low' or 'moderate', other environmental and commercial factors must be taken into consideration.

The short and long term risks and commercial aspects of the disposal option were also critical in the decision to include a stand-alone wastewater outfall line into the Pluto LNG Development proposal. In addition to mitigating the risks (commercial and environmental) associated with sharing a multiple user disposal line over which Woodside would have little control (outlined in the Draft PER), adoption of a stand-alone option within the development footprint ensures Woodside:

- always has priority access to the line and can schedule maintenance and inspection activities accordingly
- is clearly accountable for managing and monitoring discharges.

The ability to continually treat and dispose of produced water coming ashore is critical to the Pluto LNG Development. On this basis, Woodside has included within the wastewater treatment system a variety of redundancies, to allow maintenance of portions of the system whilst the system is still operational. On the same basis, a reliable disposal line is a pre-requisite for a successful and stable ongoing operation.

Woodside is continuing to explore re-use options for highly treated wastewater generated by the Development. It is Woodside's intent to minimise any discharges to Mermaid Sound, through use of wastewater within the gas processing facility and by local industry. Not only would this result in a reduced potential for impact in Mermaid Sound, but it would have the additional benefit of reducing the overall pressure on the potable water supply in the Pilbara region by replacing potable water with highly treated wastewater from the Development.

9.3 The actual chemical constituents (contaminants) and the concentrations expected to be present in the effluent are not listed. Some effort is required to better characterise the wastewater to be discharged into Mermaid Sound so that potential toxicity can be assessed and hence the degree of mixing necessary to protect the environmental values of the Sound can be estimated.

Table 4 presents estimated constituents and concentrations of treated wastewater. Concentrations are provided for end of pipe and at the edge of the mixing zone (50 m from point of discharge) where a predicted 250 dilutions is achieved. Where values for 99% species level of protection are available in ANZECC/ARMCANZ (2000) these are also provided; all predicted constituents meet these guidelines at the edge of the mixing zone. Concentrations of those constituents with a potential to bioaccumulate (benzene and mercury) meet 99% species level of protection at the end of pipe as per ANZECC/ARMCANZ (2000).

- **Table 4: Predicted Chemical Constituents and Concentrations in Treated Wastewater Discharge**

Constituent	Expected Concentration at End of Pipe (mg/L)	Expected Concentration at 50 m (edge of mixing zone) (based on 250 dilutions) (mg/L)	99% Species Level of Protection (ANZECC/ARMCANZ 2000) (mg/L)
Total free/dispersed hydrocarbons	<0.1	0.0004	N/A
Total dissolved hydrocarbons (including BTEX)	<0.1	0.0004	N/A
Benzene*	<0.05	0.0002	0.5
MEG	<1	0.004	N/A
Other production chemicals including corrosion inhibitors	<1	0.004	N/A
aMDEA	<1	0.004	N/A
PAHs, total	<0.1	0.0004	Napthalene = 0.05
Chromium, Lead, Nickel and Zinc	<0.5	0.002	0.0022 - 0.0077
Cadmium	<0.175	0.0007	0.0007
Copper	<0.075	0.0003	0.0003
Mercury*	0.0001	0.0000004	0.0001
Silver	<0.2	0.0008	0.0008

** These constituents are recognised as bioaccumulators and are predicted to meet 99% species protection limits at end of pipe.*

Concentrations of chemical constituents presented in **Table 4** are predicted concentrations based on the current design reference case. These estimates may be subject to some change as engineering design progresses.

9.4 Apart from an expectation that the wastewater treatment plant will achieve <5 mg/L, the performance characteristics of the wastewater treatment plant have not been provided. For example many of the contaminants in the water to be treated will be water soluble (e.g. BTEX, many PAHs, metals) and may not be removed by the treatment plant. If the combined concentration of many of these contaminants was 5mg/L or greater then the effluent could be expected to be toxic and would require substantial dilution to achieve safe levels.

Proposed onshore wastewater treatment facilities will ensure that the combined concentration of BTEX, PAHs and metals will be extremely low. Expected chemical constituents and concentrations, including BTEX, total PAHs and metals are provided in **Table 4**. The proposed wastewater treatment process is described below.

The system to treat produced water (i.e. condensed water) and non routine and accidentally oil contaminated water will be a combined system and will include the following phases:

- salt removal
- removal of dissolved and free hydrocarbons through a macro porous polymer
- biological treatment via a membrane bioreactor
- micro filtration and UV/ ozone treatment to remove ions (this allows treated wastewater to be used as process water in the onshore gas processing facility).

It should also be noted that non routine and accidentally oil contaminated water will be fed through a gravity separation system before it is commingled with condensed water for treatment.

Sewage and grey water will be treated in a sewage treatment plant and will follow the following steps:

- separation
- biotreatment (membrane bioreactor)
- chlorination
- nutrient removal.

9.5 WET testing of the Goodwyn Alpha produced water is used to give some indication of the toxicity of the Pluto wastewater discharge. Unfortunately these tests are almost all acute tests, many with mortality related end-points and the range of species tested does not meet the minimum dataset requirements for deriving a moderate reliability guideline (five species from four different taxonomic groups, including a fish, invertebrate and alga) (ANZECC & ARMCANZ, 2000). Given the low reliability of the dataset, significant assessment (safety) factors need to be applied to derive a low reliability guideline trigger value, as outlined in ANZECC & ARMCANZ (2000).

See response to **Comment 9.6**.

9.6 The proponent has estimated a dilution factor of 200 to apply to the wastewater outfall for the protection of marine biota (page 154). There is no logical basis for the derivation of this dilution factor. Using the recommended approach from ANZECC & ARMCANZ (2000) on the inadequate dataset for Goodwyn Alpha, an estimated low reliability guideline for dilution of the wastewater would be either the lowest chronic NOEC value (algal growth inhibition test) divided by 200, or the lowest acute LC50 or EC50 value divided by 1000, whichever is the lowest. This gives a required dilution factor of at least 6400. If the dataset was assumed to be adequate then a different approach would be taken to deriving a dilution factor, for example, using the algal growth inhibition data the dilution factor would be 320. Even so, these dilutions are based on toxicity data for untreated Goodwyn Alpha produced formation water with no other added waste streams and therefore of little relevance to this proposal.

The MEG recirculation system proposed for the Pluto LNG Development cannot tolerate any significant saline produced formation water ingress. For design purposes a nominal allowance is

made for a small quantity of 'nuisance' formation water ingress; the balance of the offshore produced water being non-saline water condensed from the hydrocarbon gas phase. The small formation water allowance is made to ensure design robustness and in practice there may actually be little or no formation water produced. Wells that produce large quantities of formation water will be shut-in until future offshore facilities are installed that can remove and treat the formation water offshore.

The Draft PER states that the Pluto gas field will be managed to avoid large quantities of formation water and it was conservatively assumed that 20% of the produced water coming to shore would be formation water with the remainder comprising condensed water. In practice this is a design allowance and the expectation is that there will be negligible formation water produced.

The Goodwyn Alpha produced formation water and associated WET testing was used as highly conservative comparison case. As stated in Section 7.8.13.3 of the Draft PER the Goodwyn Alpha produced water ecotoxicology assessment was used in the absence of toxicity information for produced water (i.e. formation and condensed water) from the Pluto gas field. Goodwyn Alpha produced water was chosen as the best available analogy in terms of toxicity given it is also a gas/ condensate facility located on the North West Shelf and uses the same types of chemicals that the Pluto LNG Development will most likely use.

Based on predicted chemical constituents and concentrations of the treated wastewater as outlined in response to **Comment 9.3**, toxicity is likely to be very low.

9.7 PFW and Condensate water will also contain MEG that will mostly be separated from the wastewater for re-use. However, a quantity of MEG will still be discharged with the wastewater. Information is required on the actual concentration of MEG anticipated to be discharged and on its toxicity.

The Draft PER (**Section 7.8.13.3**, p.152) states that prior to treatment, the concentration of MEG could be as high as 100 mg/L. However, with the wastewater treatment system proposed (as outlined in the response to **Comment 9.4**), the MEG concentration is expected to be less than 1 mg/L (refer to **Table 4**).

It is considered unlikely there will be any environmental impacts associated with discharge of MEG into Mermaid Sound as is stated in the Draft PER (**Section 7.8.13.3**, p.153):

"A review of eco-toxicity data (Hinwood et al. 1994) found MEG to be slightly toxic (1000-10 000 LC50 (mg/L)) to almost non-toxic (10 000 – 100 000 LC50 (mg/L)). The MEG is readily bio-degradable in water with degradation likely to occur through aerobic bacterial activity. No acute or chronic impacts on marine organisms resulting from discharge of MEG are expected given its low toxicity and that all wastewater streams will be bio-treated then filtered."

9.8 Statements such as 'Sedimentation of hydrocarbon compounds and heavy metal precipitates from PFW is not generally thought to be a problem in terms of impact on sediment quality as suspended particles are spread over a wide area' and 'heavy metals (and other potential bioaccumulators) associated with Pluto wastewater are likely to be very low and dilution in the receiving environment will reduce them to background levels' need to be backed up with data on discharge concentrations and modelling data.

Table 4 contains expected concentrations of hydrocarbons and heavy metals in the treated wastewater. Given the expected low concentrations of these constituents, impacts resulting from sedimentation are considered unlikely. A reduction in volume of discharged treated wastewater (refer to project update in **Section 2.3** for further details) will further ensure that impacts from sedimentation are unlikely. Model outputs show that the plume is rapidly diluted within the first 10 m of discharge. Concentrations of potential bioaccumulators will be within 99% species protection levels (ANZECC/ARMCANZ 2000) at end of pipe, to ensure the risk of bioaccumulation from discharged contaminants is negligible. A comprehensive monitoring

programme will be put in place to ensure contaminants are not bio-accumulated by marine organisms. This will include agreed 'trigger values' for initiation of further studies and remedial actions as necessary (as stated in Table G-3, Appendix G of the Draft PER).

9.9 A 100m x100m mixing zone is proposed for the outfall within a 'high ecological protection area' (DoE, 2006). Very little data has been provided to justify such a large mixing zone for this relatively small outfall (mixing zone is same approx. size as for the multi-user pipeline) and consideration needs to be given to reducing its size.

Woodside acknowledges that the 100 m x 100 m mixing zone is conservative as it is based on a PNEC derived from WET testing undertaken on untreated Goodwyn Alpha produced water which, as discussed in response to **Comment 9.6**, provides a highly conservative assessment of wastewater that will actually be discharged into Mermaid Sound.

It should also be noted, as stated in Section 7.8.13.3 (pg. 156) of the Draft PER, that the mixing zone accounts for worse case wind and tide scenarios and that approximately 70% of the time required dilutions are likely to be met within a much smaller mixing zone (likely to be within 10 m).

Further wastewater modeling has been undertaken since completion of the Draft PER to assess discharge of a revised volume of 3000 bpd of treated wastewater (as discussed in **Section 2.3**) As discussed the revised modeling shows an improvement in dilution at 50 m.

It should also be noted that the mixing zone accounts for worse case wind and tide scenarios and that even during this worse case scenario it is likely that a dilution of >500 would be achieved within 10 m of discharge approximately 70% of the time. Improved dilutions in the near-field and far-field are predicted during other seasons and tidal conditions.

9.10 The outfall must also be considered within the context of impacts on the social environmental values (e.g. recreation and aesthetics, fishing and aquaculture) as well as ecosystem health.

Refer to the response to **Comment 9.11**.

9.11 The environmental values (EVs), environmental quality objectives (EQOs) and levels of ecological protection (DoE, 2006) that apply to the marine waters affected by this proposal are not well described. The response to submissions needs to clearly describe the impact of the development on the EVs, EQOs and levels of ecological protection and the EQOs and levels of ecological protection that the proponent is committing to achieve, including the proposed mixing zone (note: strong technical arguments are required to justify a change in EQOs or levels of protection).

The Pilbara Coastal Water Quality Consultation Outcomes: Environmental Values and Environmental Quality Objectives was released in June 2006 (DoE 2006a). This document establishes an Environmental Quality Management Framework (EQMF) and presents the EPA's interim set of environmental goals (environmental values and environmental quality objectives) and spatially allocates these goals (levels of ecological protection) for state waters of the Pilbara coast. The table below provides an assessment of Pluto LNG Development activities against the environmental values (EVs), environmental quality objectives (EQOs) and levels of ecological protection that apply to the marine waters of Mermaid Sound. It includes an assessment of potential impacts on ecological and social values associated with the following development components:

- treated wastewater discharge
- the nearshore infrastructure such as the turning basin and jetty
- dredging and spoil disposal activities.

- **Table 5: Assessment of Development Activities Against Environmental Values, Environmental Quality Objectives and Levels of Ecological Protection**

Environmental Value (EV)	Environmental Quality Objective (EQO)	Proposed Indicators	Potential Impacts and Management for Treated Wastewater Discharge	Potential Impacts and Management for Nearshore Infrastructure (Jetty and turning basin)	Potential Impacts from dredging and spoil disposal	Relevant EQCs
Ecosystem Health	Maintenance of ecosystem Integrity	Physical and Chemical Stressors: ▪ Turbidity and Sedimentation ▪ Dissolved Oxygen ▪ pH Toxicants in water and sediments including the following: ▪ Metals/metalloids ▪ Non-metallic inorganics ▪ Organics	A localised mixing zone (100 x 100 m) is proposed at the wastewater discharge location as shown in Error! Reference source not found.. A low LEP is proposed in this mixing zone. Within this mixing zone elevated levels of some chemical constituents may be expected (refer to response to **Comment 9.3** for details on predicted constituents and concentrations). Outside of this mixing zone a moderate level of protection will be achieved at all times. It should be noted that in terms of chemical constituent concentrations of the treated wastewater, a high level of protection will be achieved at the edge of the mixing zone and that the moderate LEP relates to nearshore infrastructure and associated shipping during operations as discussed in	In the vicinity of the proposed nearshore marine infrastructure a moderate level of ecological protection (LEP) will be allocated, commensurate with the level allocated to existing industrial development areas in Mermaid Sound (as shown in Error! Reference source not found.). A moderate LEP would allow for elevated levels of turbidity and sediment mobilisation resulting from shipping movements, associated with operations, at these facilities. Other indicators including: metals, pH and dissolved oxygen are unlikely to be impacted by the proposed nearshore infrastructure.	There are likely to be impacts within Mermaid Sound resulting from elevations in turbidity and sedimentation, as a result of dredging. These impacts and management measures proposed are presented in detail in Section 7.9 of the Draft PER and in various responses to comments in this document Impacts on pH and dissolved oxygen levels are unlikely; however, these indicators will be monitored as described in the DSDMP. Impacts on water and/or sediment quality resulting from mobilisation of toxicants during dredging are considered unlikely given sediments in the area of dredging were found to be clean.	Physiochemical baseline data that is currently being collected by the Woodside will be used together with Australian and New Zealand Water Quality Guidelines (ANZECC & ARMCANZ 2000) to develop appropriate physiochemical EQCs for Mermaid Sound. Water and sediment quality baseline data that has been collected by the DoE will be used together with Australian and New Zealand Water Quality Guidelines (ANZECC & ARMCANZ 2000) to develop appropriate EQCs for Mermaid Sound

Environmental Value (EV)	Environmental Quality Objective (EQO)	Proposed Indicators	Potential Impacts and Management for Treated Wastewater Discharge	Potential Impacts and Management for Nearshore Infrastructure (Jetty and turning basin)	Potential Impacts from dredging and spoil disposal	Relevant EQCs
			column five of this table). Discussion of discharge of treated wastewater into Mermaid Sound and the associated mixing zone is discussed in Section 7.8.13.3 of the Draft PER. Management and monitoring of the treated wastewater and potential impacts is described in Section 7.8.13.4 of the Draft PER and in the response to **Comment 9.4**.			
Fishing and Aquaculture	Seafood for Human Consumption	Biological contaminants: ▪ Thermotolerant faecal coliforms in water Thermotolerant faecal coliforms in fish flesh ▪ Metals and organics in fish flesh	Pluto wastewater will be treated to a very high level so that biological contaminants, metals, organics and other potential contaminants are highly unlikely to bioaccumulate or otherwise impact on the quality of seafood for human consumption. Volumes of sewage and grey water will be low further reducing potential for risk from biological contaminants.	Impacts on seafood for human consumption as a result of the presence of the proposed nearshore infrastructure are considered highly unlikely.	Impacts on seafood for human consumption as a result of dredging activities associated with dredging for the Pluto LNG Development are considered highly unlikely.	Thermotolerant faecal coliform bacterial concentration guidelines as per the Australian and New Zealand Water Quality Guidelines (ANZECC & ARMCANZ 2000) will be used as the basis for EQCs within Mermaid Sound.

Environmental Value (EV)	Environmental Quality Objective (EQO)	Proposed Indicators	Potential Impacts and Management for Treated Wastewater Discharge	Potential Impacts and Management for Nearshore Infrastructure (Jetty and turning basin)	Potential Impacts from dredging and spoil disposal	Relevant EQCs
	Aquaculture	Toxicants – a range of metals, inorganics and pesticides. Physio-Chemical Stressors: ▪ Dissolved Oxygen ▪ pH	There are presently no active aquaculture leases in Mermaid Sound; nevertheless, outside the proposed localised mixing zone it is unlikely treated wastewater discharge will exceed EQCs associated with aquaculture. Dissolved oxygen and pH levels are highly unlikely to vary significantly as a result of Pluto treated wastewater discharge outside the mixing zone.	Presence of nearshore infrastructure is highly unlikely to impact upon possible future aquaculture activities within Mermaid Sound.	Impacts on future aquaculture activities in Mermaid Sound associated with mobilisation of toxicants are highly unlikely, given sediments to be dredged are clean. Potential for impacts from turbidity and sedimentation associated with dredging will be transient; considered very unlikely there will permanent impacts that may affect future aquaculture activities.	EQCs to be developed for the maintenance of ecosystem integrity will be used to maintain aquaculture values.
Recreation and aesthetics	Primary contact recreation values (for example, swimming and diving)	Biological: • Faecal Pathogens • Toxic Algae Physical : ▪ pH ▪ Water clarity Radiological: • Toxic Chemicals – a range of chemicals including inorganics,	Outside a localised mixing zone, it is considered unlikely biological, physical and chemical indicators relating to primary contact recreation will be exceeded. It is highly unlikely primary contact recreation activities will occur inside the mixing zone which includes the proposed jetty and associated berthing facilities. Radiological – see response to **Comment 9.19** for	It is considered unlikely indicators associated with primary contact recreation activities will be impacted by the presence of the nearshore infrastructure. Limited primary contact recreation activities currently occur in the vicinity of the proposed nearshore infrastructure.	Water clarity as an indicator in primary contact recreation serves to enable swimmers to estimate depth and see subsurface hazards easily. Given swimming rarely occurs in the vicinity of the dredge operations impacts are considered highly unlikely. Impacts on water clarity will be mitigated against through a variety of	EQCs to be developed for the maintenance of ecosystem integrity will be used to maintain primary contact recreation values. See Aesthetic Values section of this table for water clarity related EQC. Radiological – see response to **Comment 9.19** in this document.

Environmental Value (EV)	Environmental Quality Objective (EQO)	Proposed Indicators	Potential Impacts and Management for Treated Wastewater Discharge	Potential Impacts and Management for Nearshore Infrastructure (Jetty and turning basin)	Potential Impacts from dredging and spoil disposal	Relevant EQCs
		organics, pesticides.	discussion of NORMs and discharge of radioactive material into Mermaid Sound. Treated wastewater discharge will managed according to Section 7.8.13.3 of the Draft PER and the updated Framework Wastewater Management Plan provided as part of the response to **Comment 9.13**.		measures as detailed in the DSDMP. Water clarity is further discussed in the Aesthetic Values section of this table.	
	Secondary contact recreation values (includes boating and recreational fishing)	Biological: • Faecal pathogens • Toxic Algae Physical and chemical: • pH • Toxic Chemicals	Limited secondary contact recreation activities will occur within the vicinity of the wastewater outfall, nevertheless the treated wastewater is highly unlikely to contain chemicals at concentrations that can irritate the skin of the human body. No impact from treated wastewater on secondary contact recreation values is expected.	No impact from the presence of the proposed nearshore infrastructure on secondary contact recreation values is expected.	No impact from dredging activities on secondary contact recreation values is expected.	No impacts expected. EQCs to be developed for the maintenance of ecosystem integrity will ensure secondary contact recreation values are maintained.
	Aesthetic Values	Water Clarity Fish Tainting Substances – large range of chemicals implicated in fish tainting – related to concentration in water	It is highly unlikely that treated wastewater will result in impact on water clarity or fish flesh quality relevant to aesthetic values given the high level of treatment of the wastewater	Presence of nearshore infrastructure is highly unlikely to impact upon water clarity or fish flesh quality. For further discussion on aesthetic impacts from the Pluto LNG Development,	Dredging activity is likely to result in exceedances of the EQCs for water clarity within some areas of Mermaid Sound. A figure showing the area where water clarity will be reduced by more than	As per the Australian and New Zealand Water Quality Guidelines (ANZECC & ARMCANZ 2000) – the natural visual clarity of the water should not be reduced

Environmental Value (EV)	Environmental Quality Objective (EQO)	Proposed Indicators	Potential Impacts and Management for Treated Wastewater Discharge	Potential Impacts and Management for Nearshore Infrastructure (Jetty and turning basin)	Potential Impacts from dredging and spoil disposal	Relevant EQCs
		column.	proposed.	including nearshore infrastructure, refer to Section 11.12 of the Draft PER.	20% will be provided once re-modelling has been completed and appropriate background data has been collected and analysed. It should be noted that impacts on water clarity are transient and will not result in long term changes. Impacts on water clarity will be mitigated against through management measures and controls detailed in the DSDMP. Fish tainting substances are highly unlikely to of issue given sediments to be dredged are clean.	by more than 20%.
Cultural and Spiritual	Maintenance of cultural and spiritual values		No Impacts are predicted	No Impacts expected	No Impacts expected	No impacts expected
Industrial Water Supply	Maintenance of industrial water supply values		No impacts are expected from the treated Pluto wastewater discharge on industrial water supply values.	No impacts are expected from the treated Pluto wastewater discharge on industrial water supply values.	No impacts are expected from the treated Pluto wastewater discharge on industrial water supply values.	No impacts expected

9.12 A map showing the benthic habitats within the vicinity of the outfall is needed.

Figure 6 shows benthic habitats within the vicinity of the wastewater discharge point and the proposed Moderate Level of Ecological Protection (LEP) around the nearshore infrastructure, commensurate with the level allocated to existing industrial development areas in Mermaid Sound. A moderate LEP would allow for elevated levels of turbidity and sediment mobilisation resulting from shipping movements, associated with operations, at these facilities.

9.13 A comprehensive management plan would be required for an outfall such as this. It would need to address issues such as (but not limited to):

- *Management of the different waste streams that make up the wastewater discharge*
- *Wastewater discharge rate*
- *Wastewater contaminant monitoring program*
- *Whole effluent toxicity testing of the wastewater*
- *Diffuser performance monitoring*
- *Environmental/ecological impact monitoring around the outfall to confirm 'no impact'.*

A Framework Wastewater Management Plan in Table G-3 in Appendix G of the Draft PER which covers the issues suggested in the above comment (with the exception of 'Wastewater discharge rate'), and is provided below. Proposed revisions are highlighted in red below.

Table 6: Framework Wastewater Management Plan

Wastewater Management Plan Format	
Management Issues	The discharge of wastewater may result in marine physical and ecological effects including reduced water quality and toxicity effects to marine biota.
Objectives	To comply with applicable legislation and guidelines. To minimise the potential for adverse impacts on water quality.
Performance Indicators	Performance indicators will be developed consistent with relevant regulatory, local and Development requirements
Management Strategies	▪ The residual total hydrocarbon in water concentration of wastewater discharge will be less than 5 mg/l as an annual average for water discharged to Mermaid Sound. ▪ Other measures employed to reduce the potential for environmental impact associated with wastewater disposal are process design, procedures for chemical selection, dosing rates and operational maintenance and control of production equipment. ▪ Woodside will put in place reduction targets and mitigation measures should the results of monitoring and/or investigations indicate a potential or actual unacceptable impact. ▪ Whole Effluent Toxicity (WET) testing on actual treated wastewater will be undertaken as soon as first water becomes available and periodically thereafter. Routine monitoring to ensure discharged wastewater meets specified criteria. ▪ Construction amenities will be regularly inspected and maintained, and effluent will be disposed of offsite at an appropriate facility. ▪ During operation, approved sewage systems will be provided at Site B. ▪ An appropriate monitoring and maintenance schedule for the sewage treatment system at Site B will be developed and implemented. ▪ The oil-in-water meter will be regularly tested and calibrated as per acceptable standards to ensure its accuracy. ▪ The concentration of total hydrocarbon in wastewater discharged to Mermaid Sound will be measured daily. ▪ A contingency plan will be developed to manage wastewater in cases where unexpected volumes and/or quality of wastewater are produced.
Monitoring	Monitoring of wastewater will occur at source prior to commingling and at the discharge point. Wastewater will be monitored in accordance with regulatory requirements and will include monitoring of discharge rates. A comprehensive monitoring programme will be put in place to confirm the prediction of

	no significant impact to nearshore communities and to ensure contaminants are not bio-accumulated by marine organisms. This will include agreed 'trigger values' for initiation of further studies and remedial actions as necessary. Monitoring will confirm that an appropriate level of ecological protection is being achieved at the edge of the agreed mixing zone. The concentration of total hydrocarbon in wastewater discharged to Mermaid Sound will be measured daily. Routine monitoring to ensure treated wastewater meets the EQMF social use values at end of pipe or within a distance, from point of discharge, agreed with the relevant authorities.
Reporting	Reporting procedures consistent with regulatory, local and Development requirements will be developed.

9.14 Coral habitat has been mapped in some detail on the eastern side of Mermaid Sound for predicting the effects of the turbidity plume (e.g. Figures 7-36 to 7-40 and 7-44 to 7-51) and for this the proponent should be commended. However, it is noted that coral habitat on the western side of Mermaid Sound has not been well mapped and should be rectified. Maps showing macroalgal habitat are less detailed, and sponge/soft coral habitat and seagrass habitat have not been mapped at all. It is accepted that seagrass distribution in this area is patchy and seasonally variable; nevertheless, Figure 7-32 is not an acceptable level of detail for a seagrass habitat map.

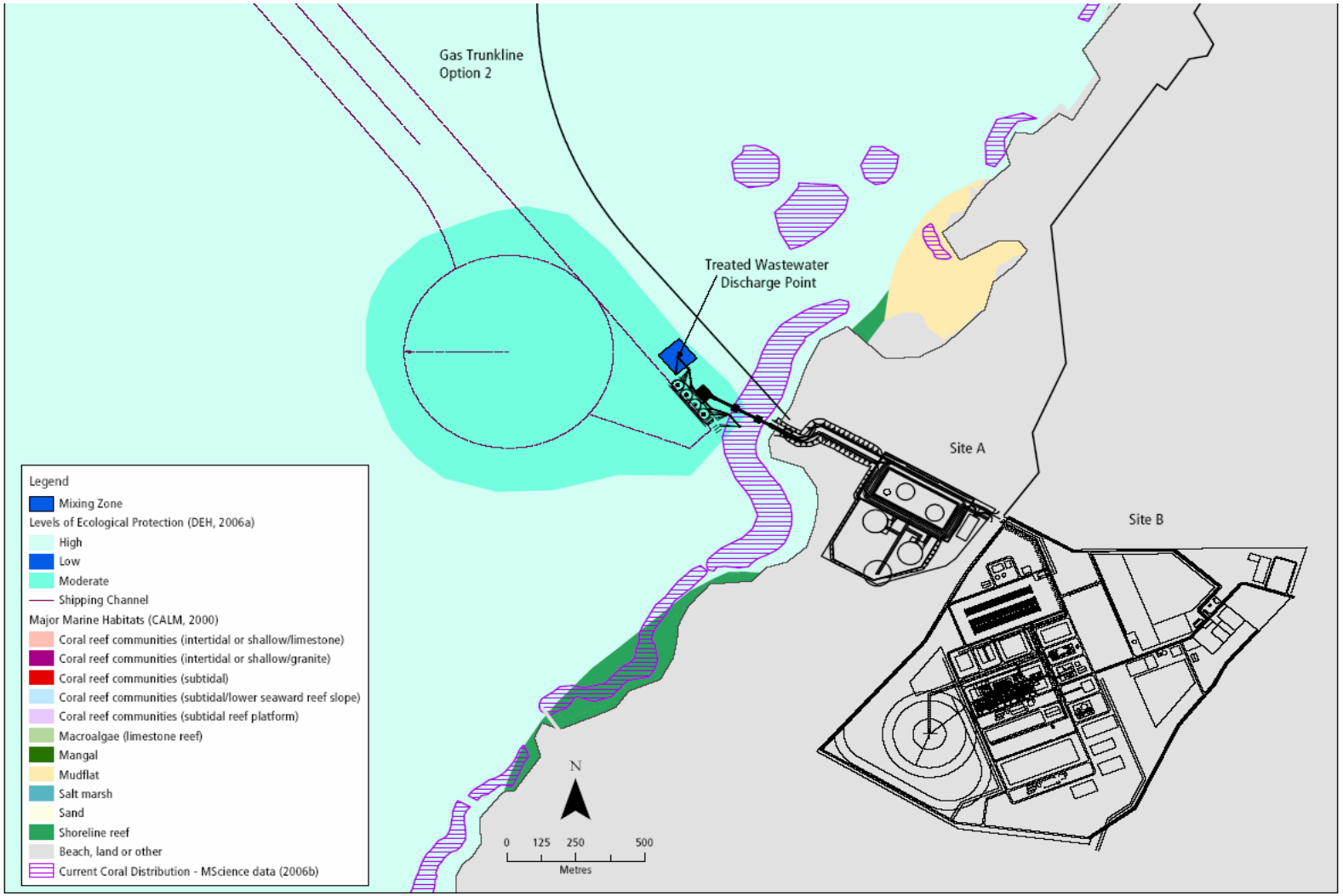
Coral habitat distribution within DPA limits on the eastern side of Mermaid Sound is shown in **Figure 7**.

Figure 7-31 and **Figure 7-32** of Section 7.9.9.2 the Draft PER have been revised to include information from studies of the marine biodiversity of the Dampier Archipelago (WA Museum 2004). The data included in the revised figures is sourced from two diving expeditions (Morrison 2004, data collected in 1998 and 1999) and a dredging expedition (Hutchins et al 2004, data collected in 1999).

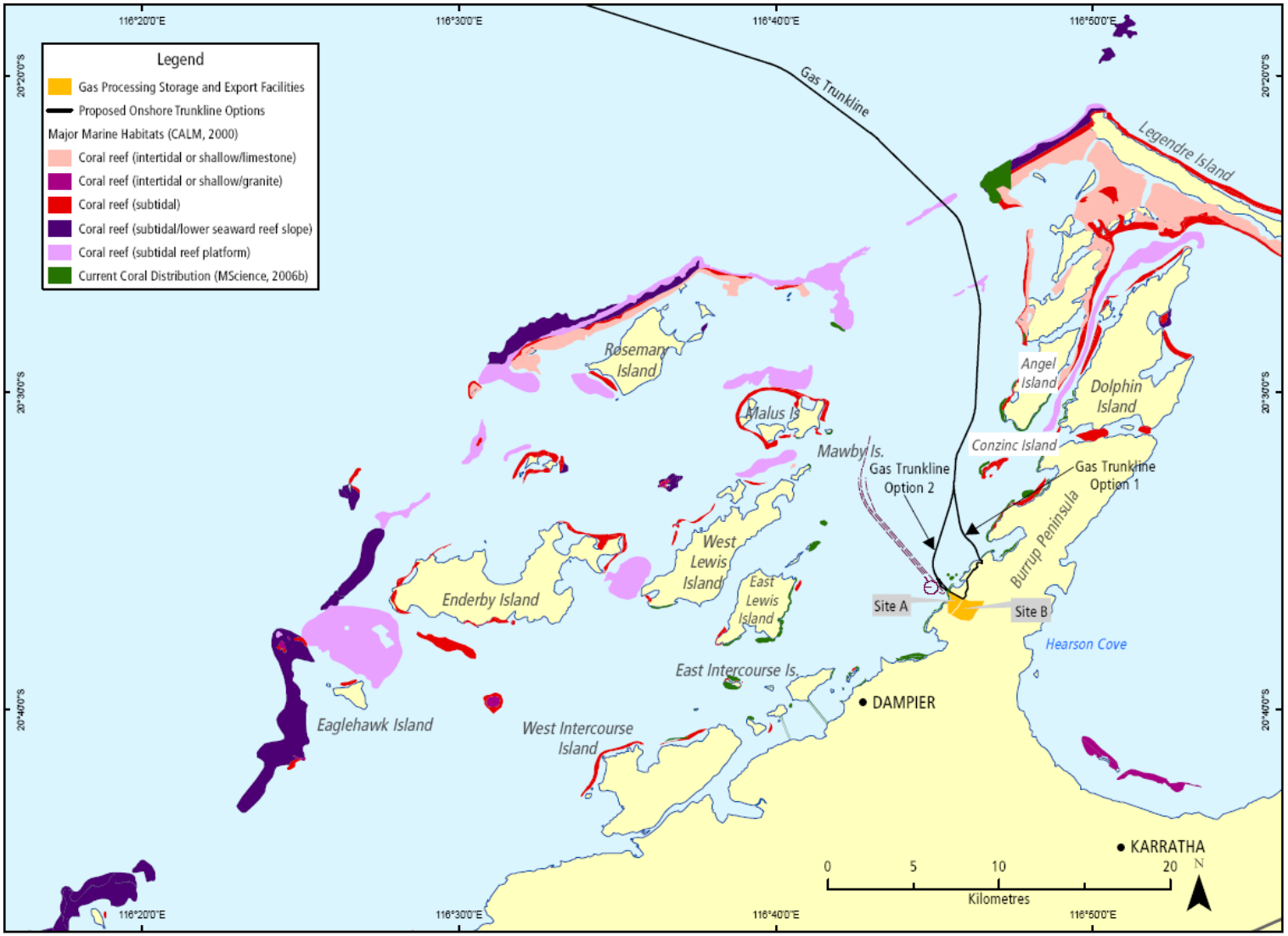
In **Figure 7-31** macroalgae data from the diving expeditions is quantitative and includes approximate percentage cover at each sample site. The dredging expedition data has records of occurrence during each dredge. Stations where no macro-algae were observed are included to provide an indication of the areas of occurrence.

Similarly, **Figure 7-32** now includes stations where no seagrasses were observed to provide an indication of the areas of occurrence. Information on seagrass from the Dampier Archipelago generally does not include information on percent cover. The information consistently report seagrass as sporadic and occurring in low density. The most common species are *Halophila sp*., which are generally ephemeral and is known for its ability to colonise new areas.

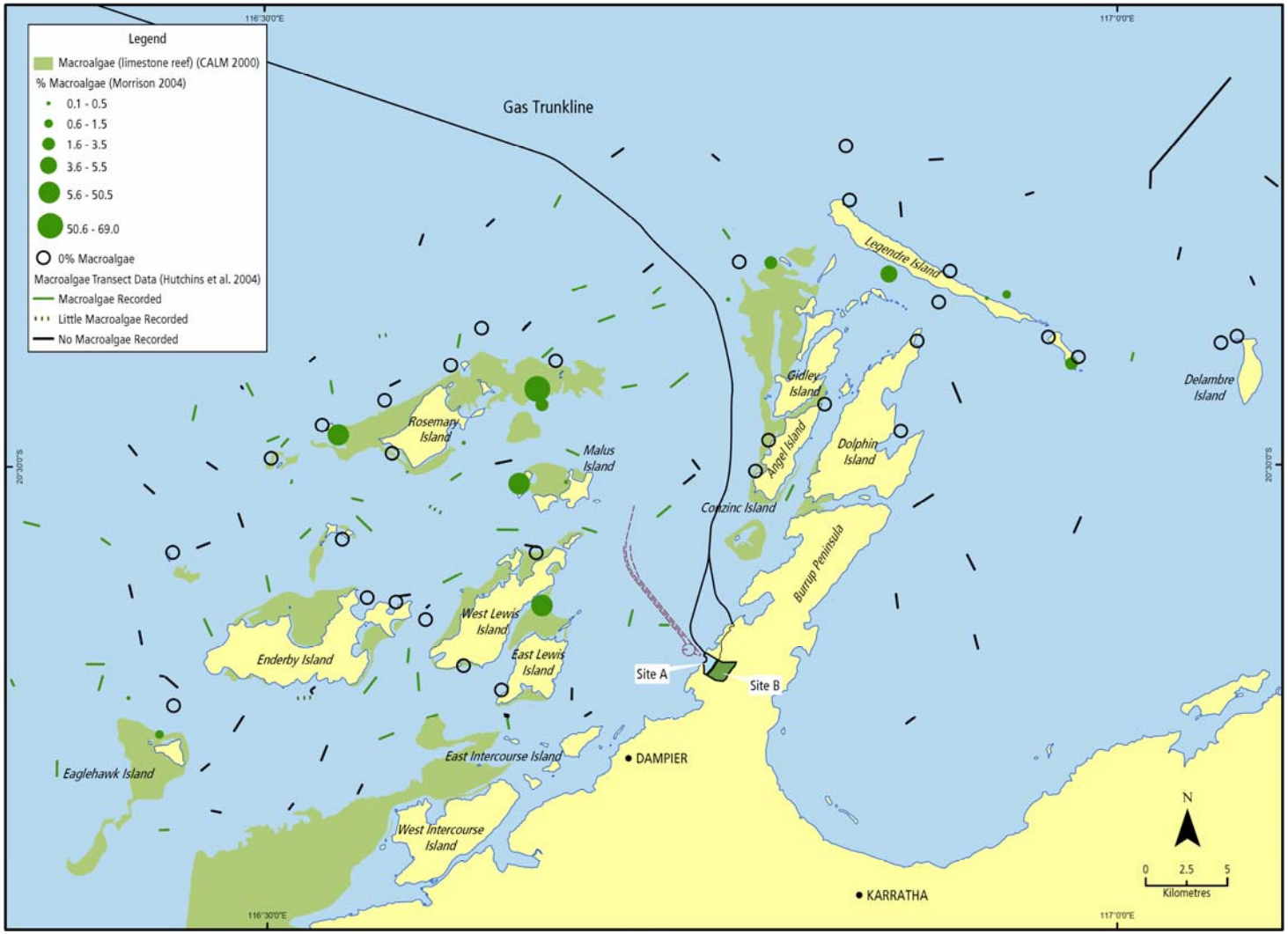
For further discussion on the predicted impacts on macro-algae and seagrass please refer to the response to **Comment 9.22.**



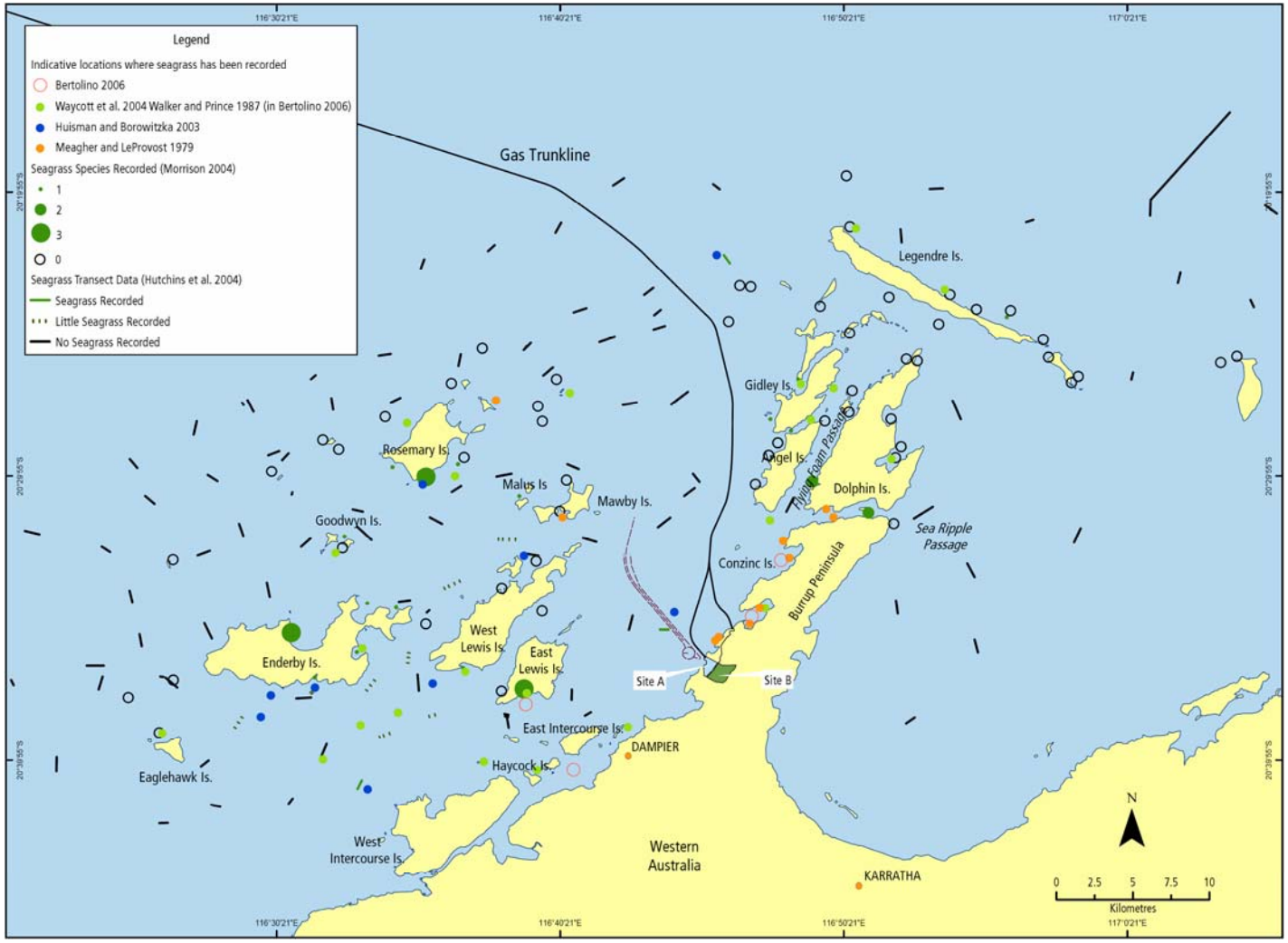
- **Figure 6: Benthic Habitats in the Vicinity of Wastewater Discharge Location**



- **Figure 7: Revised Coral Distribution inside DPA limits in Mermaid Sound**



- **Figure 7-31: Revised Macroalgae Distribution in Mermaid Sound**



- **Figure 7-32: Revised Seagrass Distribution in Mermaid Sound**

10.1 That the proponent develops a detailed quantitative benthic habitat map that encompasses the 'zone of influence' of the project's marine works to allow an informed assessment of the nature and scale of potential environmental impacts. Given that the proposal has potential to impact on a proposed marine park, a quantitative habitat survey is considered necessary. This recommendation is consistent with comments made by the former CALM to both the EPA and proponent dated 5 May 2006.

For discussion of the 'zone of influence' please refer to the response to **Comment 9-24**.

For revised benthic habitat maps please refer to the response to **Comment 9-14**.

9.15 Please provide a copy of references IRCE (2004a) and Bertolino (2006).

Both references will be provided to the EPA and DEC.

9.16 When describing background suspended solid levels the median suspended solid concentration should be provided as well as the range. Just providing the range does not give an indication of typical background concentrations.

Woodside agrees that the range of suspended solids observed does not specify typical background rates (such as the median). However, for a median value to provide information on typical levels, the dataset itself must reflect the levels in Mermaid Sound in relation to the frequency with which they occur.

To illustrate this, monitoring before and after the Trunkline System Expansion Project (TSEP) installation showed no influence on the background TSS levels as rough weather caused suspension of solids across the Sound (IRCE 2004). The range of all recordings was 1–19 mg/L with a median of 10 mg/L (unpublished data from IRCE 2004).

In 1985 the DEC recorded surface and bottom TSS values at six sites to set a 'background level'. The surface values had a range of 0.88–8.64 mg/L and a median of 2.74 mg/L (as recorded in LSC 1987).

The problem is illustrated with the relatively high number of samples (54 in total) obtained during rough weather by IRCE, versus the relatively low number (17 in total) obtained by the DEC. It is clear that the higher number of samples taken during rough weather will bias the median in this example. Other factors influence the TSS levels as well, for example, the large tidal regime in Mermaid Sound. The ability of a median to describe a 'typical' situation thus depends on the representativeness of the dataset from which is calculated.

At the time of writing the Draft PER the data available on the levels of the suspended solids in Mermaid Sound consisted of spot measurements (as described above) taken over several years during a variety of conditions but with no corresponding time-series recording tidal cycles and sea states. In recognition of the need for corresponding time series data Woodside commenced a baseline study in August 2006 deploying five loggers continuously logging turbidity. Site-specific calibrations both in the field and in the laboratory provide estimations of continuous TSS levels at five sites in Mermaid Sound. This data will provide a solid basis for calculating statistics (such as the median) to support the understanding of the sediment flux within Mermaid Sound. This will provide information on general values as well as time series data of TSS variation over time and the temporal persistence of elevated levels.

9.17 Natural sedimentation levels are described to be as high as 240 mg/cm^2/day. This is extremely high and DEC suspects only occurs over unusual circumstances. Typical sedimentation rates in Mermaid Sound are generally in the 2 – 20 mg/cm^2/day.

Typical sedimentation rates in Mermaid Sound are lower than 240 mg/cm^2/d and this rate was not used to describe typical background sedimentation rates in the Draft PER.

The value of 240 mg/cm^2/d was used specifically in the impact assessment to determine a possible threshold value where intense mortality would occur in line with community and habitat loss as defined by EPA Guidance Statement No. 29 (EPA 2004). The observed rate of 240 mg/cm^2/d occurred following rough weather (IRCE 2004) and is not referred to in the Draft PER as a 'typical sedimentation rate'. However, the observed rate is not considered unusual, as the observation period did not occur after cyclonic influence, a situation when even higher rates are expected to occur.

For a discussion of background sedimentation rates, please refer to the response to **Comment 10.2**.

9.18 The models used to predict movement and fate of suspended sediment plumes do not appear to take into account on-going settlement and re-suspension of particles. This would seem to be a very significant process for a 2 year dredging and disposal program and could result in a significant underestimation of the influence of the dredging program if not adequately taken into account. Could the proponent please clarify how this process has been addressed through the modelling.

The sediment dispersion model used in the Draft PER follows a particle generated by either dredging or spoil disposal until first settlement on the seafloor. Therefore, suspension is accounted for up until first settlement and after that it 'drops' out of the model. Sedimentation patterns predicted by this model give an estimate of cumulative sedimentation, that is, how much sediment is predicted to accumulate on the seabed in each model cell without accounting for re-suspension. This is not seen as a limiting factor as the validity of the impact which can be predicted with this model output depends on the interpretation of both model output and observed sedimentation flux patterns in Mermaid Sound.

Observations from previous dredging programmes in Mermaid Sound suggest that impacts from sedimentation (possibly in synergistic effect with TSS, but not from TSS alone) generally occur within 1 and 1.3 km from the uplift area. In this area sedimentation rates can be very high inundating the coral community and causing long-term losses (Blakeway 2005). Peaks in TSS alone have not been observed to have a similar level of impact and has not been observed to cause losses of coral communities (Blakeway 2005.). This indicates that the near-field impacts are coupled to sedimentation but exactly how much is unknown. Outside the near-field footprint impacts are most likely coupled with increased TSS levels reducing light levels below a critical point for coral survival. Impacts such as these have not been recorded in Mermaid Sound from previous dredging programmes.

The model outputs predict conservatively high rates of accumulating sedimentation, with near-field rates of such proportions that the coral community is likely to become inundated and suffer intense mortality to the extent that the benthic primary producer community can be considered 'lost'. However, it is understood from the preliminary baseline monitoring results that the high rate of re-suspension in Mermaid Sound will cause re-suspension of at least parts of the settled particles soon after settling, thereby assisting in the removal of particles from the affected coral community.

The coral losses stated in the Draft PER were estimated using cumulative sedimentation predictions and theoretical thresholds which define an area in the near-field where corals are at risk of experiencing high sediment deposition. Resuspension of a proportion of the settling particles in the near-field will lesson the strain on the affected coral community by removing landing particles. Not taking re-suspension into consideration in the model predictions of sedimentation rates will over-estimate the accumulation of sediment and thereby possibly overestimate near-field estimate of losses. It is not clear where sediment goes once it is re-suspended and lifted from the surface of the corals. This is a complex issue and background baseline monitoring does not give a clear indication of the drift path of the suspended solids.

Woodside is currently scoping a revised model where wave energy is added and where particles are allowed to re-suspend depending on their size and the ambient energy field. This

will provide further information on the fate of particles after re-suspension including migration to further afield areas where they may result in an increase in turbidity and light attenuation, and therefore indirect impacts on benthic primary producers from light deprivation.

Woodside believes that the impact assessment and specifically the coral community loss estimations caused by the first-time settlement of particles in the near-field area, close to both the uplift area and spoil disposal area, provide a realistic estimate of coral loss without re-suspension being accounted for in the model. Reference should be made to Table 7-34 of the Draft PER where the coral community loss estimates have been compared to previous observations.

9.19 In figure 7-15 the measured current speeds are generally significantly greater than the modelled current speeds. What effect is this likely to have on the predicted extent of the suspended sediment plumes?

The current meter is mounted near the bottom of the seabed where the influence of local topography and seabed is greatest; the current meter data itself only gives an estimate which is representative of that particular location and depth. The instrument is at a precise depth (1 m above seabed) while the current prediction is for a band spanning from the seabed to a position above the depth of the meter and hence is depth averaged over a 2 m depth. Because this band is near the seabed, where drag is maximised, this would tend to diminish peak speed predictions.

Having said that, the comparison shows that the north–south current is being well represented for 70–80% of the time during each tidal period (that is, has precisely the same current speed and timing throughout most of each tidal cycle). Where currents are under-represented, it is only for a short period (< 1 hour in any six hours) spanning the peak and given the magnitude of the current speeds (0.1–0.2 m/s) would not lead to vastly larger migrations on any one tidal cycle.

Under-representation of the short-lived peak current speeds is likely to affect the spread of finer particles but not as a long-term migration in one particular direction. Rather, by leading to a marginally smaller deposition footprint in the north–south direction (that is, a bit narrower towards both the north and south) because a tidally-driven particle can only migrate in one direction as far as a tidal migration before it gets carried back. For a discrepancy of this nature along the channel, the under-representation that could have occurred is estimated at about 50–60 m in the width of the deposition footprint but only if this had not been corrected for.

The circulation in Mermaid Sound is strongly tide-affected during spring tides and more wind-affected during neap tides. To account for wind forcing, the dispersion modeling used current data that was predicted using wind data measured concurrently at Karratha and LeGendre Island (either end of the study area) – using distance-weighting to account for variations along Mermaid Sound. This wind data was not available for the comparison to the current meter. Hence, wind data from a hind-casting atmospheric model (NCEP/NCAR Reanalysis) that used a generalised topography and that lacked sea/land breeze effects had to be used. Despite the less accurate wind data, the model data shows a similar response to wind systems during the neaps.

Recognising that the modeled currents may not account for all sub-scale transport processes and could be under-representative of the tidal or wind-driven magnitudes, Woodside included conservative horizontal and vertical dispersion allowances in the dispersion modeling. This had the effect of increasing the spatial spread of particles by at least the same magnitude, and therefore avoided under-representing the potential for sediments to affect sites to the north or south (as well as east–west) of the suspension source. This is standard quality control practice in sediment dispersion modeling, that is, to start with the understanding that errors are likely to be present in the forcing data. Sensitivity tests were then carried out for these errors to determine their significance.

9.20 The modelling results in Table 7-29 suggests that resettled sediment particles from the dredging process will be of the same particle size distribution as native sediment composition. In practice this does not appear to be the case for Mermaid Sound sediments. Both DEC (2006) and environmental consultants (MScience, 2007) have found a layer of fresh fine sediment overlaying the original sediments in the vicinity of recent dredging programs.

Table 7-29 of the Draft PER compares receiving sediment particle size composition with the likely composition of 'produced' sediments from sidecasting and overflow. While the composition is similar Table 7-29 does not state the compositions will be 'the same'. For example, there is 0% and 4% coarser particles (>100 µm) in the TSHD overflow and side-cast material from the CSD, respectively, compared to 7% in the receiving sediment. As described in Section 7.9.12 of the Draft PER finer particles are generally predicted to drift further away from the source of suspension than coarser material before settling, therefore there is some scope for a change in the seabed particle size distribution.

Despite this, a thick layer of yellow fines, as depicted in DEC (2006), is not predicted to arise as a result of dredging from the Pluto LNG Development. There may be other causes for the previous deposition of fines in the inner Mermaid Sound such as an alteration of the local hydrodynamics from coastline modification.

9.21 It is not clear over what time period many of the model outputs cover (e.g. Figures 7-11 and 7-12). Outputs should be for a sufficient time period to show cumulative effects over many tidal cycles (e.g. Figure 7-16 only shows cumulative effects of propeller wash for a 100 minute period).

Figures 7-11, 7-12a-c, 7-19a-c, 7-20a-b, 7-21, (p.174–195) in the Draft PER were not intended to be cumulative plots, but were intended to show examples of the levels of suspended solids caused by an isolated activity or concurrent activities (as described in each of the figures). These figures show how suspended solids are being generated from each type of activity, with each image captured after a number of days into the simulation of that activity or activities. The extent of the plumes shown is therefore the result of the balance between delivery of sediments at the source and the expected settling and dispersal at distance under particular example conditions. Woodside acknowledges that to accurately interpret the example figures the period of simulation is needed. **Table 7** provides clarification of how long dredging had been occurring before each image was captured. Note that in each case there was ample time for the plume to develop.

- **Table 7: Dredging Duration Prior to Image Capture**

Figure No. (Draft PER p.174–195)	Number of Days into Simulation	Time of Image Capture
7-11	5	2 pm
7-12a	5	2 pm
7-19a	31	8 am
7-20a	17	2 pm
7-21	21	4 pm
7-12b	5	2 pm
7-12c	5	2 pm
7-19b	19	5 pm
7-19c	18	4 pm
7-20b	15	2 pm

The predicted TSS levels at adjacent coral habitats throughout the proposed dredging programme (phase 1 as described in Figure 7-25) is summarised in the Technical Appendix D, Volume 2 of the Draft PER. The mean and range of predicted TSS levels during each month from the dredging and spoil disposal activities are summarised in box-whisker plots. It should be

noted, however, that these box-whisker plots are inclusive of the TSS associated with the Phase I spoil disposal programme, where all spoil was to be disposed into spoil ground A/B. The currently preferred option is for disposal of the majority of spoil into the offshore spoil ground 2b, thus decreasing the TSS exposure near spoil ground A/B. Monthly predictions of maximum TSS rates from limited spoil disposal into spoil ground A/B is shown in Figures 7-23 to 7-25 in the Draft PER, with predicted daily maximum levels at selected locations of coral habitat in Figure 7-35 of the Draft PER.

In summary, Figures 7-11, 7-12, 7-19, 7-20, 7-21 of the Draft PER are not meant to be cumulative plots. These plots are presented in Technical Appendix D, Volume 2 of the Draft PER, with Figure 7-42 in the Draft PER presenting the cumulative plots closest to Holden Point where coral losses are predicted due to dredging activities.

9.22 Potential impacts on seagrass and macroalgal meadows should be addressed in more detail. The statement 'Habitat for macroalgae is mainly found in the outer Mermaid Sound, and indirect impact from dredging or spoil disposal is considered unlikely' is contradictory to the information in the benthic habitat map Figure 7-34.

As discussed in Section 7.9.9.1 (p.210–211) of the Draft PER the anticipated impacts on seagrass are low, with no loss of seagrass habitat predicted. The assessment is based on the following observations:

- No seagrass was found during seabed surveys of the proposed navigation channel, and proposed spoil ground 2b (described in Section 7.9.9.1 p.211, and Section 7.9.5.2, p.168 in the Draft PER). Spoil ground A/B is currently in use. No direct impact (removal of seagrass habitat) is therefore anticipated from the Pluto LNG Development.
- As described in Section 6.3.1 (p.109) and Section 7.9.9.1 (p.210-211) of the Draft PER there are no records of dense seagrass beds found in the Dampier Archipelago, all records are of sporadic and low density presence, often of seasonal species like Halophila sp, which are able to colonise new areas well. Potential indirect impacts on sporadic occurrence of low cover seagrass may arise from sedimentation or light attenuation stress, however such impacts will not be long-lasting as the habitat will not be removed, and re-colonisation can occur as soon as conditions allow.

As discussed in Section 7.9.9.1 (p.210–211) the anticipated impacts on macro-algae are low, with no loss of macro-algae habitat predicted. The assessment is based on the following observations:

- No macro-algae of parts of macro-algae were found during seabed surveys of the proposed navigation channel (described in Section 7.9.9.1 p.211). Only very sparse macro-algae were observed during one survey of the proposed spoil ground 2b (Section 6.3.1 p.109) while another survey did not record any macro-algae at this location (Section 7.9.5.2 p.168). No direct impact (removal of macro-algae habitat) is therefore anticipated from the Pluto LNG Development.

- As described in Section 6.3.1 p.109 and Section 7.9.9.1 p. 210-211 of the Draft PER the presence of macro-algae in the Dampier Archipelago is most predominant around the islands of the archipelago, with little marco-algae recorded from the west coast of the Peninsula. The occurrence is seasonal and the life cycle of macro-algae makes them resistant to permanent indirect impact. Potential indirect impacts may arise from sedimentation or light attenuation stress, however such impacts will not be long-lasting as the habitat will not be removed, and re-colonisation can occur as soon as conditions allow.

The statement 'Habitat for macroalgae is mainly found in the outer Mermaid Sound, (Section 7.9.9.2 and Figure 6-13) and indirect impact from dredging or spoil disposal is considered unlikely' refers to the outer Mermaid Sound. Whilst not specifically defined, for the purposes of the Draft PER the outer Mermaid Sound is considered to be the northern half of Mermaid Sound, extending northwards from Mawby and Conzinc Islands (Figure 6-13). The

inner Mermaid Sound is considered to be the area extending south from Mawby and Conzinc Islands. **Figure 7-32** shows some macroalge within the inner Mermaid Sound, however most of the macroalgae habitat shown in **Figure 7-32** occurs in the outer Mermaid Sound (included in the outer Mermaid Sound is the macroalgae around Conzinc Island, Angel Island and further north).

9.23 Table 7-31 provides predicted sedimentation thresholds for scleractinian coral in Mermaid Sound. It provides Acute, Medium-term and Chronic thresholds for resilient coral species associations, but only Acute thresholds for vulnerable species associations. Since both resilient and vulnerable scleractinian coral species associations will be exposed to turbid plumes and additional sedimentation from the dredge and dredge spoil disposal program it is not clear why medium-term and chronic thresholds have not also been used in the modelling to predict potential impacts on vulnerable coral communities. This could have resulted in an under-estimation of the effect on the corals.

The thresholds for resilient species were developed to capture impacts caused by prolonged dredging activities in the vicinity of Holden Point. Here continuous dredging activities are predicted to elevate the risk of many acute events occurring close together. The findings of Stoddart et al (2005) and Blakeway (2005) indicate that sites within 1 km of the uplift area were exposed to a significant decrease in water quality associated with continuous dredging.

However, sites close to the spoil disposal were not influenced in the same way. For example, water quality (TSS and turbidity) at the three closest monitoring sites to the spoil disposal ground A/B (impact site 'CONI' and 'COBN' and near-reference site 'ANGI') did not experience elevated TSS and turbidity levels, and the water quality was similar to that of the far-reference sites (Stoddart and Anstee 2005). Furthermore, the model predicted occasional spikes in sedimentation but no low, chronic elevation. It was therefore considered appropriate for the Pluto LNG Development impact assessment to develop only an acute threshold level to capture potential impacts from sedimentation for corals near the spoil disposal area.

Spoil ground A/B has been in use for a number of years, and has had more than 31 million m^3 of spoil disposed to it. When comparing the predicted coral community losses from the proposed Pluto LNG Development spoil disposal programme into spoil ground A/B with that of previous programme the predicted losses appear to be of a conservative nature as no intense mortality and loss of coral community has been observed during any of previous disposal programmes (**Table 7-34** of the Draft PER).

Current observations from aerial photography in Mermaid Sound confirm that the plume associated with spoil disposal into A/B during January and February (summer months) is relatively confined to the site of disposal. It does not appear to spread eastward towards Angel Island and Conzinc Island causing chronic elevation in turbidity.

The proposed spoil disposal programme is currently being revised and is aimed at limiting the disposal of spoil into spoil ground A/B to only coarse sediments. This will reduce the impact on the coral communities at Angel Island and Conzinc Island – hence the current plume prediction is deemed a worst case scenario.

For further discussion on the coral thresholds refer to the response to **Comment 9.26**.

9.24 Maps showing the zone of direct and indirect effect on benthic primary producers also need to show the boundary at which no effect (including short-term reversible physiological effects) are expected to occur. This zone is likely to be based on water quality achieving background conditions.

Table 7-32 is fundamental to the interpretation of the impact assessment presented in the Draft PER.

The impact zones identified in the Draft PER consist of loss of coral community due to either direct removal of the primary producer habitat, or loss of the community itself due to sedimentation, in accordance with the Guidance Statement No 29 (EPA 2004). No losses are anticipated from suspended solids alone on the grounds that the model does not predict plume persistence and hence prolonged periods of light attenuation. This prediction is supported by prior observations (Stoddart and Anstee 2005) and interpretation of baseline data (see also the response to **Comment 9.18**).

While the impact assessment in the Draft PER has indicated the location and extent of likely losses; this does not include areas of 'low impact' as identified in Table 7-32 in the Draft PER.

Woodside recognises that the identification of this zone is paramount to management and the development of the DSDMP to aid in the establishment of appropriate impact and reference sites. The zone at risk of low impact is closely linked to the deterioration of water quality and the reaction of the benthic primary producers over time. This link is not well understood, and a cautionary approach is suggested in the *Revised Environmental Quality Criteria Reference Document for Cockburn Sound* and the *Pilbara Water Quality Management Framework*. Here a deterioration of water quality above natural variation identifies the area at risk of impact to the biological receptors. Different protection levels identifies the accepted level of deterioration from background levels before further monitoring and possibly management is needed.

The *Pilbara Water Quality Management Framework* has established the protection level of the majority of Mermaid Sound as 'high' to achieve set Environmental Quality Criterias (EQCs) for this level of protection, Environmental Quality Guidelines (EQGs) are developed for relevant stressors, such as for example suspended solids. An exceedence of an EQG indicates that an area is at elevated risk of impact to the ecosystem and that monitoring of the biological indicators themselves is needed. In turn set Environmental Quality Standards (EQSs) for the biological indicators must not be exceeded. If they are, management measures must be put in place.

According to the *Revised Environmental Quality Criteria Reference Document for Cockburn Sound*, the EQG for suspended solids for a high protection area stipulates that when the median of the observed TSS level over a certain period exceeds the 80% percentile of the natural background variation there is an elevated risk of impact to the environment, and relevant biological indicators must be monitored to ensure that the EQS is not exceeded.

Woodside is committed to implementing a detailed DSDMP reflecting this approach. However, to establish the zone of influence based on exceedance of the 80% percentile of background levels, these background levels need to be established. The baseline survey currently being undertaken is collecting continuous information on the background levels of sedimentation, light levels and turbidity (in NTU, this is converted to TSS via site specific and reliable relationships determined in situ and in the lab). Data is being collected over nine months during both summer and winter periods. Different background levels are likely to exist between seasons.

During the development of the DSDMP zones of influence can be established by identifying areas where monitoring of biological indicators (corals) is needed to trigger management measures and ensure these areas do not sustain an unacceptable impact.

As discussed in response to **Comment 10.6** a similar approach of monitoring biological indicators with coral cover decrease trigger levels for management measures is currently in use by the DPU dredging programme. The DSDMP for the proposed Pluto LNG Development dredging programme will take the same approach.

In summary, in the Draft PER Woodside has established zones of predicted coral community loss, which cannot be avoided due to the proximity of dredging and spoil disposal to sensitive habitat, and the direct removal of habitat off Holden Point.

Woodside acknowledges that zones of influence based on water quality have not been established. However, these zones can be better established during development of the DSDMP for management of the areas where losses are seen as preventable with management

measures. The baseline monitoring programme will provide the data needed for the establishment of these zones.

9.25 Model outputs of the suspended sediment plume and the cumulative sedimentation pattern associated with dredging the outer portion of the shipping channel, including propeller wash and dredge spoil disposal, should also be provided to give an indication of potential impact on benthic primary producer habitat around northern West Lewis Island and Malus Island. It is noted that coral communities along East Lewis Island and West Lewis Island have not been mapped.

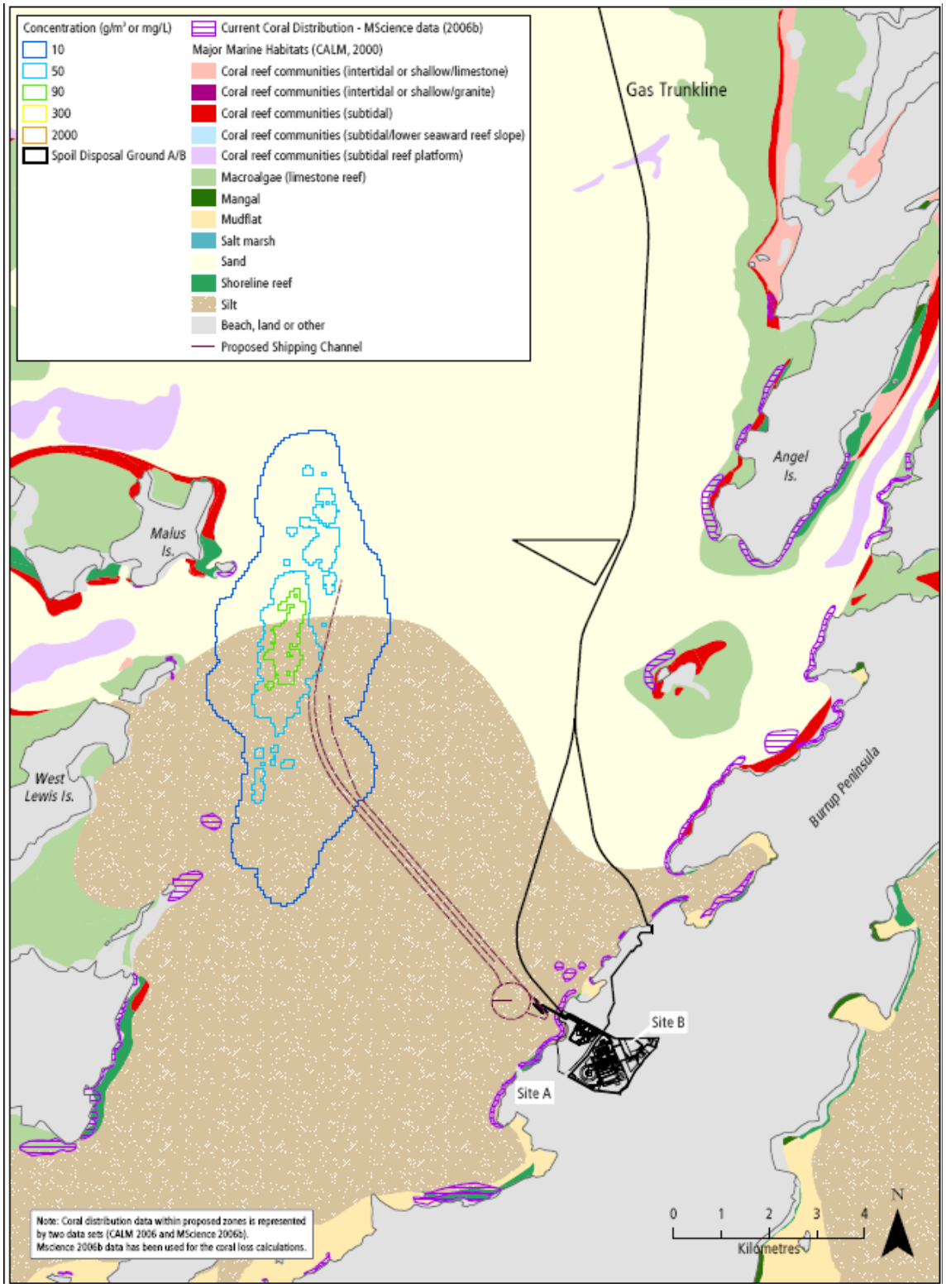
Modeling of the TSHD operations was undertaken during the Phase 1 modeling, as described in Section 7.9.7.2 (p.176-177) in the Draft PER. This included the outer end of the proposed navigation channel, with allowances for propeller wash by the TSHD (the only type of dredging expected at this location). Total suspended sediment plume plots were not included in the Technical Appendix D, Volume 2 for this specific location; however, TSS concentrations over time were reported in box-whisker plots for coral habitats along East and West Lewis Islands (Appendix D, Volume 2 of the Draft PER). These TSS concentrations included TSS from all sources including TSHD activity along the channel and dredging in other areas in accordance with the Phase 1 modeling. Note that propeller wash expected from transiting over the outer channel was much reduced because the water is deeper and hence under keel clearance is greater.

Revision of the spoil disposal programme shifted the main spoil disposal from A/B to the proposed spoil ground 2b, thus making the whisker-box plots obsolete as these were inclusive of all TSS sources (including spoil disposal into A/B). **Figure 8** shows the highest TSS concentration predicted at any location/depth during the month of TSHD operation at the outer end of the proposed navigation channel in accordance with the Phase I modeling but without concurrent spoil disposal activities. The maximum predicted TSS levels at the areas of coral communities are low, from 3–5 mg/L to 5–10 mg/L. Revised modeling of spoil disposal into A/B during the Phase 3 modeling predicted low TSS levels at Malus Island (Figure 7-35a of the Draft PER).

Woodside acknowledges that the model outputs presented in the Draft PER and in this document do not include the cumulative effects of dredging the outer end of the navigation channel while also disposing of spoil into A/B. However, these cumulative effects will be investigated further during the remodeling proposed to undertaken in conjunction with development of the DSDMP ; if impacts are predicted management measures to avoid those can be put in place (such as disposing into 2b while dredging the outer end of the channel).

Appendix A (of this document) contains a complete summary of the monthly predicted cumulative sedimentation patterns from dredging the proposed navigation channel and turning basin, according to the Phase 1 modeling. These figures are also shown in Technical Appendix D, Volume 2 of the Draft PER, however on the figures presented in this document the sedimentation pattern from the Phase 1 modeled spoil disposal into A/B are not included. Although the schedule and methodology for dredging the proposed navigation channel and turning basin may vary from the conceptual programme, these plots are indicative of the final dredging programme and predicted impacts.

The areas of coral community above the sedimentation thresholds predicted to suffer loss of coral communities due to excess sedimentation are shown in the Draft PER in Section 7.9.10.4 (p.224–230).



- **Figure 8: Highest Predicted TSS Level During One Month of TSH Dredging in the Outer End of the Proposed Navigation Channel**

9.26 The proponent has placed a great deal of confidence in the modelling and the coral sedimentation thresholds. The proponent has assumed that corals will only be impacted where modelled sedimentation in a polygon exceeds the thresholds (Figures 7-44 to 7-51). Given the level of uncertainty in the data it would be more appropriate to draw a generalised line around the modelled zone of threshold exceedances that included most of the impact polygons and assume this to be the predicted impact area.

Presentation of Areas of Loss: Woodside has not assumed that coral will only be impacted where modeled sedimentation in a polygon exceeds the thresholds. The areas above thresholds are defined as areas of indirect loss of habitat, as defined in Table 7-32 in the Draft PER. These areas above the thresholds are taken as having received sedimentation above a level at which the coral community will be inundated as was seen during dredging in Mermaid Sound in 2004 (the site 'SUPB' – Blakeway 2005). Here intense mortality caused the overall community to deteriorate to a level where recovery will take an unknown number of years. The substrate is covered with sediments, preventing settlement of larvae until cleared.

Woodside acknowledges that a theoretical model is only an indicative tool in the impact assessment process, and refers to further investigation of the predicted losses in Table 7-32 of the Draft PER.

The polygons marked as losses reflect the output of a stochastic model, where two adjacent model cells are not necessarily predicted to experience the same sedimentation regime. While Woodside acknowledges that in reality impacts are not expected to happen in these exact square model cells as marked on Figure 7-53 of the Draft PER, the outputs are meant to highlight the general areas where impacts are predicted to occur. While a general line around these areas is a valid way of presenting the losses, the pixilated method is an alternative way of conveying the estimates but with the same output, that is, both in effect draw a line where on one side impacts are predicted and on the other not. The pixilated output of the model is meant to reflect the boundary between predicted 'solid' areas of coral community loss, and areas without losses; they better represent the transition areas which are likely to be patchy.

Thresholds: The limitations of the theoretical thresholds have been acknowledged in the Draft PER (Section7.9.10.3 page 221) and in Technical Appendix G, Volume 2. The complexities involved in linking water quality to various degrees of impact on different coral species, morphologies, sizes and community types results in uncertainty in the predictions of 'coral habitat loss' as needed for the calculation of percentage loss within management zones in accordance with EPA Guidance Statement No. 29 (EPA 2004). It is acknowledged that the sedimentation thresholds are only theoretical, giving a generalised indication of impacts, and should not be applied in management (p.220 of the Draft PER).

The acute threshold was developed so that for the inner harbor a cumulative sedimentation load of 500 mg/cm^2/d (including a conservative background level, refer to response to **Comment 9.17**) would cause intense mortality and a subsequent loss of coral habitat and/or community. Such a load would cause a layer of less than 5 mm to form on a flat seabed. The coral communities in Dampier are generally not flat, with many growth forms protruding greatly from the seabed. If such an event was predicted to happen once at any one time, the area in question was considered as loss of coral community in line with EPA Guidance Statement No. 29 (EPA 2004). For the mid and outer harbor the threshold was halved (250 mg/cm^2/d for any one day) while the conservative, high background was kept at 55 mg/cm^2/d so that the model was interrogated with the threshold (250–55 = 195 mg/cm^2/d for any one day).

Sensitivity analysis of the coral sedimentation thresholds are shown in **Figure A1** to **Figure A-19** (**Appendix A**, this document). The thresholds were halved before subtraction of the conservative background sedimentation rate, as outlined in **Table 8** below. The figures indicate that halving the acute thresholds does not have a dramatic effect on the extent of the area of predicted coral loss. This is due to the nature of the increased sedimentation pattern observed repeatedly during dredging operations specifically in Mermaid Sound (Woodside acknowledges that it may be different in other areas of Australia). Here increased sedimentation rates are observed in proximity to the uplift area, but decreases rapidly with distance away from the

dredge. This was observed by LSC (1989) and again during the current DPU dredging programme. This rapid decrease in sedimentation rates makes the impact assessment more robust than at first assumed from the limitations of using theoretical thresholds developed from literature values and in situ observations in Mermaid Sound.

Sensitivity analysis of the medium-term and chronic thresholds for the inner harbor likewise show that the estimated area of loss do not vary much by halving the thresholds (before subtraction of the background), nor by changing the duration from 5 and 15 consecutive days, respectively, to any 5 days out of 15, and any 15 days out of 30 for medium-term and chronic, respectively. The details of the sensitivity analysis are given in **Table 8**.

- **Table 8: Sensitivity Analysis of Medium-term and Chronic Thresholds**

	Threshold as in Draft PER*		**Threshold used for sensitivity analysis***		**Figure Ref**
Description	**Level**	**Duration**	**Level**	**Duration**	
Acute for resilient species	500 (445) mg/cm^2/d	Any 1 day	250 (195) mg/cm^2/d	Any 1 day	**Figure A1** to **Figure A19 (Appendix A,** this document**)**
Medium-term for resilient species	300 (245) mg/cm^2/d	Any 5 consecutive days	300 (245) mg/cm^2/d	Any 5 days of any 15 day period	
			150 (95) mg/cm^2/d		
Chronic for resilient species	200 (145) mg/cm^2/d	Any 15 consecutive days	200 (145) mg/cm^2/d	Any 15 days in a 30 day period	
			100 (45) mg/cm^2/d		
Acute for vulnerable species	250 (195) mg/cm^2/d	Any 1 day	125 (70) mg/cm^2/d	Any 1 day	**Figure A20** to **Figure A22 (Appendix A,** this document**)**

**values in parenthesis are minus the background level of 55 mg/cm^2/d and are the values used to interrogate the model*

The relationship between sedimentation, light deprivation and coral impact is problematic and not well understood (Gilmour et al. 2006). Woodside acknowledges that there is uncertainty in using a theoretical model and theoretical threshold levels to predict impacts. This is why Table 7-34 in the Draft PER was developed, to verify the estimates against the observed outcomes of numerous previous dredging programmes in the area. Though the Pluto LNG Development dredging programme is long, it is reasonable to gauge predicted impacts from programmes that have already taken place in the study area. The programme for the dredging of the LNG channel in the 1980s is a good example. Here the near-field impacts were observed within 1.3 km of dredging, and has subsequently seen coral recruitment along the coast (LSC 1989), thus not loosing the impacted coral habitat indefinitely.

9.27 It appears that a fundamental assumption for the modelling has been that sediments with a high proportion of silts and clays will be dredged during winter and coarser sediments will be dredged during summer and transition seasons. This is likely to have a significant impact on the extent of predicted suspended sediment plumes and sedimentation patterns.

Is the proponent committing to only dredge these respective sediments at the modelled times of year? If not, the modelling should be run to show the effect of dredging each sediment type at each time of year.

Table 7-25 (p.178) in the Draft PER provides a summary of the scenarios that were run to assess impacts from the conceptual dredging programme (Phase 1 and 2) and the revised spoil disposal plan (Phase 3).

Phase 1 and 2: The modeling of the dredging operation itself (not including spoil disposal) assumes particle size distributions as described in Section 7.9.7.4, (p.181) in the Draft PER. '…For the cutter suction dredging data from Geraldton (GEMS 2003) were used to represent sediments suspended form cutter suction dredging into limestone, and data from Dampier (SKM 2004) was used to represent sediments suspended from trailer suction dredging overflows. A conceptual sediment profile for the dredging channel was used to establish the depths of different sediments, and represented a basis for determining material composition along the navigation channel'.

The impact predictions from dredging the proposed navigation channel and turning basin are based on outputs from the conceptual modeling (phase 1 and 2), with particle size distribution assumptions as described above. The seasonal variation in weather pattern might influence the final sedimentation patterns but the indicative plume migration, spread and sedimentation will be representative of the finalised dredging programme.

Phase 3: Figures 7-23, 7-24, 7-25, 7-36, 7-37, 7-38 in the Draft PER explore selective spoil disposal (in terms of spoil coarseness) into distinct parts of spoil ground A/B and the northern extension during different seasons, as per the phase 3 modeling. As described in Section 7.9.7.9, page 195 of the Draft PER the phase 3 modeling assumed fine sediments disposed into spoil ground A/B during winter, where dispersion would be limited due to generally calm weather patterns. However, current revisions of the proposed spoil disposal programme are limiting the disposal of spoil into spoil ground A/B to coarse sediments only. This will reduce the impacts, in terms of coral community loss, at Angel and Conzinc islands where the predicted plume as shown is now deemed a worst case scenario – coarse material is generally subject to less drift before settlement than fines.

9.28 The impact of the dredging and spoil disposal program on the environmental value of recreation and aesthetics needs to be addressed (e.g. water clarity)

Refer to the response to **Comment 9.11**.

9.29 The presence of Naturally Occurring Radioactive Material in produced water is discussed in Section 7.8.11. The response to submissions needs to include what the radioactive constituents are, the expected concentrations, the environmental fate of these radioactive materials and how these will be managed in accordance with APPEA 2002 Guidelines for Naturally Occurring Radioactive Materials. Since discharge would be from a shallow nearshore outfall, this is a potentially significant issue.

Formation water within the Pluto gas reservoir may contain minimal quantities of Naturally Occurring Radioactive Materials (NORMS). It is too early to accurately assess the likely extent or nature of potential constituents of NORMS that could be present in the formation water that will flow from the production wells.

However, if NORMS is present in formation water, the quantity transported to the onshore system will be minimised by firstly limiting formation water ingress and secondly managing accumulation of NORMS.

The MEG recirculation system proposed for the Pluto LNG Development cannot tolerate any significant saline formation water ingress. For design purposes a nominal allowance is made for a small quantity of 'nuisance' formation water ingress the balance of the offshore produced water being non-saline water condensed from the hydrocarbon gas phase. The small formation water allowance is made to ensure design robustness and in practice there may actually be little or no formation water produced. Wells that produce large quantities of formation water will be shut-in until future offshore facilities are installed that can remove and treat the formation water offshore. This inherently limits the quantity of NORM that can be carried to the onshore facilities.

As described in the Draft PER (Section 7.8.11), the build up of scale in the offshore system, and hence, the risk of accumulating NORMS, will be controlled with the use of appropriate inhibitors

and management of the MEG composition. In the onshore facilities the opposite approach will be used, with precipitation of salt/ carbonate scales (and possibly any NORMS) deliberately encouraged in the MEG pre-treatment system and in the MEG reclamation system. This ensures scaling occurs in a controlled fashion in locations where it can be managed.

Any NORMS present may precipitate at the same time (as RaCO3) and would be managed and disposed in accordance with the APPEA guidelines and legislative requirements at the time. Management of NORMS will be addressed in an environment management plan to be prepared for regulatory approval under petroleum legislation. Due to the active precipitation of salt/scale within the MEG system, the produced water recovered from the MEG system is not expected to contain any significant level of soluble NORM. Any solid NORM would be removed with other precipitated solids in the MEG system or the wastewater treatment system, thus minimising the accumulation of the NORM in the system.

9.30 The EPA's guidance on Benthic Primary Producer Habitat (BPPH) Protection specifies actions when the cumulative loss threshold is exceeded. Since these thresholds are greatly exceeded for Management Unit 1, and exceeded for Management Unit 2, the EPA expects:

- *an adequate environmental offset package to be developed to ensure "no net loss", or preferably a "net environmental benefit";*
- *a best practice approach to minimising the impacts; and*
- *the development of a comprehensive management plan.*

Adequate information has not been provided in the PER and further detail needs to be provided in the response to submissions.

Woodside is currently investigating options for environmental offsets. In particular, contribution to marine research programmes is being considered as a secondary offset. The following are examples of research topics that may be considered:

- investigations into artificial reef designs and materials that may be successful in the Dampier Archipelago
- feasibility studies to investigate the potential for coral rehabilitation/transplantation (as future offsets)
- investigation of coral-turbidity-light interactions in Mermaid Sound
- studies to better define coral spawning events and coral recruitment occurring in Mermaid Sound
- further studies defining local and/or regional metocean features that underpin the understanding of variables such as movement and fate of sediments, movement of coral recruits/propagules, and the movement and fate of discharged contaminants.

The development of environmental offsets will be undertaken in consultation with the EPA, DEC and other relevant authorities.

A Framework Dredging and Spoil Disposal Management Plan is provided in Appendix I, Volume 2 of the Draft PER. This Dredging and Spoil Disposal Management Plan will be further developed in consultation with regulatory authorities.

A comprehensive Dredging and Spoil Disposal Management Plan, including details of supporting monitoring programmes, will be developed before the start of the dredging programme. Management plans for other dredging programmes in the region (specifically in Mermaid Sound) will be used as a basis for the development of monitoring and management programmes for the Pluto LNG Development. Recent outcomes and lessons learnt from the Hay Point dredging programme on the east coast will also be used to develop the Dredging and Spoil Disposal Management Plan.

9.31 The proponent has estimated that this project could potentially result in BPPH losses that exceed the thresholds of 10% and 1% for Management Units 1 and 2 respectively. In these circumstances, as outlined in the BPPH Guidance Statement No. 29, the EPA expects a substantial justification for the proposal, supported by technically defendable information that demonstrates understanding of the ecological role and value of the BPPH within the local context. The proponent is expected to determine the significance of any impacts on the ecosystem integrity of the area. The EPA also expects an adequate environmental offset package to counterbalance the damage/loss of BPPH with the goal of achieving 'no net loss' and preferably a 'net environmental benefit'. The proponent has not attempted to address these issues and hence has failed to provide an environmental argument for why these losses might be acceptable

The Draft PER has been prepared using the most comprehensive information available to Woodside at the time of assessment. The environmental impact assessment presented in the Draft PER is the result of extensive literature reviews, consultation with marine and coral experts, modeling and studies by specialists. The level of information in the Draft PER has been presented to enable the reader to form an objective view of the potential impacts associated with the Pluto LNG Development.

It is acknowledged that the thresholds in Management Units 1 and 2 will potentially be exceeded. The acceptable cumulative loss criteria for Management Unit 1 is set at 10%, a difficult target to meet as Dampier is a major port. Direct loss of benthic primary producers within Management Unit 1 as a result of the proposed Pluto LNG Development dredging programme is estimated to be 2.7% whilst historical losses are estimated to be approximately 18.6%.

The coral species within Management Units 1 and 2 are common and widespread in other areas of the Dampier Archipelago; this widespread distribution offsets any potential loss of ecological integrity of the wider ecosystem even though localised impacts may arise. Recruitment into disturbed areas within Mermaid Sound is expected from other areas within Dampier Archipelago, and the integrity of substrate habitat will not be permanently altered in areas of indirect coral losses, therefore recovery of systems is anticipated.

Woodside is currently investigating options for environmental offsets – refer to the response to **Comment 9.30**.

10.2 The proponent needs to provide the baseline data that are currently being collected on sedimentation, turbidity and light level, and develop a series of multiple impact thresholds (i.e. including frequency, intensity and duration of exposure to the physical variables) for corals that incorporate variation in tidal and sea state as opposed to just seasonal variation. These thresholds should then be used within the model as the basis for the environmental impact prediction. Given the length of the dredging campaign (i.e. 24 months) and the potential for impact on significant coral habitat, the environmental impact assessment needs to be based on the sedimentation and turbidity thresholds established using the methodology alluded to in Appendix A of the PER.

Background Sedimentation Rate: In the absence of baseline data on the background sedimentation rates, the values used for setting the fixed background rate for use in the impact assessment were obtained from various studies where measurements were taken both during and before/after dredging and spoil disposal activities. Values obtained during dredging programmes were not excluded; rather all values were used in the formulation of the background sedimentation level as Mermaid Sound is believed to be chronically influenced by anthropogenic activities.

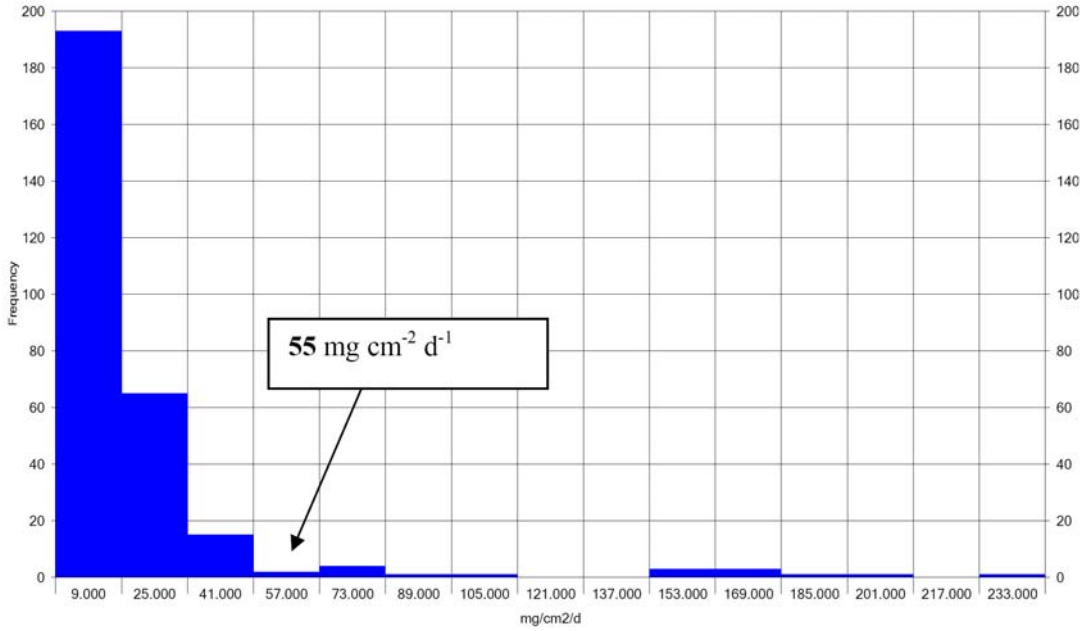
The theoretical conservative background rate was set so that over 90% of the measured sedimentation levels were below the fixed rate. Reference should be made to Figure 17 and Table 8 as presented in Appendix G, Volume 2 of the Draft PER.

The incorporation of a fixed, high background rate into the model introduces a degree of conservatism; by assuming that the background rate is always high the cumulative sediment load resulting from dredging and background will reach the coral mortality threshold even on days where the background rates will be much lower (**Figure 9**). This precautionary approach aids in creating a conservative impact assessment.

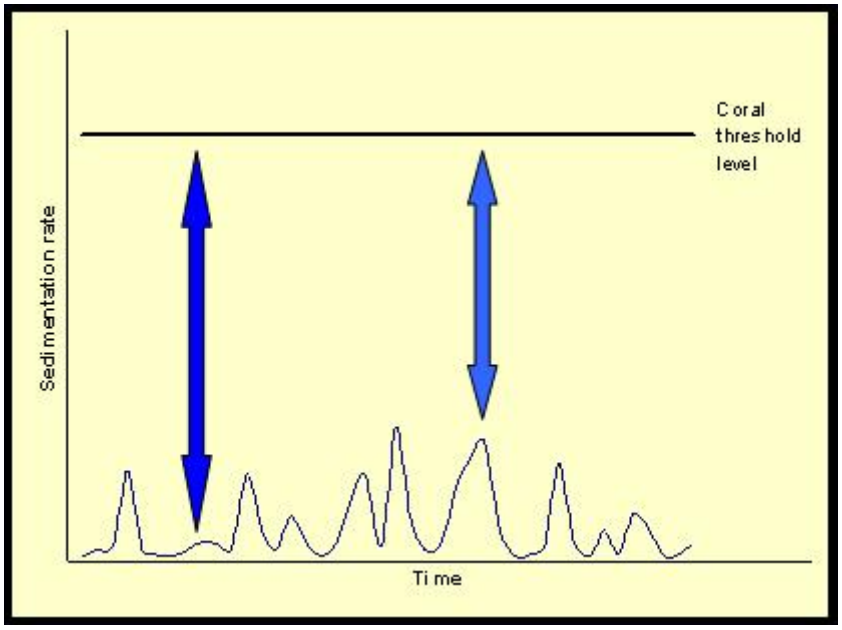
When a high rate of background sedimentation is assumed throughout the dredging programme, only the more extreme events will cause a background sedimentation rate higher than the assumed fixed rate incorporated into the model. In any case during any extreme events dredging is likely to stop for example, during cyclones. The predicted estimates of total sedimentation (background and dredging related) will therefore be conservative, that is, higher than what would be expected most of the time (**Figure 10**). This is emphasised even further in the outer harbor, where background sedimentation rates are generally lower. To address this, and as described in Section 7.9.10.3 of the Draft PER, a lower mortality threshold was derived for this area recognising that corals here live in regimes with generally lower sedimentation. Similarly, by using the high fixed background rate impacts are likely to be an over-estimate in the outer harbor.

Regardless of which corals (inner, mid or outer harbor) are most resilient to sedimentation, using the same conservative background rate for all areas will assist in avoiding an under-estimation of the impacts. The potential for over-estimating would give a worse-case scenario, which is preferable for impact assessment purposes.

The use of the same background sedimentation rate, which accommodates more than 90% of all the rates, is therefore considered a conservative approach in that this will yield a total sedimentation level above that expected the majority of the time during the proposed Pluto LNG Development dredging programme.



- **Figure 9: Compilation of Available Sedimentation Rate Data at the Time of Impact Assessment (from SKM 2006 – technical report Appendix G from the Pluto LNG Development draft PER).**



- **Figure 10: Thick black line represents the absolute coral threshold level, at which mortality will occur. The thin black line represents the background sedimentation level. The blue arrows represent the "allowable" sedimentation rate for dredging before the coral threshold level is reached. By assuming a constant high background level the total sedimentation level during the dredging programme is likely to be over-estimated.**

Trigger Levels versus Threshold Levels: McArthur et al 2002 outlines a methodology for determining trigger levels for benthic biota aimed at dredging management through water quality monitoring. Trigger levels can be developed based on the natural background variation and the assumption that corals are adapted to this regime and will be unable to cope with any significant increase in TSS or sedimentation levels. By basing the trigger levels on the frequency, intensity and duration of the observed background sedimentation and TSS time series it is possible to derive set levels at which corals are likely to become stressed.

However, a limitation in this method is the determination of the loss of coral habitat in accordance with the Benthic Primary Producer Guidelines; the trigger levels will not provide information on the level at which the coral community will suffer mortality to a degree where it is considered a loss in accordance with the guidance statement. As the link between physical stressors and the level of impact on corals is not well understood, mortality cannot be predicted using the trigger levels described in McArthur et al (2002). The intention of such trigger levels is to flag deterioration of water quality *before* impacts occur.

The theoretical mortality thresholds for the Pluto LNG Development Draft PER instead focused on setting a level at which an acute or semi-acute event would cause intense mortality to a similar extent as was observed during the 2004 dredging programme as is described in Blakeway (2005). Gilmour et al. (2006) has set indicative stress and mortality curves for sedimentation and turbidity; however, the authors emphaise that there is currently insufficient data to establish these levels with confidence. Woodside acknowledges this uncertainty in using theoretical mortality thresholds. Please refer to response to **Comment 9.26** for a discussion on threshold sensitivity analysis.

Sea state and Tide: Trigger levels developed on the basis of the baseline data will provide early warning indicators of conditions where the risk of impact to corals is increased. Such trigger levels are likely to vary with sea state and tide, as outlined in the responses to **Comment 10.2**. While a management programme relying mainly on water quality would need to develop trigger levels for varying conditions, it needs to be emphasised that the use of such detailed trigger levels for predictive purposes would be limited, as theoretical models are not able to

predict weather during a two year period with the accuracy needed to investigate the impacts caused by the frequency of various intensities and the duration of these in relation to tidal and sea state. The theoretical model is a predictive tool which may give a general idea and prediction of the impacts based on average expected weather and tidal regimes within each season.

Baseline Data: The baseline survey has collected a large data set, which can be provided upon request in a specified format. The data set has not yet been analysed, as the baseline survey is still ongoing. A substantial amount of analysis is needed for interpretation of the data set, with the incorporation of weather and shipping data also required. This analysis is scheduled to be completed in May 2007.

Woodside concurs that the baseline data will be very valuable in establishing zones of influence based on the McArthur approach, which is commensurate with the *Pilbara Water Quality Framework Plan* and the *Revised Environmental Quality Criteria Reference Document for Cockburn Sound*. However, the use of trigger levels to determine the extent of coral community loss is limited.

Please refer also to the response to **Comment 9.24** for a discussion on how to establish zones of influence based on the Pluto LNG Development baseline data.

10.3 Appendix A of the PER (p. 494) outlines the methods used for determining baseline sedimentation and turbidity thresholds at which corals may become stressed (based on McArthur et al. 2002). It is recommended that the proponent provides the baseline data as discussed above, and develops a series of tolerance thresholds for corals to light (as opposed to TSS or Nephelometric Turbidity Units (NTU)) that represent tidal and sea state as opposed to just seasonal variation. The theoretical model should then be interrogated with these light thresholds to form the basis for the environmental impact prediction. Once impacts have been determined, the proponent can use this information to develop a monitoring and management framework.

In order to conduct an accurate environmental impact assessment, an understanding of the relationship between TSS and light attenuation for the limestone component of this projects dredging program is required. The proponent should discuss the potential chronic impact on benthic communities that may arise from any prolonged reduction in light associated with dredging.

Reference should be made to the response to **Comment 10.2** for details on disclosure of the baseline data, and a discussion on the use of trigger values based on the baseline data for impact assessment purposes.

Woodside recognises the enhanced risk of chronic impacts on corals in Mermaid Sound due to the length of the proposed dredging programme. Baseline monitoring has collected light data in situ which will provide an enhanced understanding of the light regimes within the coral habitat in Mermaid Sound. This dataset has been complemented with data collected by another proponent in Mermaid Sound during dredging and with concurrent coral monitoring. To address impacts from light attenuation during the Pluto LNG Development dredging programme this baseline light data and a revised model taking resuspension into consideration will be used.

From recent data collected during the DPU dredging programme data has become available on light attenuation in relation to TSS both at impact and reference sites. TSS values have been measured by taking water samples at the bottom and on the surface at both impact and reference sites. Light data has been collected concurrently using both a light meter (surface and bottom) and a secchi desk. The sediments liberated during the DPU dredging in proximity to Holden Point are representative of the sediments, which will be liberated through the proposed Pluto LNG Development dredging programme. This includes the limestone component liberated through CSD.

The identified relationship between TSS and light attenuation will be used to investigate the

critical depth for coral communities in Mermaid Sound during the proposed Pluto LNG Development dredging programme.

10.4 Given the apparently dissipative nature of Northern Spoil Ground, the proponent should provide detailed information regarding the projected long-term fate and impacts of material disposed to all the proposed disposal grounds.

As indicated in Section 6, Appendix I of the Draft PER, spoil disposal will be managed to reduce potential impacts to as low as reasonably practicable. Proposed measures to mitigate impacts and to reduce the footprint associated with spoil disposal will be given effect through an approved Dredging and dredge spoil disposal management plan (DSDMP).

Section 7 of the Draft PER includes results of predictive modelling and assessment of the spoil disposal footprint. Further modelling will be undertaken during development of the DSDMP to further refine understanding of this footprint as further information becomes available about proposed activities, including materials relocation.

As indicated in Section 8.1.3 of the Draft PER, a post dredge survey will be conducted following completion of the dredging work to document the condition of affected benthic habitats following the cessation of dredging activities. Interpretation of the post-dredging survey findings will be supported by information that will be available from sites that have been established across the project area as part of the environmental baseline surveys now being conducted before dredging activities start.

Woodside notes the comment about the apparent dissipative nature of the Northern Spoil Ground and is aware that the Northern Material Relocation Site (NMRS) is a repository for disposed materials generated from activities by various port users, including Woodside.

Apparent losses from the NRMS have been evaluated recently in relation to disposal of dredged materials from works conducted at the turning basin for the LNG V Expansion Project. This suggested that a small proportion of material was lost during offloading mud and ooze while a similar proportion appeared to have been lost and dispersed during dredging. Some migration of materials was apparent around dump boxes. There was evidence of erosion of materials from dump areas and also from the remainder of the NRMS that included periods where the area had been subject to effects of tropical cyclones.

The NMRS is reserved for deposition of marine silts, mud and ooze contained within a bund of stable granular material. Because of its nature, some materials, such as mud and ooze, are difficult to quantify accurately. Theoretically, volume changes can be evaluated from survey information for the dredge area, in the dredge hopper, by sounding the solids and using derived factors to determine amount of material in suspension above solids, and by survey at the material relocation site.

Losses will occur at the dredging stage through the action of dragging the suction head through the material and causing some of it to become suspended and be dispersed due to current action. Propeller wash from the dredge will also cause a certain amount of loss. Such losses are impossible to measure accurately but can be estimated. Losses can also occur through current action when material is deposited at the relocation site before the material has had a chance to settle. These losses are also difficult to measure accurately.

Currents can also cause material to be eroded from the site over time, particularly during cyclonic events. An approximate value for such losses can be measured by comparison surveys, however, due to the sizes of the areas, unless losses are significant depth-wise, survey tolerances may render calculated volumes as unreliable.

Woodside would be supportive of opportunities to work with DPA and others using the spoil ground to improve collective understanding of the nature and extent of material dissipation. Woodside will consult with the DPA and the Dampier Spoil Management Committee in relation

to appropriate means of disposing material generated from marine construction and dredging work. Woodside is investigating the feasibility of locating more material to the deep water spoil ground (i.e. spoil disposal ground 2B).

10.6 That the proponent develops threshold curves and a predetermined range of triggers for monitoring and managing impacts on corals. Pre-programmed management responses for the 80th percentile to the 95th percentile of natural variation for sedimentation and turbidity should be developed. A third tier of management would be introduced should the 'not to be exceeded value', being the 99th percentile, be reached at sensitive benthic systems.

A detailed monitoring and management response framework similar to the one currently being used for the Dampier Port upgrade should be developed (including the establishment of a Dredge Management Group).

Woodside welcomes the approach to setting water quality management trigger levels established above. As discussed in the response to **Comment 9.24** the *Revised Environmental Quality Criteria Reference Document for Cockburn Sound* and the *Pilbara Water Quality Management Framework* establish a similar approach to management and monitoring. Environmental Quality Guidelines (EQGs) for physical stressors developed for Cockburn Sound.

The baseline data collected will be used to enhance the understanding of the hydrodynamics and sediment flux in Mermaid Sound, and develop trigger levels following the methods of McArthur et al. 2002 or the *Revised Environmental Quality Criteria Reference Document for Cockburn Sound*. However, following on from the outcomes of the recent Hay Point dredging programme it is not believed that the dredging programme can be managed primarily from water quality data (such as sedimentation, turbidity, suspended solids and light attenuation). Such data is important to collect continuously during the dredging programme, and is proposed as part of the Pluto LNG Development monitoring programme. However, management decisions are to be based primarily on the outcomes of coral monitoring. During the Hay Point dredging programme water quality became important contextual information for the dredging management group with which to understand and interpret coral reports.

It is envisaged that the Pluto LNG Development establish a Dredging Management Group and develop a management plan in line with current monitoring undergoing in Mermaid Sound, where frequent coral monitoring forms the basis of management decisions, with water quality collected for the purpose of early warning indicators, and an enhanced understanding of coral health observations and the impacts from dredging.

10.7 The proponent should provide additional information on the characteristics of the potential light spill from the proposal, i.e. model zone of light influence. Additionally, the proponent should outline the proposed light reduction management measures and clearly demonstrate their effectiveness. The proponent should demonstrate that the project's light reduction and management practices are aligned with industry best practice.

Modeling the zone of light influence (light spillage modeling) was initially considered for the environmental impact assessment process, however investigations into available light modeling methodology indicated that it would be of limited benefit in the assessment of the Pluto LNG Development. Light modeling has a number of limitations preventing it from being used to translate the model outputs into impacts on fauna. Limitations of this approach include the following:

- Light modelling typically models light emissions in lux, which is an artificial unit of measurement used to measure the intensity of light spectrum visible to the human eye (Pendoley 2005). Lux is weighted for visible light pertinent to human vision (between 500 and 650 nm); it does not account for light emissions between 300 and 500 nm or above 650 nm. Turtles see light outside the range pertinent to human vision, for example green

turtles are known to respond to light in the 350 to 450 nm range (Witherington and Bjorndal 1991). Therefore, light modelling does not model all the light that turtles react to.

- Light modelling does not account for various atmospheric conditions that affect light and light scattering, and therefore influence sea turtles' reactions to light. For example, an overcast sky can cause light to reflect off clouds thus increasing the influence of a light source (compared to the same light source during clear skies). Aerosols such as salt or dust in the atmosphere can also scatter light and light intensity.
- Light intensity is only one of several cues which direct nest site selection and seafinding behaviour in sea turtles. Modelling of light spillage would ultimately provide insight into only one dimension of a multi-faceted problem.
- Seafinding will occur even in the presence of artificial night lighting. Therefore any conclusions drawn from the modelling would be fraught with assumptions relating to the significance of light intensity as an influence on turtle behaviour.
- There is no single, measurable level of artificial brightness on nesting beaches that is acceptable for sea turtle conservation. The data obtained would therefore provide limited information in relation to impacts on sea turtles. Put simply, our limited appreciation of the influence of lighting impacts at different light intensities precludes a meaningful analysis of the data.
- The products of light spillage modelling would essentially be contour maps which indicate wattage at distance from source. Such modelling would not account for sky glow from sub-coastal development, light impacts from external sources, or the continuity (in silhouette) and elevation of the landward horizon.
- In the case of the Pluto LNG Development, it would prove impossible to isolate the impacts of proposed lighting from background light sources such as the existing Dampier Port Authority, NWSV Karratha Gas Plant and marine vessels in the wider locality. There are no published, scientifically valid means to measure light pollution in this context.

Since obtaining access to Site A in early 2007, Woodside has been undertaking visual monitoring for signs of turtle nesting activity at Holden Point Beach, directly adjacent to the Site A lease area. This monitoring is conducted each morning as a part of routine security checks along the site boundary. The purpose of this monitoring is to identify any signs of turtle activity including digs and tracks, and in the event that signs of activity are observed, to alert the Site Environmental Officer who is tasked with identifying type of turtle (if possible), determining whether nesting is likely to have occurred and recording this information.

To this date there have been no observed signs of turtle activity on Holden Point Beach. This is consistent with advice that the beach west of the Site A (i.e. Holden Point Beach) is not a significant site for sea turtle activity (Pendoley 2006). Hence, risk to nesting turtles from lighting associated with the Pluto LNG Development is considered low.

The DEC will be consulted regarding strategies to minimise impacts on turtles during the development of detailed Environmental Management Plans.

10.8 The proponent needs to discuss and address the potentially negative environmental consequences of the Pluto LNG Development resulting from the recreational requirements of additional people attracted to the West Pilbara region by the project. The proponent needs to develop strategies in consultation with DEC to assist in the avoidance and management of these impacts.

The workforce required for the construction of the Pluto LNG Development is in the order of that required for previous / existing developments including NWSV Phase V. There is no expectation that this will result in increased environmental impacts to the west Pilbara through increased recreational activity.

10.9 Given the unavoidable impacts and residual risks identified within the PER, if the Pluto LNG Development proceeds there will be a net environmental loss. Net environmental benefits cannot be achieved until all potential impacts are fully assessed, managed and offset as far as reasonably practicable. As such, DEC recommends that both the proponent and Government commit to ensuring that appropriate environmental offsets are provided for the impacts of the proposed development.

This comment is acknowledged. Consultation will be undertaken with the DEC and other appropriate authorities regarding environmental offsets for terrestrial and marine aspects of the Pluto LNG Development.

10.10 The scenarios modelled for dredging works tested a change from 15 hr/day to 24 hr/day (p. 176). It is understood that a 24 hour operation was applied to simulate worst case dredging operation impacts. DEC requests that the proponent outlines the differences in impacts between the two scenarios and comments on the effectiveness of using 'dredge resting phases' to reduce impact on significant coral systems potentially at risk.

Table 7-25 (p.178) in the Draft PER provides a summary of the scenarios that were run to assess impacts from the revised dredging and disposal programme (divided into Phase 1, 2 and 3).

As outlined in Section 7.9.7.4 (p.181) of the Draft PER, the simulations for the conceptual programme (phase 1) assumed operations for 15 hours a day, which were the basis for impact assessment from dredging of the proposed navigation channel. Both TSS and sedimentation sensitivities were later undertaken based on 15 hr operations (9 hr off) versus 24 hr operations (phase 2 modeling). Results indicated that there would not be a higher build up of TSS at distance from the dredging (that is, at Mermaid Sound scale) if dredging were longer each day. This was in line with the conclusion that there would not be a general build-up of TSS levels in Mermaid Sound over the course of the operation. Instead, elevations would be generated by the evolving movements of the plume. However, with 24-hour operations, the coral communities close to the dredging were predicted to receive more episodes of exposure over time and sometimes higher concentrations due to 'double-dosing' (that is, the plume passing over again before the remnants of the last exposure had dissipated). This phenomenon is due to the wider range of opportunities for exposure that arise from generating the plume for longer each day.

Evidence to support the findings that TSS levels are not predicted to build up over time at the Mermaid Sound scale, but will be patchy in distribution is given in Stoddart and Anstee (2005). Here, water quality, plume modeling and tracking before and during dredging in Mermaid Sound highlighted that previous dredge modeling that did predict a build up was grossly overestimating TSS levels.

The simulations for the revised spoil disposal programme (phase 3) assumed 24 hour dredging operations for the estimation of spoil disposal frequencies. While there may be increased levels of TSS and more frequent spikes during such a 24 hour operations programme in reality the effective dredging operations will not reach 24 hours due to periodic downtime for refueling, routine maintenance and repairs.

10.11 The presence of rock pinnacles found in 300-500 metres of water is noted in the PER (p. 107 & 111). These formations support deep water coral species such as Lophelia sp., and are a source of habitat, protection and nutrition for marine fish and other fauna. Similar rock pinnacle communities have been identified around the world supporting significant biodiversity and abundant marine life in areas that would otherwise be essentially barren and void of marine life. DEC supports the proponent's commitment to avoid placing project infrastructure or impacting on areas of sensitivity including rock pinnacles (p. 133).

This comment is acknowledged.

10.12 The PER states that marine vessels will anchor in prescribed areas within the port. DEC recommends that where possible moorings be installed and utilised to reduce the area of impact caused by anchorage. Consultation with the Dampier Port Authority and Government bodies will be necessary for the development and management of this strategy.

This comment is acknowledged. Woodside will consult with the DPA and other relevant regulatory agencies regarding operation of vessels within the Port of Dampier.

Terrestrial Impacts and Management

10.13 DEC considers weed management as a high priority on the Burrup Peninsula, especially preventing the establishment and spread of weeds within the non-industrial lands of the Burrup Peninsula. As such, DEC requests an opportunity to review and comment on the proposed Weed Management Plan (Appendix G).

In addition, DEC requests an opportunity to review and comment on the proposed Sea Turtle Management Plan, Marine Pest Management Plan, Blasting Management Plan, Vegetation and Flora Management Plan, Fauna Management Plan, and the Dredging and Spoil Disposal Management Plan.

The comment is acknowledged. Woodside will consult with the DEC when developing detailed environmental management plans.

10.14 DEC understands that there is a level of uncertainty in regard to the taxonomy of Rhagada species collected at both Site A and Site B (p. 320). As such, DEC recommends that the proponent commits to completing the short range endemic fauna survey by conducting further genetic investigations to resolve the issue. Given the taxonomic uncertainty and significance of short range endemic fauna on the Burrup Peninsula, the proponent needs to manage impacts and risks to land snails at Sites A and B.

Woodside is supportive of research, and will undertake studies to further understand the taxonomy of the *Rhagada* species collected at Site A and Site B.

In terms of managing impacts and risks to land snails, Woodside proposes to minimise impacts by avoiding land snail habitat where possible. Where land snail habitat cannot be avoided, management measures will be developed in consultation with the DEC and other regulatory bodies, and these management measures will be incorporated into the framework Fauna Management Plan (Appendix G of the Draft PER).

6.2 There should be concern for the two regionally significant vegetation associations that are likely to lose more than 50% of their area, as this would be highly detrimental to faunal assemblages, particularly invertebrates (as yet unsampled), that may be dependant on these associations. Some greater focus on the fauna of these should have been undertaken.

The two areas of regionally significant vegetation associations that are likely to lose more than 50% of their area are AcImTe/TeCa and AbCc'Te, as identified by Trudgen (2002).

Vegetation association AcImTe/TeCa is a mosaic community consisting of vegetation associations AcImTe (*Acacia coriacea*, *Indigofera monophylla*, *Triodia epactia* (Burrup form)) and TeCa (Triodia epactia (Burrup form), *Cymbopogon ambiguus*). A total of 140 occurrences of vegetation association AcImTe were recorded by Trudgen (2002) on the Burrup Peninsula with 73.9% of the vegetation association represented in the Burrup Conservation Zone; AcImTe is not considered regionally significant. Vegetation association TeCa has 97 occurrences (as

mapped by Trudgen 2002) and 4.3% of its extent occurs in the Burrup Conservation Zone. The mosaic AcImTe/TeCa is considered significant due to the presence of TeCa, which has limited representation in the Burrup Peninsula Conservation Zone.

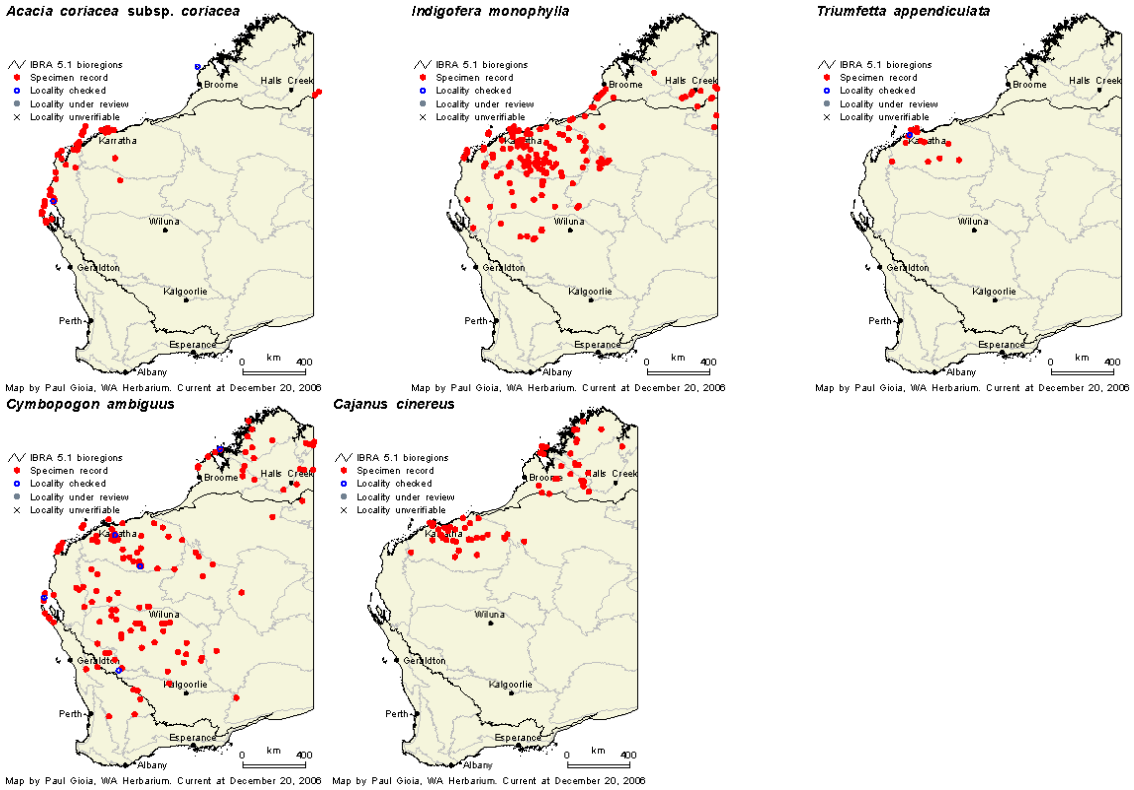
Vegetation association AbCc'Te was mapped twice on the Burrup Peninsula, and has 19% of its extent within the Burrup Peninsula Conservation Zone.

A desktop fauna assessment was undertaken for Site A and B; this is consistent with the advice provided by the DEC and the results (fauna species likely to occur in the site) are presented in Section 8.3 of the Draft PER. With regards to impacts on faunal assemblages that may be dependent on these vegetation associations, it is acknowledged that both vertebrate and invertebrate assemblages may utilise these two vegetation associations.

The broad habitat or landform that supports the two vegetation associations have been classified as upland stony plateau (ENV 2006) and upper undulating hills and slopes (Astron Environmental 2005), both of which are very common landforms on the Burrup Peninsula. The structure of the vegetation associations (shrublands over hummock grasslands, hummock grasslands) and the flora species comprising the vegetation associations are also found elsewhere on the Burrup Peninsula. Vertebrate fauna likely to inhabit these landforms, and therefore utilise the two vegetation associations, are broadly distributed and generally mobile species (Section 8.3 of the Draft PER). It is not anticipated that there would be any particular niche elements of these two vegetation associations that would be specifically utilised or depended upon by vertebrate fauna. Terrestrial vertebrate species on conservation significance (as discussed in Section 8.3.7 of the Draft PER), including species such as the fossorial skink *Notoscincus butleri*, and the Pilbara olive python (*Liasis olivacea baroni*), would not be restricted to these two vegetation associations. Loss of these associations is not considered to be likely to result in a loss of biodiversity at the species, or even the genetic level with respect to vertebrate fauna.

It is acknowledged that there is potential for the clearing of the two vegetation associations to impact upon biodiversity at the population or genetic level for invertebrate species, particularly as short range endemism can occur in some species over very short distances. However, the landforms and more importantly, the microhabitats within the landforms that invertebrates may depend upon (such as soil depth, rock type and detrital layers) are not expected to be disjunct or finite within the two vegetation associations. The landforms are very common and found throughout the Burrup Peninsula, including areas within the Burrup Peninsula Conservation Area (as identified by the Burrup Peninsula Land Use Plan and Management Strategy 1996). The upland stony plateau (ENV 2006) and upper undulating hills and slopes (Astron Environmental 2005) represent the connected interzone between isolated fauna habitats such as rockpiles and drainage lines that are much more likely to support short range endemic species. The connectivity of this basic landform, upon which the two vegetation associations occur, is evident in Figure 1 and Figure 2 of Astron Environmental (2005).

With respect to the potential loss of biodiversity resulting from clearing of these two vegetation associations, it is important to consider the potential dependence of invertebrate fauna on particular floristic taxon occurring within the associations. It is possible that unknown or as yet undescribed invertebrate taxa may specifically depend on a particular plant for its survival and persistence. In consideration of this, the structure and distribution of the main plant taxa within the two vegetation associations was considered. It was determined that the dominant taxa are well represented within the site, within the Burrup Peninsula and beyond the physiographic boundaries of the Burrup Peninsula. For example, the distribution maps of taxa within the two vegetation associations are presented below (Naturebase 2006). In all cases the taxa are distributed beyond the Burrup Peninsula. In cases of locally significant flora taxa within the associations, such as those described by Trudgen (2002) as being of conservation significance for the Burrup Peninsula, *Triodia epactia* is very broadly distributed across the Burrup Peninsula, and two other taxa with close affinities (*Triodia angusta* and *Triodia wiseanna*) are also very common in the area.



- **Figure 11: Distribution of Flora Taxa that Occur Within Vegetation Associations AclmTe/TeCa and AbCc'Te**

5.8 Should there be a requirement to quarry rock material from land it is DPA's preference that this be undertaken adjacent to existing Port land to extend available flat land for future potential Port uses in the area.

Should the Pluto LNG Development require rock other than that quarried from the Site A and Site B, then this is likely to be sourced from one or a number of existing quarries in the region. Quarries will be assessed based on the quality and quantity of rock they can supply under approvals, the location of the quarry, and other commercial considerations.

13.1 …how does Woodside justify the commencement of site preparation works at Burrup without developed Environmental Management Plans in place?

Site preparation works associated with Site A commenced in January 2007 after necessary environmental and heritage approvals were obtained and Environmental Management Plans for those works were in place. The EMPs were developed in consultation with the DEC and DEH: the Fauna Management Plan being formally approved by the DEH as a requirement under the Commonwealth EPBC Act approval.

Social and Economic Impacts and Management

4.1 Fisheries listed under section 10.7.3 of the PER should include reference to the Blue Swimmer Crab Fishery and the Marine Aquarium Fishery. The proposed live rock [lobster?] aquaculture site at Withnell Bay should also be listed under section 10.7.5 of the PER. These fisheries, in addition to those already listed in the PER, should be given warning of any proposed construction activities and the proponent should conduct information sessions for the affected fishing operators as required.

Sections 10.7.3, 10.7.5 and **11.8** of the Draft PER should be updated as follows with regard to the Northern Developmental Blue Swimmer Crab Fishery, the Marine Aquarium Fish Managed Fishery and the proposed live rock aquaculture site:

Western Australian State Managed Fisheries: The DFWA manages several fisheries on the North West Shelf, of which eight have boundaries that overlie or are in close proximity to part or all of the offshore area of the Pluto LNG Development, they include:

- the Pilbara Demersal Finfish Fishery comprising:
- the Pilbara Fish Trawl (Interim) Managed Fishery
- the Pilbara Trap Managed Fishery
- the Onslow Prawn Managed Fishery
- the Nickol Bay Prawn Fishery
- the Pearl Oyster Fishery
- the Western Australian Mackerel Fishery
- the North Coast Shark Fishery
- the Marine Aquarium Fish Managed Fishery
- the Northern Developmental Blue Swimmer Crab Fishery.

The Marine Aquarium Fish Managed Fishery: The Marine Aquarium Fish Managed Fishery operates in state waters spanning the entire Western Australian coastline. In recent years the fishery has been active in waters from Esperance to Broome with popular areas including the area from Karratha to Port Hedland (Newman and Cliff 2006). The Marine Aquarium Fish Managed Fishery is known to operate on coral reef around Conzinc and Angel islands.

The fishery targets more than 250 species of fish as well as coral, live rock and invertebrates. It is primarily a dive-based fishery that uses hand-held nets to capture target species from boats up to 8 m in length (Newman and Cliff 2006).

There are 13 licences in the fishery and in most years all licences are actively used. While the fishery operates throughout all Western Australian waters, catches are relatively low in volume due to the special handling requirements of live fish, with 28 936 fish being caught in 2005. Collectors can however, earn a high return from the capture of very small quantities of individuals (Newman and Cliff 2006).

The Northern Developmental Blue Swimmer Crab Fishery: The Northern Developmental Blue Swimmer Crab Fishery (NDBSCF) occupies waters out to the 200 m isobath between 115°E latitude and 120°E latitude, from approximately Onslow to Port Hedland. Two commercial fishers are authorised to operate in the NDBSCF with each exemption holder having slightly different fishing area boundaries. Exemption holder one being permitted to fish within the zone 115°6'60 E to 120°E, while exemption holder two is permitted to fish within the zones 115°E to 116°45'E and 117°E to 120°E (DEH 2006).

The fishery targets blue swimmer crab (*P. pelagicus*); however, operators are also permitted to retain coral crabs (*C. cruciata*) and sand crabs (*O. australiensis*) as by-product. Crabs are caught using approved crab traps and there is no closed season. In 2003, 49.1 tonnes of blue swimmer crab were taken with a total value of approximately $325 000 (DEH 2006).

10.7.5 Pearling and Aquaculture

Several land-based aquaculture sites exist in the vicinity of the Pluto LNG Development. There are currently no active pearling leases in the Dampier Archipelago. A live rock aquaculture site is also proposed at Withnell Bay. Live rock is substrate (usually rock or dead coral) that has

been colonised by a range of flora and fauna such as bryozoans and coralline algae and is used by aquarium enthusiasts to enhance an aquarium's appearance and function

Preventative and Management Measures: As previously stated in Table 11-9 of the Draft PER, Woodside will ensure those stakeholders that could be potentially affected by construction activities are appropriately informed before the start of construction. Notification to Mariners and compliance with port authority regulations will be required under maritime and port legislation and regulations. Fisheries bodies, including the Marine Aquarium Fish Managed Fishery, the Northern Developmental Blue Swimmer Crab Fishery and the proposed aquaculture proponent at Withnell Bay, will be contacted by Woodside prior to commencement of construction activities and fishers provided with relevant information on timing of construction activities and related equipment and vessel movements. Where necessary, briefing sessions will be conducted with relevant fishers to ensure they are fully aware of proposed construction activities that could affect their activities.

6.3 Overall there is no mention of underwater cultural heritage (UCH) other than 'shipwrecks' in Section 10.4. UCH needs to be included in Section 10.3 Aboriginal Heritage as there is potential for submerged rock art in the area.

Woodside is required to notify the Aboriginal Cultural Material Committee if the company believes that its activities will damage Aboriginal heritage sites and to seek consent to use land for a required purpose in that instance. Woodside has no reason to believe that it will disturb Aboriginal heritage sites during maritime operations associated with the Pluto LNG Development.

6.4 Overall prior to construction phase of the Pluto development, a systematic desktop and field survey of the development area including the seabed should be made for Indigenous, historic and maritime cultural heritage sites by appropriately qualified archaeologists.

Prior to archaeological heritage surveys commencing over Site A and Site B detailed desktop analysis was completed to identify previously discovered Aboriginal heritage sites and to assess the extent of heritage surveys previously conducted over these areas of land. This work was completed to further Woodside's understanding of the heritage landscape, to assist the survey work and to comply with the heritage survey standards expected by the Department for Indigenous Affairs.

11.15 Woodside refers to the 'Burrup Land Use Management Plan' as if it is a final document. Our understanding is that it is still a draft only (and we have not seen or been consulted about it)

The Burrup Peninsula Land Use Plan and Management Strategy was endorsed by Cabinet in 1996, following public consultation.

In 2006, the Department of Environment and Conservation released the draft management plan for the Proposed Burrup Peninsula Conservation Zone. This draft management plan is a separate document, but refers to the Burrup Peninsula Conservation Zone outlined in the Burrup Peninsula Land Use Plan and Management Strategy (1996).

11.16 the 'Social Impact Management Plan' is proposed to be developed after the project is approved. This is too late: it needs to be developed, with input from organizations like ours, before any project approval is given so that findings and recommendations can be part of an application for the project approval

13.10 What is the timing for the publication of these [Social Impact Management Plan] documents? The draft PER states that the Social Impact Management Plan is due by early 2007. What is the intended review and comment process and procedures for these documents?

Woodside have been consulting with the Karratha Community Liaison Group to develop a social impact study and management plan that ensures Woodside maximises positive impacts, and minimises any negative impacts associated with the Pluto LNG Development. Independent consultants were engaged in the preparation of the Social Impact Management Plan.

The Social Impact Management Plan is due for release in the first half of 2007, prior to approval of the Development, and further consultation is planned on the management measures proposed by Woodside.

12.1 The nearest resident is 6 km away however the report has not clearly established whether workers living quarters are located on site.

The Pluto LNG Development workforce will be accommodated away from site, within existing towns.

12.2 …itinerant Indigenous communities were not considered in the document and further investigation is recommended to ascertain if they are potential sensitive receptors.

There are no itinerant Indigenous communities on the Burrup Peninsula and the representation of Indigenous people within the Shire of Roebourne and local workforce is well documented. Indigenous participation in the local community and the workforce has been captured in ABS census data and examined in a number of studies and reports and relevant aspects are addressed in the Pluto LNG Development Social Impact Assessment due for release in the first half of 2007.

Given the pre-existing scale of industrial development in the area and the absence of itinerant Indigenous communities, the issue of potentially sensitive receptors of this character does not apply. However, the local Indigenous community is of significance and is growing in terms of regional workforce demographics. The Pluto LNG Development will provide some opportunities for local and itinerant workers generally. Specific opportunities are being identified for the local, regional and national Indigenous community.

12.5 …an integrated mosquito management program to ensure that the risk of exposure to employees to mosquito-borne diseases is minimized will be an important OSH component for the site.

This comment is acknowledged. Risk of exposure of the workforce to mosquito borne diseases will be considered in health and safety management plans.

12.6 Woodside is advised that it is required to comply with the Health (Pesticides) Regulations 1956 made under Part VIIA Division 8 of the Health Act 1911 for pest controls. Any weed control must e conducted by either appropriately trained employees or contractors who have an appropriate licence.

This comment is acknowledged. The Weed Management Plan will be developed in consultation with regulatory authorities and will include reference to relevant legislation.

12.7 The proponents are advised that they are required to develop a Drinking Water Quality Management Plan to be submitted to the Department of Health. This plan must demonstrate compliance with the 2004 Australian Drinking Water Guidelines.

This comment is acknowledged. Woodside will consult with the Department of Health regarding management of drinking water quality.

Aboriginal Heritage

1.9 The cultural contents of Site A, which are unique in the world, are considered only cursorily, there is no mapping of them, only an inadequate summary of previous surveys.

1.12 [We recommend that the EPA request the following from Woodside]…To provide fully documented evidence on the number of rock art motifs to be destroyed and moved, of the number of stone arrangements to be destroyed or disturbed, and on the number of both rock art items and arranged stones that will be located within 200 m of any plant components. This is required for both Site A and Site B.

Woodside has described the cultural heritage environment in section 10.3 of the PER and its impacts on that environment in section 11.3. Detailed and specific information about the nature of Aboriginal heritage sites has been provided to the Department of Indigenous Affairs as part of Woodside's heritage approval application. Specific details about individual heritage sites will not be publicly released by Woodside due to confidentiality restraints and because much of this information is sensitive and gender specific to indigenous persons.

Woodside has clearly stated in the Draft PER the expected local and regional impact that the company will have on cultural heritage. Further to the statements made about the impacts on rock art, approximately 80% of the standing stones across the development fall outside of Woodside's disturbance zone. The most significant standing stone complex across the development which comprises 64% of the total number of standing stones is located at Site B. This site will be protected within a designated 'preservation zone' to ensure that these standing stones will be left undisturbed and in-situ within their existing environment.

No stone arrangements will be disturbed and Woodside estimates that it will have to retrieve and relocate approximately 150 individual engravings (motifs). 95% of the rock art on Site A and Site B will remain undisturbed.

Woodside has already successfully relocated all of the rock art and artefacts from within the Site A disturbance area without loss or damage. In total 42 engravings have been successfully moved to a pre-determined relocation zone where they remain barely discernable within the surrounding uncleared land.

8.3 ...considering the absence of the traditional custodians' knowledge of the site and lacking any completed inventory of the carvings, Woodside cannot be sure what significance any particular rock has in the context of the whole collection. It is unwise that Woodside continue preparing for development on Site A and applying for development on Site B until all these questions can be answered, especially when a location has not been confirmed and the plant has not been approved in full by their own board.

11.11 Woodside acknowledges that at the time of writing the PER, it does not have complete heritage survey results. In addition, it has no survey results from us as we were not invited to participate.

Traditional custodians have participated on heritage surveys and Woodside has completed a detailed inventory of all heritage material on Site A and Site B. Archaeological heritage site significance ratings have considered the question of representation (please refer to response

13.20). Woodside's work program on Site A is being executed under all required approvals. Woodside's decision to proceed with site works prior to making a final investment decision on Pluto LNG Development has been considered carefully by the company and in the context of maintaining the ability to meet customer requirements for the supply of LNG by late 2010 and its decision to commit $1.4 billion to long lead items and the Front End Engineering Design phase of the Development.

At the time of writing the PER the Wong-Goo-Tt-Oo Group had not completed its heritage survey over Site B. This survey is now complete and the results have been submitted to the Department of Indigenous Affairs as part of Woodside's Site B heritage approval application. The results from the survey completed by the Ngarluma group have also been submitted to the Department of Indigenous Affairs as part of Woodside's heritage approval application for Site B. The matter of representation in these surveys raised by the Ngarluma Aboriginal Corporation has been addressed above.

1.10 The impact of the construction of the Pluto plant in this location will totally destroy the ambience of this sacred cultural precinct at Holden Point, and will result in the destruction of hundreds of rock art and stone arrangement sites. At the former, any boulders that can be transported will be, and already are presently, removed and dumped in a compound (we have thousands of boulders in such graveyards of rock art already, where they are of no value to either Aborigines or scientists). What cannot be moved, and that includes all stone arrangements, will be bulldozed.

8.1 Woodside's proposed Pluto expansion will cut through Site A of the Burrup Peninsula – one of the densest areas of rock carvings on the archipelago. Although Woodside has stated they aim to move 150 rocks and not destroy any carvings, the company has also admitted to GetUp that some of the rocks may have to be damaged in the process of moving, especially if they are too large or too difficult to move in any given particular place.

Woodside's response to point 1.10 above is as per the Company's response to points 1.9, 1.12, 13.2, 13.5, 13.8.

The retrieval and relocation of heritage sites, including rock art, at Site A rock has been 100% successful with no damage to rock art or any heritage site. No rock art has been destroyed. Woodside will apply the same relocation principles to Site B and aims to successfully relocate all heritage items.

1.1 Two weeks before the submissions commenting on the above application by Woodside closed, on 5 February 2007, Woodside began destroying rock art sites at the Pluto A Site at Dampier, i.e. without having obtained clearance from the EPA.

1.4 Woodside, in pre-empting your decision, has shown its contempt for the EPA's authority.

All preliminary site works on Site A, including the retrieval and relocation of artefacts and rock engravings, were conducted in accordance with the required statutory approvals, including that of the EPA and the Minister for Aboriginal Affairs. Those activities were not part of the Draft PER.

1.3 The Australian Heritage Commission has determined that Dampier should be on the World Heritage List, as well as on the National Heritage List.

The decision as to whether the Dampier Rock Art Precinct, including the Burrup Peninsula, should be placed on the National Heritage List is before the Commonwealth Minister for the Environment.

Woodside does not oppose the inclusion of the Burrup Peninsula on the National Heritage List.

Woodside's position in relation to this matter is conditional a gas precinct being established within an area of land already zoned for industrial development and that this area be excised from the boundary of the proposed NHL area. Woodside also believes that a suitable management framework should be in place before heritage listing occurs

11.5 sites to be destroyed in the Pluto Site B area include 'rare' and 'unusual' sites and sites of 'high' significance

11.10 We dispute the opinion that the sites to be disturbed 'are mostly of lower significance.' In our traditional law and custom, all sites at the Burrup are of highly sacred significance.

Significance assessments of heritage sites differed between the archaeological and ethnographic heritage surveys. Woodside acknowledges that the Burrup Peninsula and heritage sites within it are considered as highly significant by the Indigenous groups of the area and the broader community. The criteria for archaeological significance rating are discussed in Woodside's response to point 13.20 below.

No heritage sites given a high archaeological significance rating fall within Woodside's proposed disturbance zone at Site A. One site of high archaeological significance falls within the disturbance zone at Site B that Woodside intends to relocate and preserve. Woodside has also established designated preservation zones at Site B in which a significant standing stone complex and rock art depicting Thylacines will be protected. Successive Western Australian Ministers for Indigenous Affairs has approved Woodside proceeding with the Pluto LNG Development on Site A and Site B subject to conditions including the preservation of large numbers of heritage sites.

11.6 Given the heritage significance of our Country, Woodside has to 'demonstrate' that it has 'properly considered how to minimise any adverse impact by the proposal on heritage values'. Given its failure to consult with us, it cannot 'demonstrate' that any Aboriginal heritage matters have been considered or addressed.

Woodside has addressed these points in its responses to points 13.2 and 11.1, 11.2, 11.4, 11.14, 11.12, 11.13 and 8.3

11.7 …despite a pledge by Woodside given to the Department of Indigenous Affairs that it would not start any heritage destruction at Pluto Site A until an approval had been given to Site B, it has gone ahead and started shearing the front off sacred sites with a diamond saw.

No such pledge was given however it was Woodside's preference to wait for a decision on the Site B heritage approval prior commencing works on Site A. The time taken to finalise the approval process and Woodside's schedule for the Pluto LNG Development left the company with no choice but to commence works at Site A in January. Heritage approval for Site B was subsequently granted in February.

Diamond saws or similar equipment were not used on Site A. All rock art was successfully relocated to a designated relocation area identified in consultation with traditional custodians.

13.2 …what consideration does the PER commit to, to seriously address the impacts and provide alternatives to those key issues such as 'physical destruction or removal of cultural heritage'.

The Draft PER outlines the steps that Woodside has taken to minimise impacts to the Aboriginal heritage environment. For example, Woodside considered Aboriginal heritage when selecting a site on which to locate the Pluto LNG Development. This culminated in Woodside selecting areas containing large plateau style flat upland areas that typically contain less heritage sites, in particular rock art, than valley systems and watercourses.

A heritage site minimisation methodology was also employed by Woodside resulting in a Pluto LNG Development footprint that will avoid as many heritage sites as practicable. This process took into consideration advice from the indigenous groups of the area and the results of archaeological and ethnographic heritage surveys. This process has resulted in Woodside being able to avoid an estimated 95% of the rock art across the Pluto LNG Development. Discrete areas of land containing a vast majority of the heritage sites will be left un-disturbed and in-situ.

Where heritage sites fall within Woodside's proposed disturbance zone heritage sites cannot be left in-situ. Woodside aims to relocate all artefacts and rock engravings from within the development area to a designated relocation zone. This process is undertaken with the involvement of indigenous monitors, Woodside and contract archaeologists and in consultation with relevant agencies. The work has been completed at Site A with a 100% success rate.

13.5 …what is the likely impact of dust emissions (construction works, traffic, blasting etc.) and carbon emissions (LNG plant) and their probably sedimentation, on rock art?

There is expected to be no impact from dust emissions on rock art. Woodside's environmental management plans will address dust emissions and dust suppression measures will be implemented. Woodside will also apply active heritage site protection measures to all heritage sites (including rock art) situated in close proximity to any works or traffic. This may include covering, bolstering or strapping heritage sites to ensure they remain un-disturbed and in-situ during and after the completion of works. Specialist blasting techniques will also be used to ensure that heritage sites will not be damaged by fly rock or vibration.

Studies into the possible effects of chemical emissions on rock art are ongoing and preliminary results from the independent Burrup Rock Art Management Committee have concluded that there is no effect from emissions on rock art.

Dust suppression is exercised during construction activities and protection works are in put place during blasting activities. Small-charge blasting techniques are utilized, with little or no flyrock and dust. Vibration is kept to a minimum and protection works including sandbagging and geo-fabric covering are put in place to ensure protection of heritage sites.

Studies into the possible effects of chemical emissions on rock art are ongoing. Data collected by an independent, government-funded committee (Burrup Rock Art Management Committee) suggests that there is no link between current emission levels and effect on the rock art.

13.7 The Woodside draft PER is weak in its description of the aboriginal cultural heritage sites and its significance in terms of world anthropological history. Though Woodside reference their environmental and Indigenous community policies; they have been retrospective and casual with regards to a number of items: 'delay or stop activities where effective environmental controls are not in place', 'openly communicate our environmental performance with our workforce…and the wider community.'

Woodside has described the cultural heritage environment in Section 10.3 of the Draft PER and its impacts on that environment in Section 11.3. Detailed and specific information about the nature of Aboriginal heritage sites has been provided to the Department of Indigenous Affairs as part of Woodside's heritage approval application. Specific details about individual heritage sites will not be publicly released by Woodside for a number of reasons including:

- it was agreed with the Indigenous people who participated in surveys that survey information would not be made publicly available
- confidentiality restraints
- the majority of this information is culturally sensitive and gender specific.

Woodside has not provided information about the heritage landscape at Site A and Site B in terms of world anthropological history. The Company is not required to consider this question

during the heritage survey process but has attributed archaeological heritage site significance ratings to international benchmarks. With the Pluto LNG Development footprint encompassing less than 1% of the total area of the Burrup Peninsula there remains opportunities for further anthropological research.

Specific procedures have been put into force on site to ensure all work is conducted in accordance with the relevant cultural heritage management plan. The Cultural heritage Management Framework and plans are published on Woodside's website at: http://www.woodside.com.au/Regions/Australia+and+Asia/Development+Opportunities/Pluto/Approval+Process/Cultural+Heritage+Management.htm

Woodside continues to comply with all of its policies in the pursuit of the Pluto LNG Development.

13.8 …what commitments does Woodside provide to ensure Woodside's ongoing accountability for the preservation of the rock art?

Woodside is committed to, where practicable:

- leaving rock art and other heritage sites undisturbed and in-situ
- implementing recommendations made by representatives of the Ngarluma, Yindjibarndi, Yaburarra, Mardudhunera and Wong-Goo-Tt-Oo groups; and to
- restricting the development footprint for the required onshore infrastructure.

At Site A, where site preparation activities have already commenced, the development footprint is limited to only 1/3 of the total area of the site. At Site B, Woodside's footprint will, in most part, be contained to the large plateau type flat upland areas. Apart from the required crossing points the integrity of the gully systems will be protected. This commitment is embedded within Woodside's heritage management approach which is to avoid impacts to the heritage environment as far as practicable.

Woodside's commitment and approach will result in approx 95% of rock art across Site A and Site B being left undisturbed and in-situ with Woodside's aim being to relocate the remaining 5% into a designated relocation zone(s). In containing its development footprint as far as practicable Woodside will also be leaving untouched large areas of land within which heritage sites will be left undisturbed and in-situ in their original current environment.

In addition to Woodside's commitments the company must comply with conditions set by the Minister for Indigenous Affairs under the consent that it has received to develop Site A and Site B.

To ensure Woodside's compliance with approval conditions and commitments all site activities are undertaken under a cultural heritage management framework and cultural heritage management framework plans. These documents are available to the public on Woodside's website and can be found at:

http://www.woodside.com.au/Regions/Australia+and+Asia/Development+Opportunities/Pluto/Approval+Process/Cultural+Heritage+Management.htm.

Woodside has dedicated Heritage Management staff to ensure the company's commitments and approval conditions are met.

13.9 'Aboriginal heritage sites left in situ where practical.' On what grounds/ criteria will the test of practicality be administered? How will this be monitored and assessments reviewed?

Woodside is still completing the detailed Front End Engineering and Design (FEED) phase for the Pluto LNG Development during which engineering planning, including the layout of infrastructure, will be finalised. Throughout this FEED phase planning and engineering staff will consider the location of Aboriginal heritage sites and embed in the final layout design heritage management conditions set by the State Minister for Indigenous Affairs. It is during this work, considering technical constraints and land access requirements, that heritage sites will be avoided as far as practicable.

Woodside's commitments will be monitored by the Department of Indigenous Affairs and representatives of the Indigenous groups of the area with whom Woodside meets regularly to provide heritage management updates.

13.11 Who are ACHM (Australian Cultural Heritage Management Pty Ltd) referenced to have conducted archaeological surveys according to Woodside PER? What constraints, if any, were there on their ability to conduct the archaeological surveys? Was their scope just for the Site A disturbance footprint?

Australian Cultural Heritage Management (ACHM) is an Aboriginal heritage management consultancy firm based in South Australia who Woodside contracts to provide independent heritage management advice. ACHM employs experienced archaeologists with particular expertise in the Burrup Peninsula and have been working on the Burrup Peninsula for some 6 years now.

Woodside placed no constraints on ACHM and made clear that company expected an extremely thorough survey exceeding the standards set by the Department of Indigenous Affairs. ACHM surveys have not been limited to the Woodside's proposed disturbance footprint as it was the results of the archaeological and ethnographic surveys over that the entire Site A and Site B lease areas that helped Woodside to shape the disturbance footprint to avoid heritage sites as far as practicable. ACHM will continue to work with Woodside to monitor initial ground disturbance works and the retrieval and relocation of heritage sites.

13.13 Woodside commit to retrieve and relocate approximately 150 rock art. What monitoring and extraction procedures apply to the removal and relocation of the rock art?

Woodside's aim is to retrieve and relocate all rock art from within the company's disturbance zone that is estimated to be approximately 5% of the rock art in place or around 150 single engravings (motifs). On industrial Site A this work has been completed with 100% success rate and with no damage to any rock art.

The retrieval and relocation of heritage material, including rock art, is monitored by representatives of the Indigenous groups of the area and is undertaken by a crew of professional riggers and crane operators, assisted by engineers and health and safety specialists. Prior to the works commencing a detailed retrieval and relocation method statement is written that outlines precisely how the work will be undertaken. This work instruction also records the wishes of the Indigenous representatives with respect to how and where heritage items should be handled and placed and is included to ensure that Woodside fully considers how to complete this work with sensitivity to Indigenous cultural considerations. Only after the work instruction has been approved can the retrieval and relocation works begin.

The process for the retrieval and relocation of heritage material includes clearing boulders around the heritage item to be relocated and in the case of rock art, wrapping the host boulder to protect it from damage caused by scraping or scratching, strapping it to ensure that fracturing will not occur and placing netting around it to create a hitching point for a crane to hoist it onto transport vehicle for transportation and then to gently place the item into a designated relocation

area. Where possible, rock art is placed into this relocation area in the same aspect and orientation as its original environment context.

The retrieval and relocation of rock art and other heritage items at Site A has been completed successfully and with no damage to any heritage item or rock art.

13.14 Figure 11-1a and b clearly identify a connection point to Site E (LNG plant) on the southern boundary of Site A. Does this connection point fall within the 'do not disturb boundary'

This connection point does fall inside the "do not disturb area" identified by the Minister for Indigenous Affairs under the Site A heritage approval conditions. As illustrated in figures 11C-E this connection point is no longer required in a Site A and Site B development scenario. In effect this means that a large area of Site A (approximately two-thirds) will be left untouched so heritage sites can be left un-disturbed and in-situ in their original environmental context.

13.13 Rock art population estimates are inconsistent throughout the document and illustrate that extensive rock art surveys have yet to be completed

It is true that heritage surveys have not been completed across the entire Burrup Peninsula and to this extent only estimates are available as to the amount of rock art on the Peninsula. It has been estimated by the National Trust that up to 1 million pieces of rock art exist on across the Dampier Archipelago that includes the Burrup Peninsula.

Woodside has conducted very detailed archaeological and ethnographic heritage surveys across Site A and Site B to best understand the cultural heritage landscape. Woodside has found approximately 3 000 single engravings of which an estimated 150 or 5% will need to be retrieved and relocated from within the disturbance area that is required to build the onshore components of the Pluto LNG Development. Woodside expects to identify some additional archaeological material as planning and field work progresses ahead of the commencement of relocating heritage material on Site B; however, this is not expected to change the view that 95% of the rock art will remain undisturbed in situ.

13.15 What archiving methods are currently being employed and under what management plan is the rock art being removed, destroyed or relocated as part of the site preparation works?

During the archaeological and ethnographic heritage surveys of Site A and Site B detailed information pertaining to the location and nature of heritage sites was recorded and reported to the Department of Indigenous Affairs (DIA) in accordance with DIA standards and the *Western Australia Aboriginal Heritage Act*. Prior to the retrieval and relocation of heritage sites further recordings of each heritage site has been completed where required and detailed recording of the new location of each heritage site has been undertaken – this information will also be submitted to the Department of Indigenous Affairs.

The archiving of heritage sites has been very carefully managed by Woodside to ensure that all information pertaining to each heritage item has been captured and stored. The Department of Indigenous Affairs maintains the Register of Aboriginal Sites where some information about the location and nature of heritage sites is made available to the public.

All of Woodside's heritage management work, including the retrieval and relocation of heritage sites is executed under Woodside's Cultural Heritage Management Framework and specific Cultural Heritage Management Plans that have been written and implemented for each phase of work. These plans can be found at:

http://www.woodside.com.au/Regions/Australia+and+Asia/Development+Opportunities/Pluto/Approval+Process/Cultural+Heritage+Management.htm

13.18 Please advise the impact of blasting works and vibration on rock art? Particularly standing stone arrangements?

Blasting works and vibrations associated with construction and operation activities will have no impact on rock art or standing stones. Woodside has made a commitment that all heritage sites outside of the final designated disturbance area will remain undisturbed and in-situ. To achieve this outcome specialised small-charge blasting techniques will be used with the aim of producing little or no flyrock, vibration and dust.

Further, Woodside will also apply protection measures to heritages sites that lie in close proximity to the designated disturbance area. These protection measures will include placing protective matting on heritage material, bolstering it with sandbags, placing with wooden boxes over the top of heritage sites and / or placing protective screens around it.

13.20 How was the level of significance of the rock art determined? I.e. high level vs. low level? Table 11-7 Consequence D, E and F please provide the referencing key?

The criteria used to assign significance ratings to rock art was as follows:

Low Significance: Minimally altered places such as low-density artefact scatters or single/small groups of engravings of small size and simple composition, grinding patches or other Aboriginal site features which contain little information and/or are a common class of site.

Medium Significance: Sites that are relatively common and tend to have only moderate differentiation in information potential and character among them, and that have a good potential for recording and information recovery, (such as medium density artefact scatters, quarry/workshops, and open camp sites), or which have good potential for recording and relocation without significant loss of information, (e.g., a single engraving, or small groups of engraving boulders that are only moderately preserved and/or capable of salvage and relocation).

High Significance: Sites of a class that is considered to be rare or a site which has rare or unique research or educational qualities, sites which have a high/varied research and/or educational potential, including major archaeological deposits, quarry/workshops, most engraving sites – particularly larger and more varied sites.

13.21 'Any archaeological discoveries during site preparation work will be reported to the regulatory authorities..' Who are the regulatory authorities? Who is responsible for auditing this process?

Under the Western Australia Aboriginal Heritage Act Woodside must report the discovery of Aboriginal heritage material to the Registrar of Aboriginal Sites. The Department of Indigenous Affairs administers this Act and will audit this process and Woodside's compliance with heritage approval conditions set by the State Minister for Indigenous Affairs.

13.22 Given that the CHMP has yet to be written, are the current rock art extraction procedures being reported/ monitored/ recorded to any regulatory authorities?

Woodside, under conditions set by the Minister for Indigenous Affairs must report its heritage management activities, including the retrieval and relocation of rock art, to the Registrar of Aboriginal Sites. The Department of Indigenous Affairs audits and monitors Woodside's compliance with these and all other conditions set by the Minister for Indigenous Affairs.

The retrieval and relocation of heritage sites has and will be conducted under a Cultural Heritage Management Plan.

No works have commenced on Site B and will only commence when Woodside has obtained necessary approvals. As with Site A, specific CHMPs will be written for discrete work activities on Site B – no work on Site B will take place until the relevant cultural heritage management plan has been issued. Woodside's cultural heritage management plans for the Pluto LNG Development can be found at:
http://www.woodside.com.au/Regions/Australia+and+Asia/Development+Opportunities/Pluto/Approval+Process/Cultural+Heritage+Management.htm

Safety Risk Assessment

5.4 It is noted the main flare on Site B is located in close proximity to DPAs security gatehouse operations. To avoid potential issues relating to noise impacts, the DPA strongly suggests that Woodside consider relocating the flare to an alternative location.

The noise assessment results for the gas processing plant at Site B conclude that the sound pressure level at the site boundary at the East West Service Corridor will be below the community noise level limit set at 65 dB(A) for an industry to industry boundary. The DPA's security gate house is approximately 250 m beyond the site boundary (and 500 m from the current flare location) so noise levels at the gate house will be somewhat lower than at the boundary. Optimisation of the plant layout is ongoing and if the opportunity to increase the distance between the flare and the DPA's security gate house arises then it will be taken advantage of, however other factors such as ensuring safe thermal radiation levels for site personnel and minimising environmental and heritage impacts limit the options available. It should be noted that moving the flare to any other location within Site B would only create a small reduction in noise levels at the DPA security gate house.

1.5 Already the equivalent of 100 Hiroshima bombs is stored in energy at the NW Shelf site, the Pluto project would add another 120 Hiroshima bombs equivalent and should therefore be built elsewhere because such concentration of volatile substances is dangerous.

Woodside is committed to ensuring the safety of our staff, contractors and the communities of Karratha and Dampier.

The estimation of the potential risk or hazard of LNG based on the relative energy content of a bomb does not consider thermodynamics and the behaviour of hydrocarbons.

Atomic bombs are designed to have the capability of releasing the energy contained within them in a matter of seconds or milliseconds. This is what makes them so destructive. Hydrocarbons (including LNG) do not have this same capability and explosions only occur under very defined and well-understood situations.

Only a fraction of energy can be released from the combustion of fuels such as LNG as it depends on the efficiency of combustion, the availability of oxygen, the energy of activation and how much fuel is left unburnt.

Liquefied natural gas is essentially no different from the natural gas used every day in homes and businesses around the world except that it has been chilled to minus 161 degrees centigrade at which point it becomes a liquid.

1.14 [We recommend that the EPA request the following from Woodside]…To provide firm estimates of the quantities of condensate, propane, butane, light oil, hydrogen and other flammable, toxic, volatile or explosive substances to be stored at the completed and operational Pluto plant..

At the current stage of design quantities of hazardous materials are still uncertain, and only coarse estimates are available, however the gas processing plant will contain sufficient quantities of hazardous materials to be classified as a Major Hazard Facility as defined in the *National Standard for the Control of Major Hazard Facilities* [NOHSC:1014(2002)]. Woodside is therefore required to comply with the requirements of the Standard, which include providing information to the regulatory authority and to the community regarding the nature of hazards at the facility. The information provided will include the maximum quantity of each hazardous material that is present or likely to be present at the facility.

4. References

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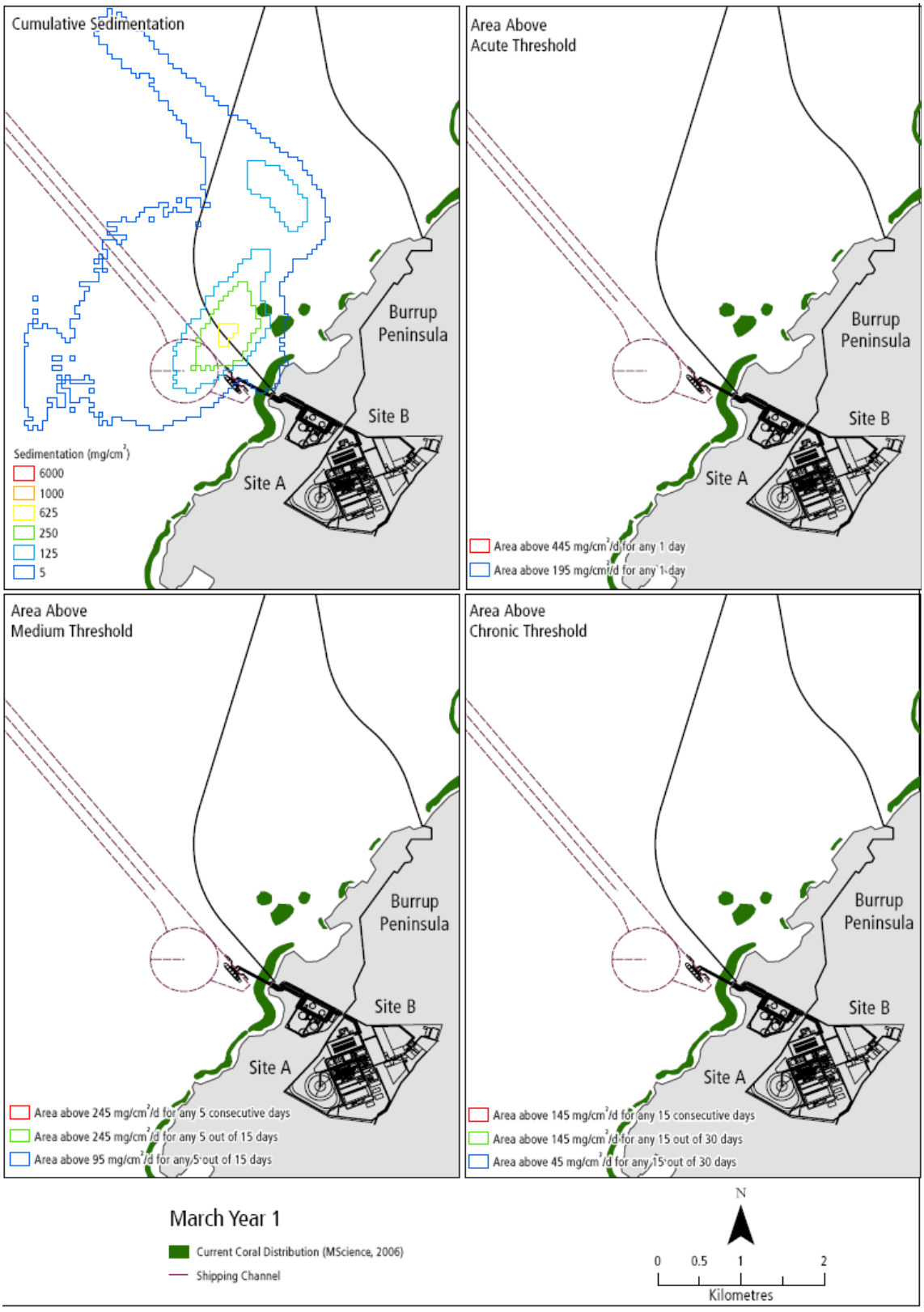
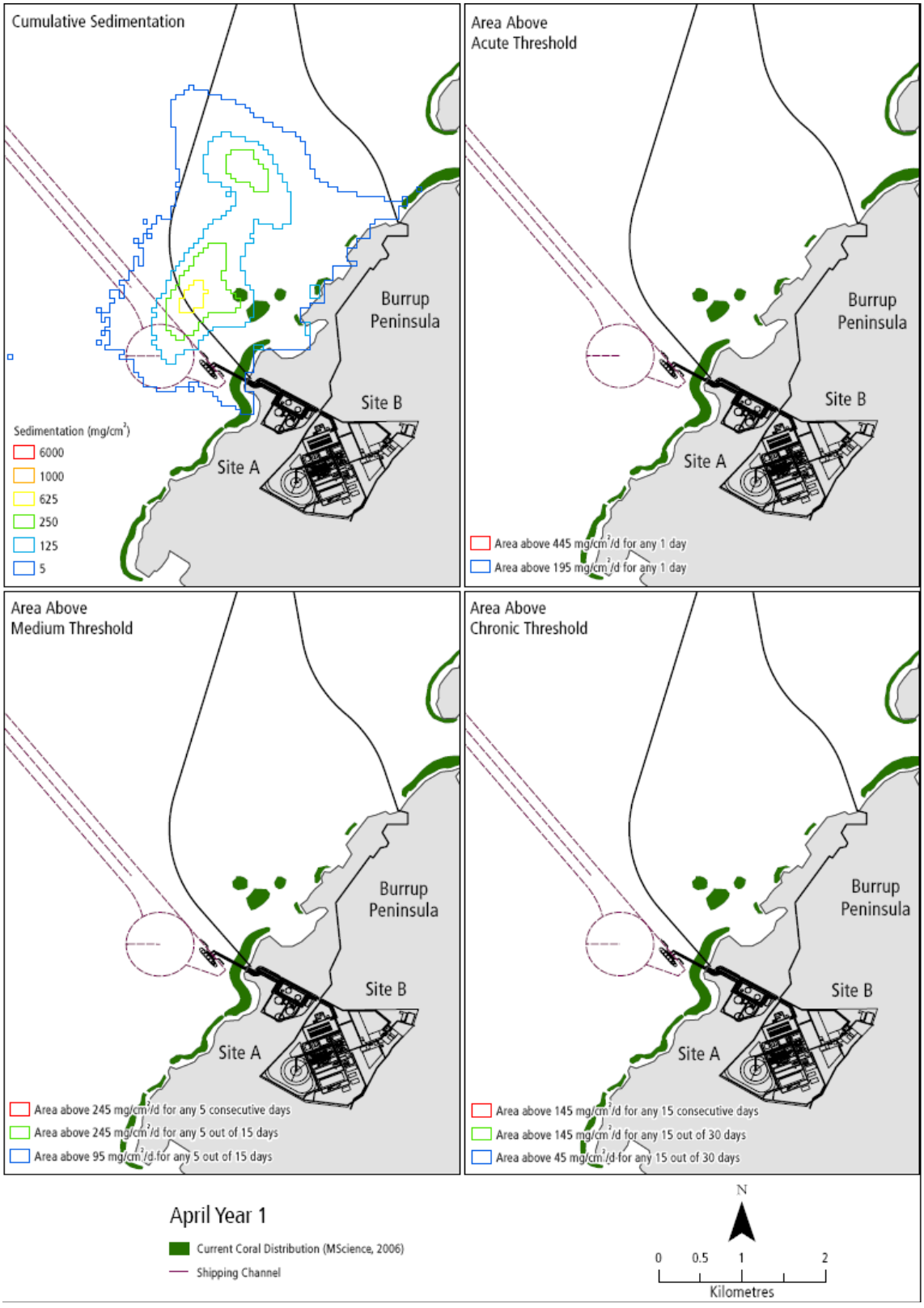
5. Appendix A - Cumulative Sedimentation and Threshold Sensitivity Analysis



- **Figure A 1 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for March Year 1.**



- **Figure A 2 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for April Year 1.**

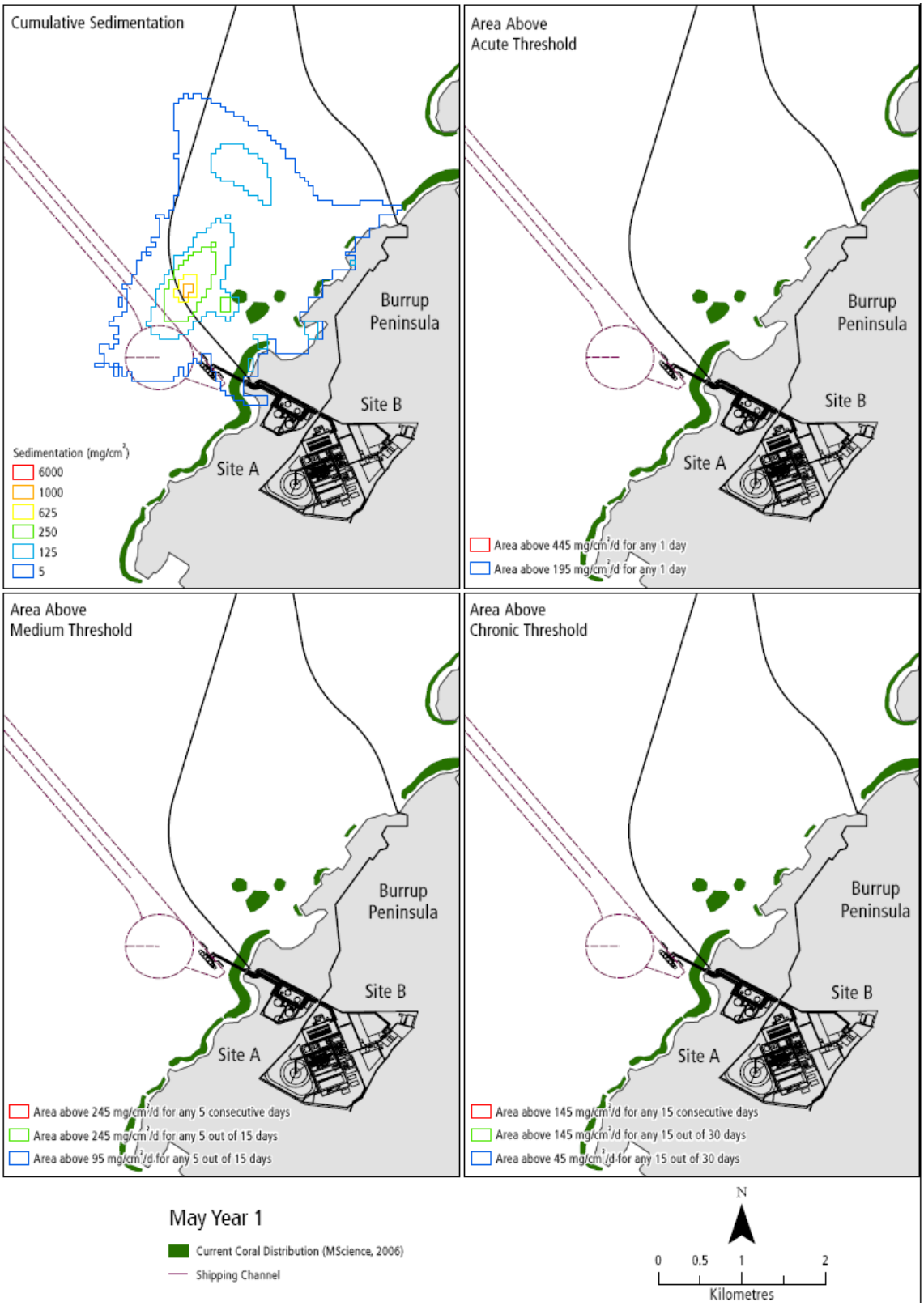


Figure A 3 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for May Year 1.

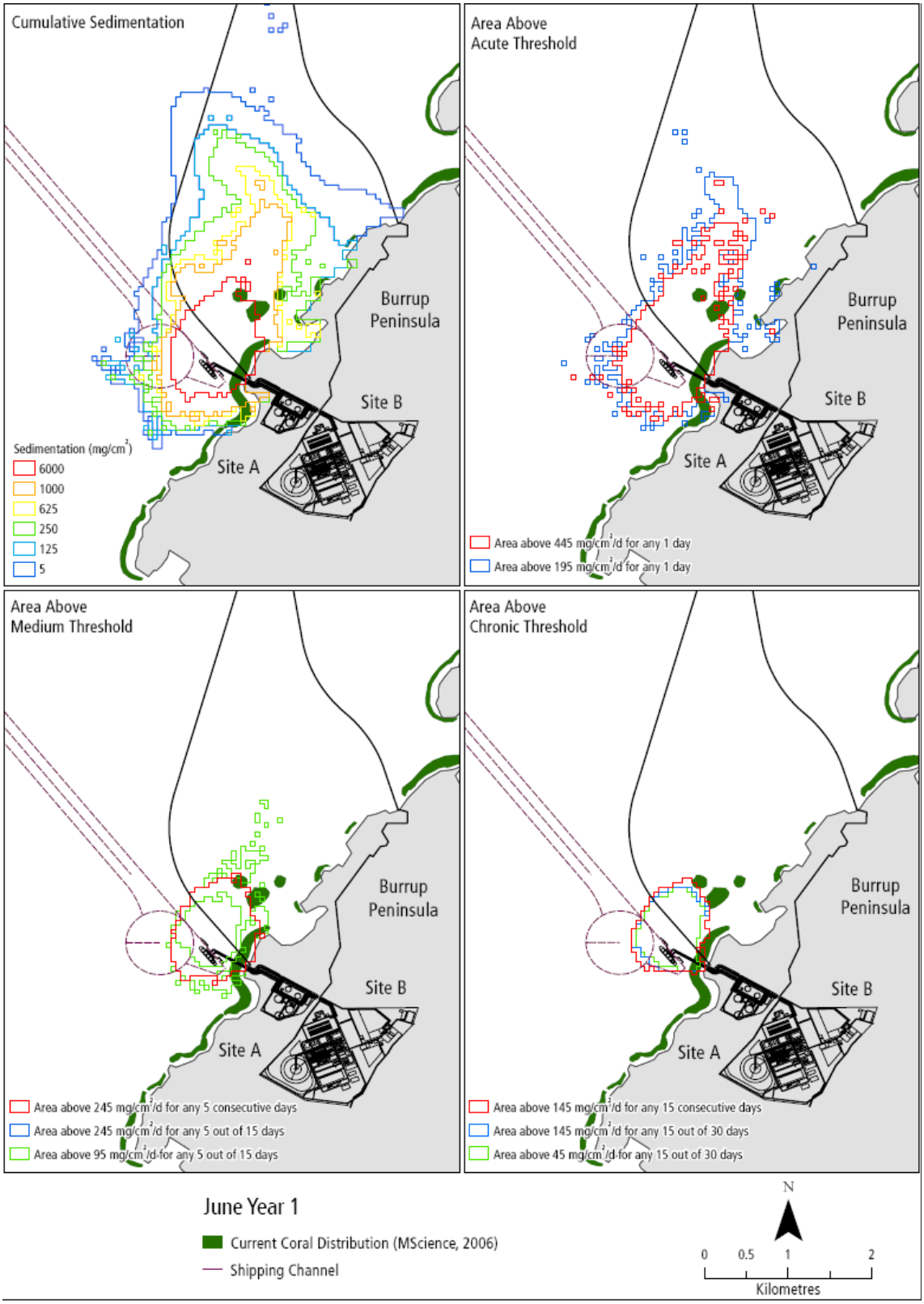
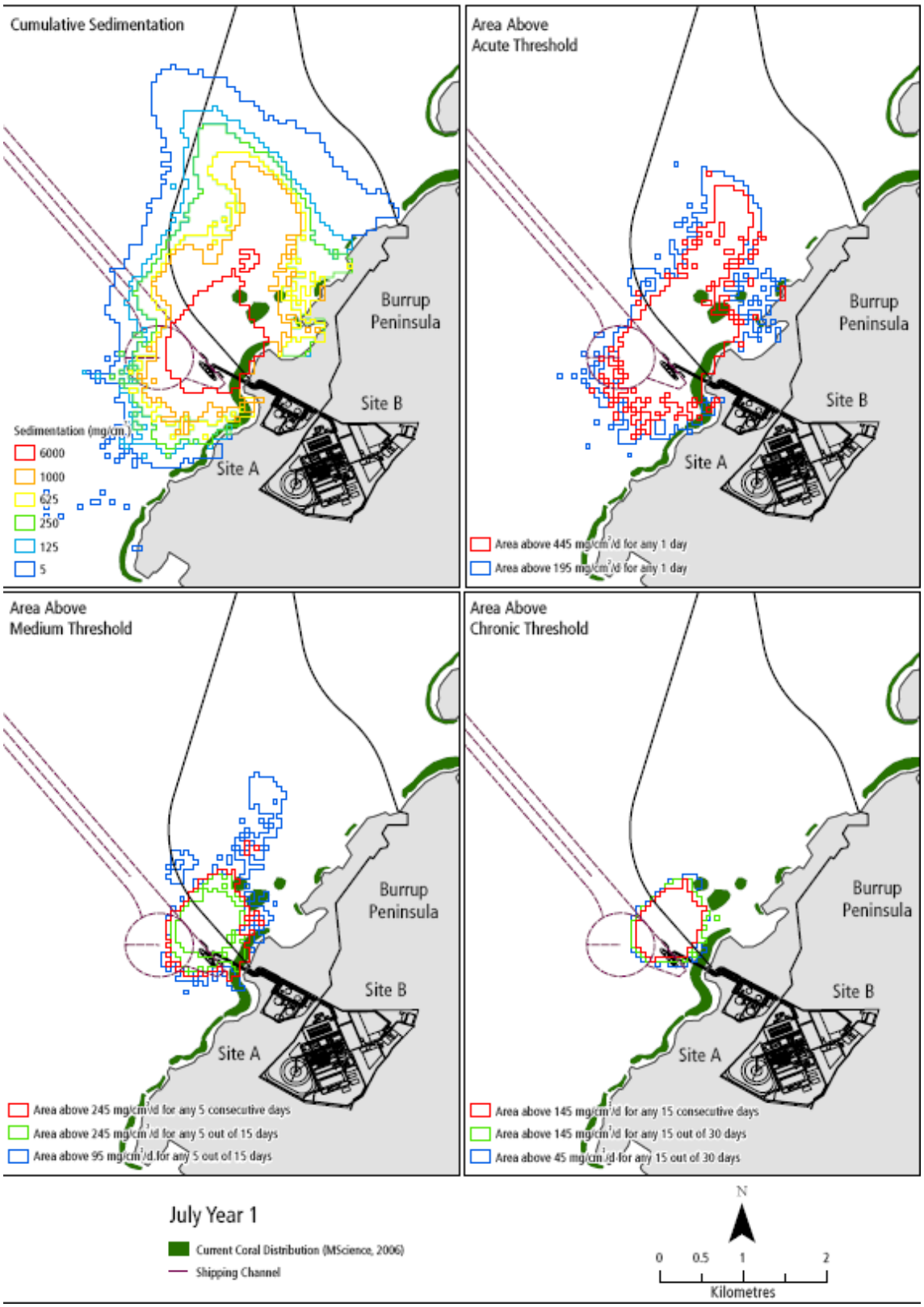
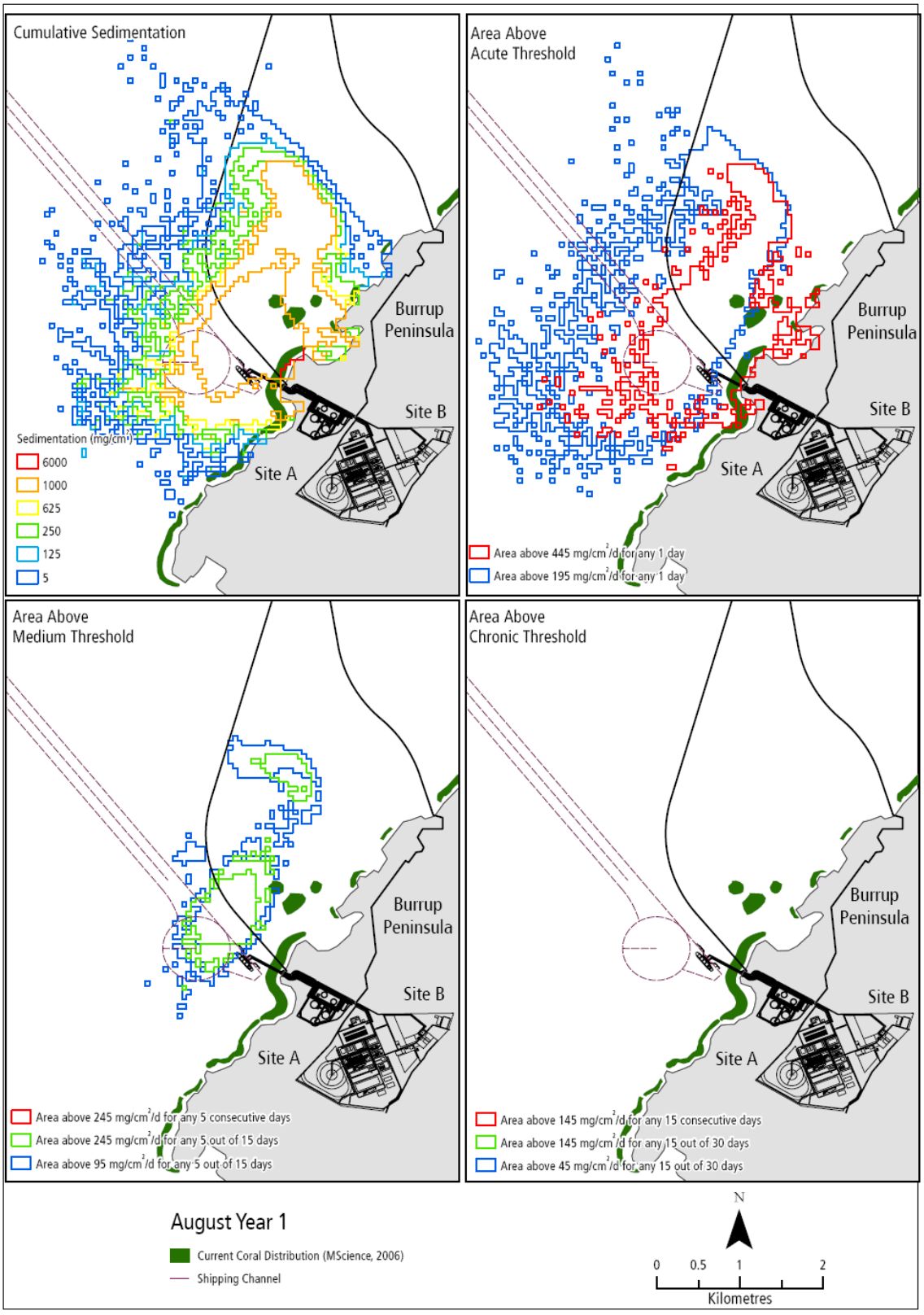


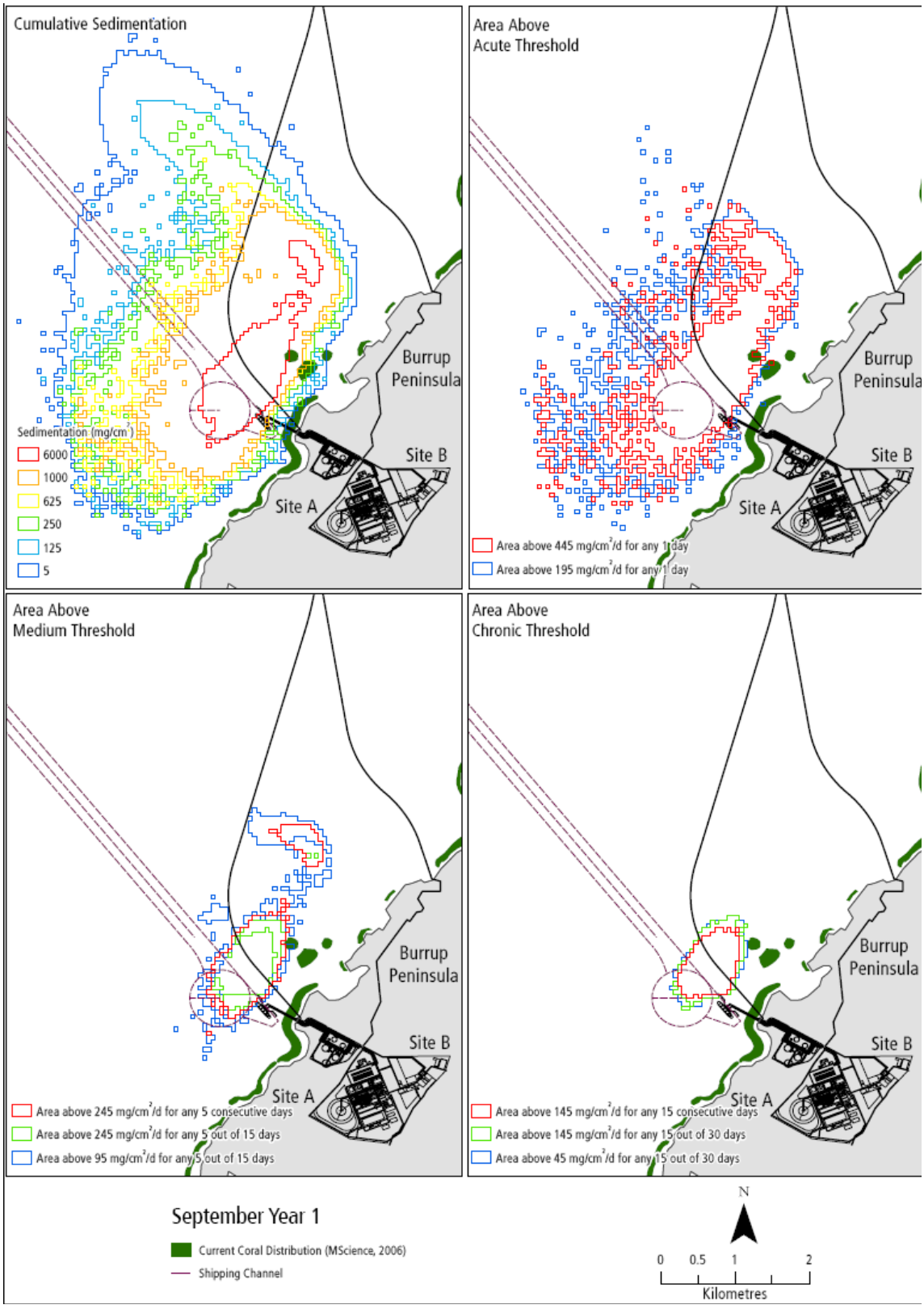
Figure A 4 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for June Year 1.



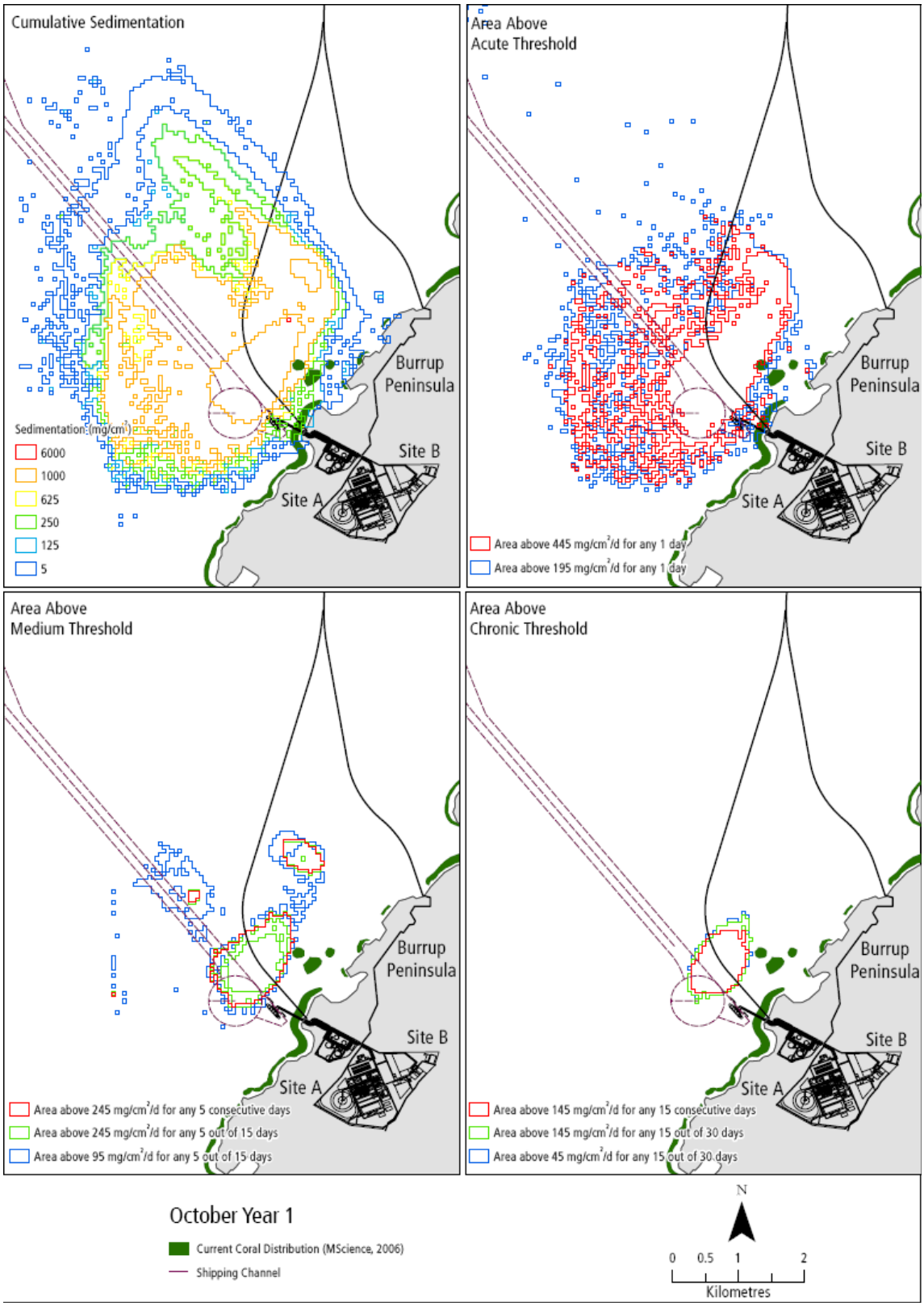
- **Figure A 5 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for July Year 1.**



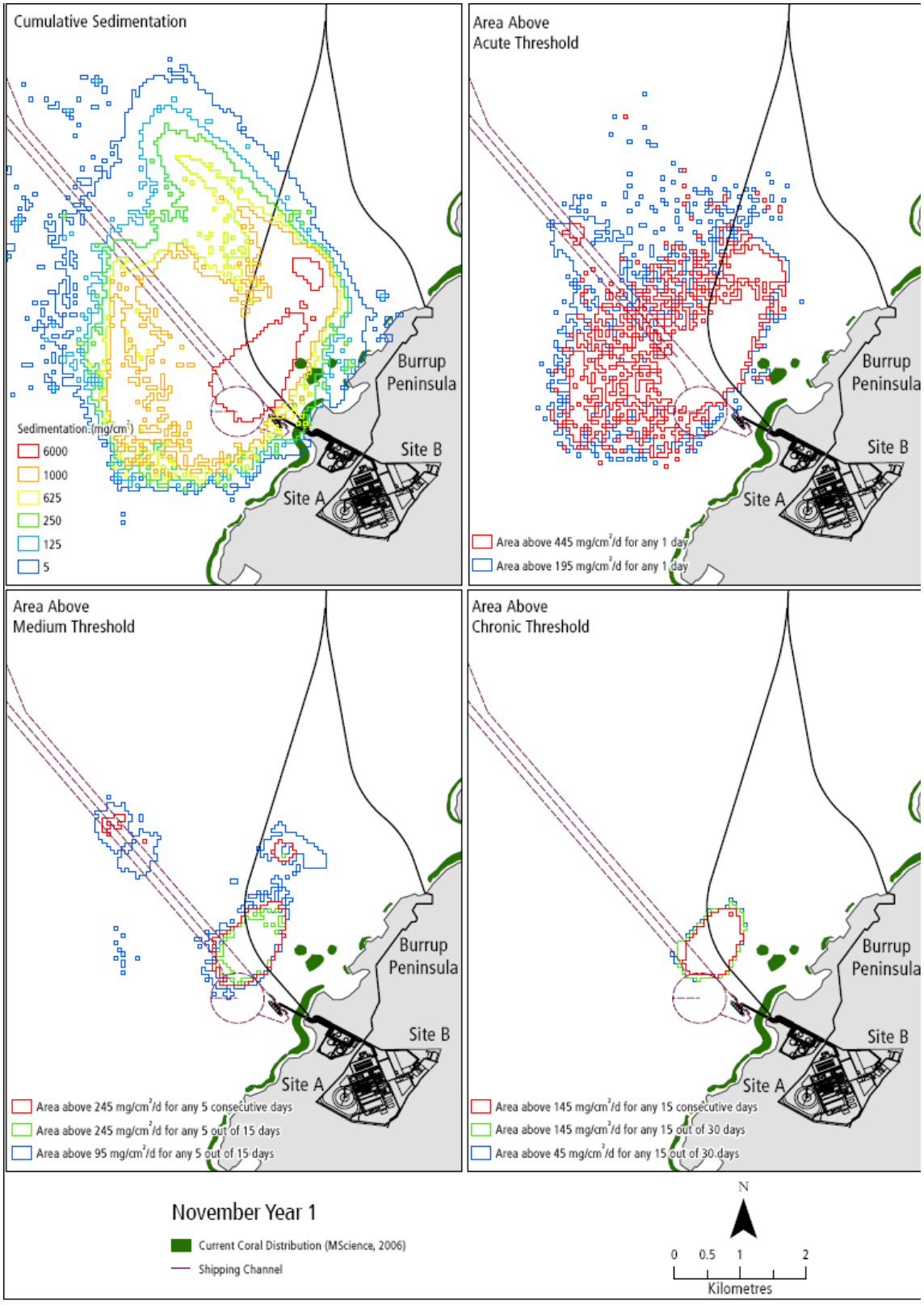
- **Figure A 6 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for August Year 1.**



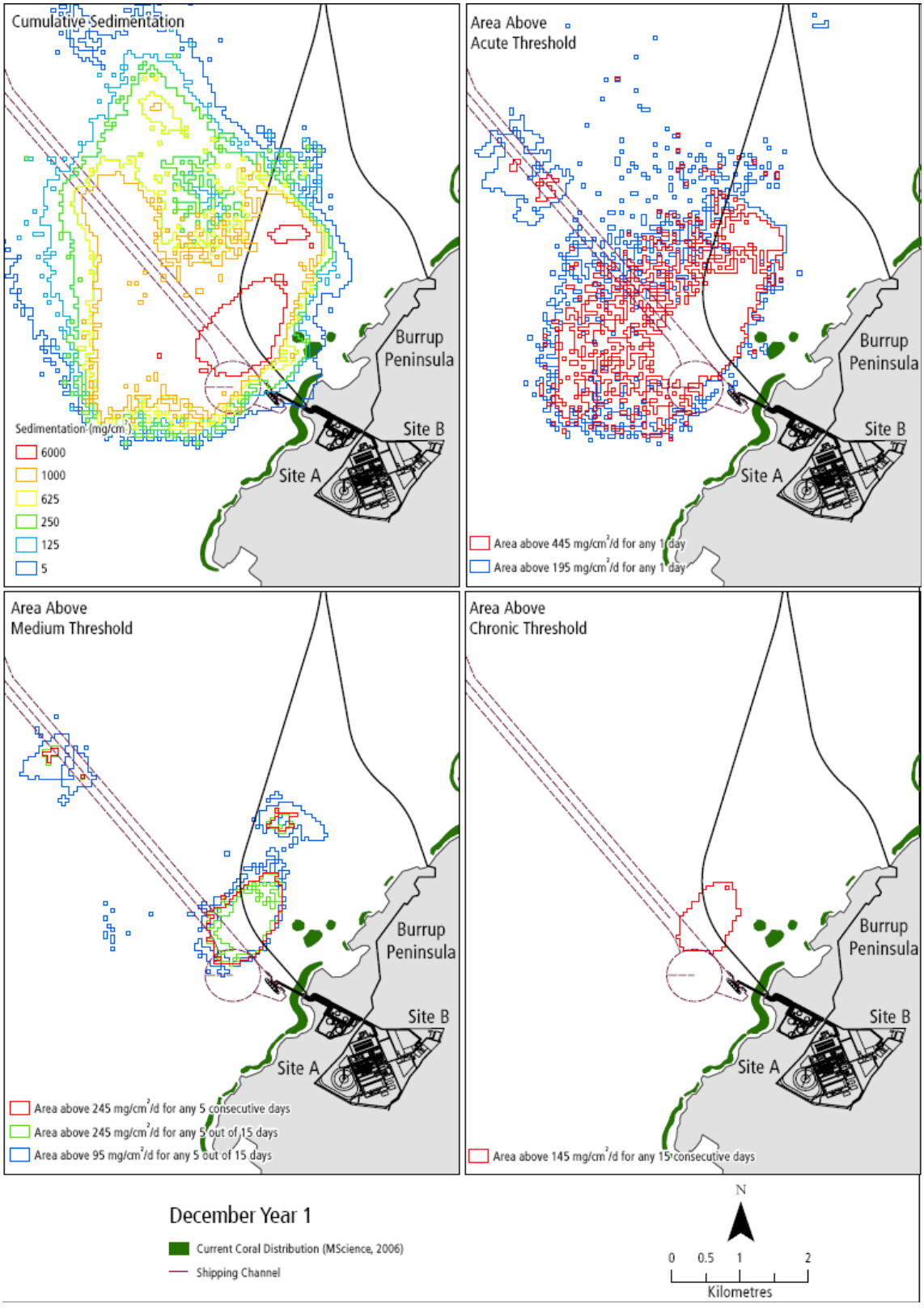
- **Figure A 7 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for September Year 1.**



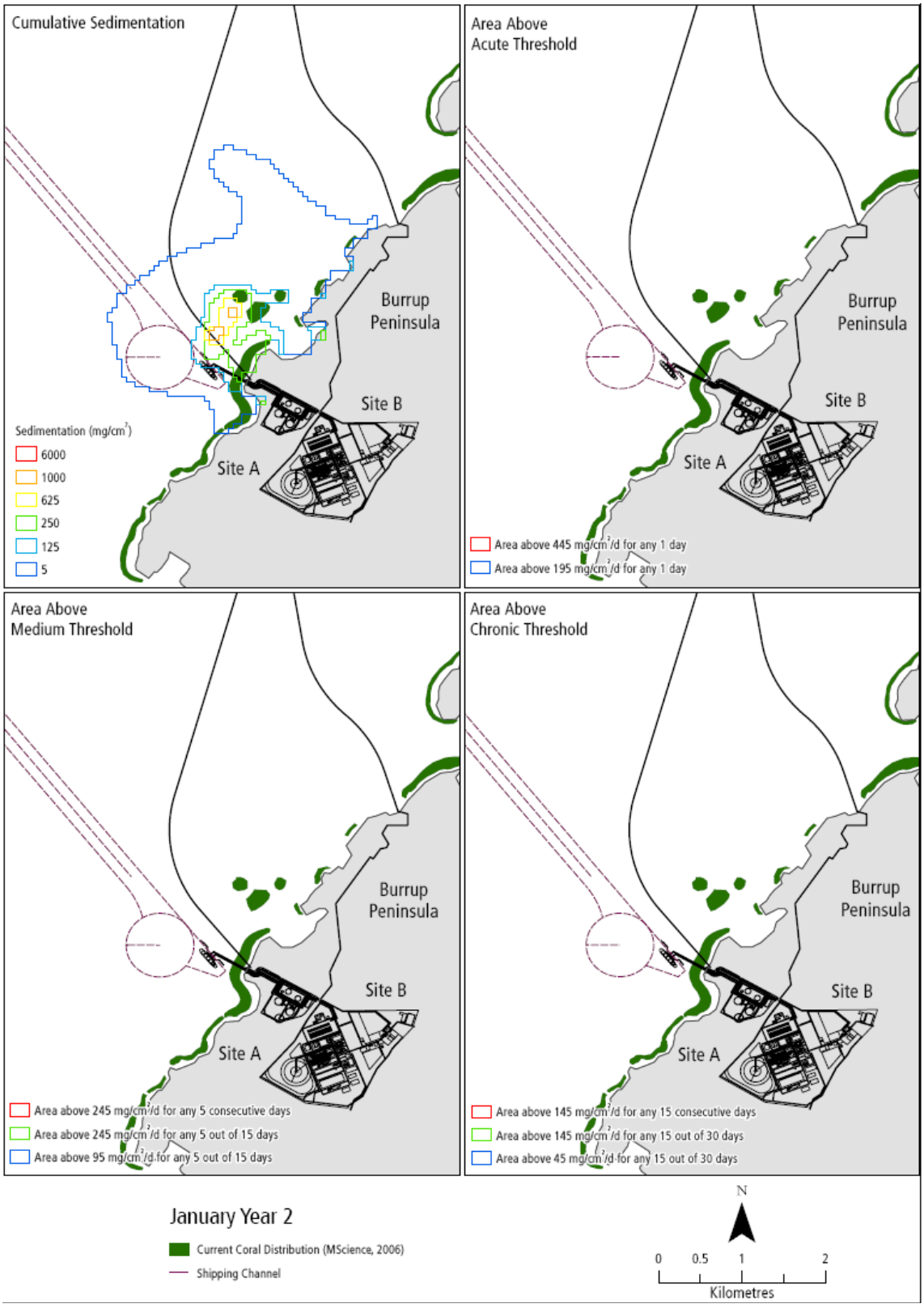
- **Figure A 8 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for October Year 1.**



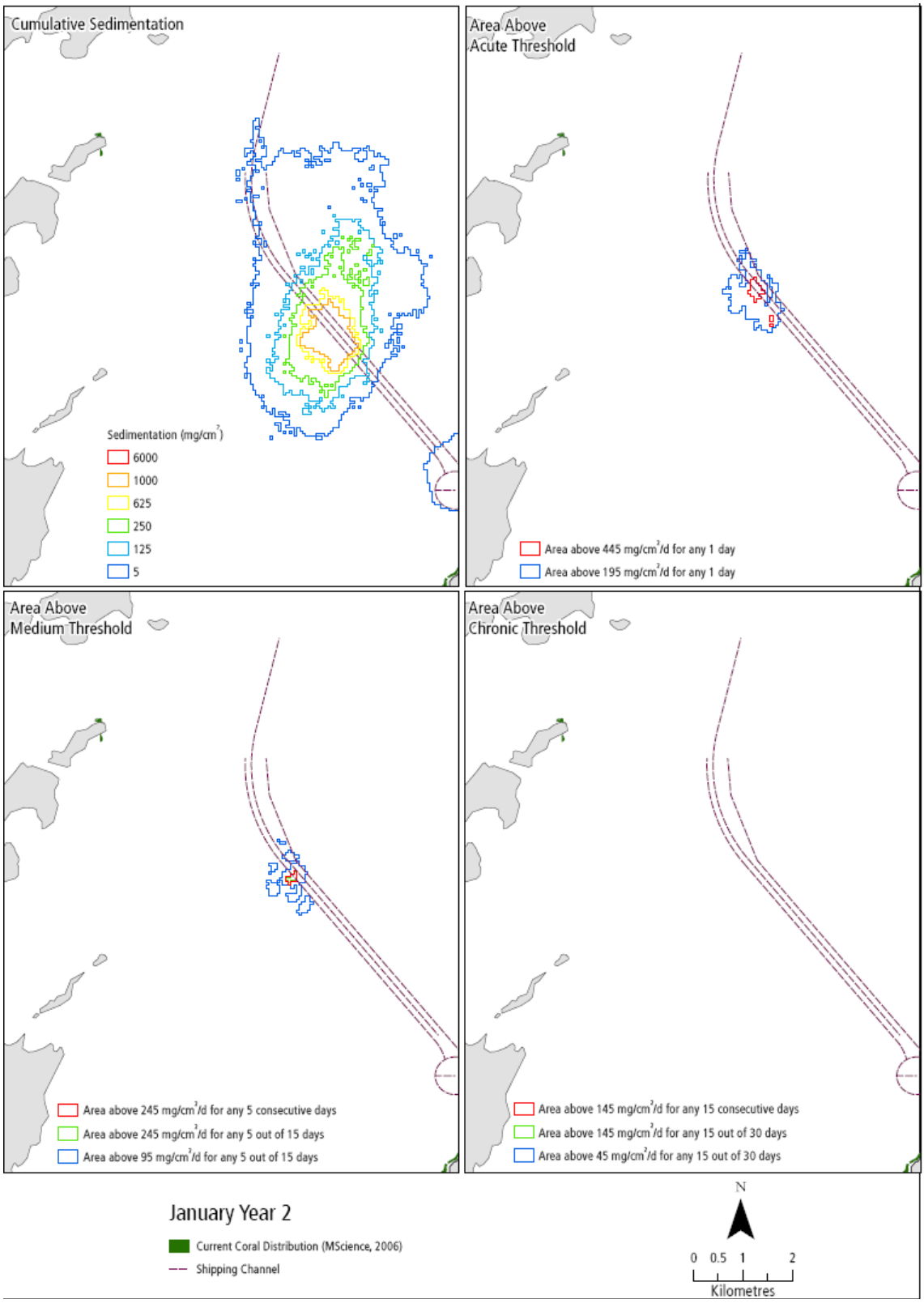
- **Figure A 9 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for November Year 1.**



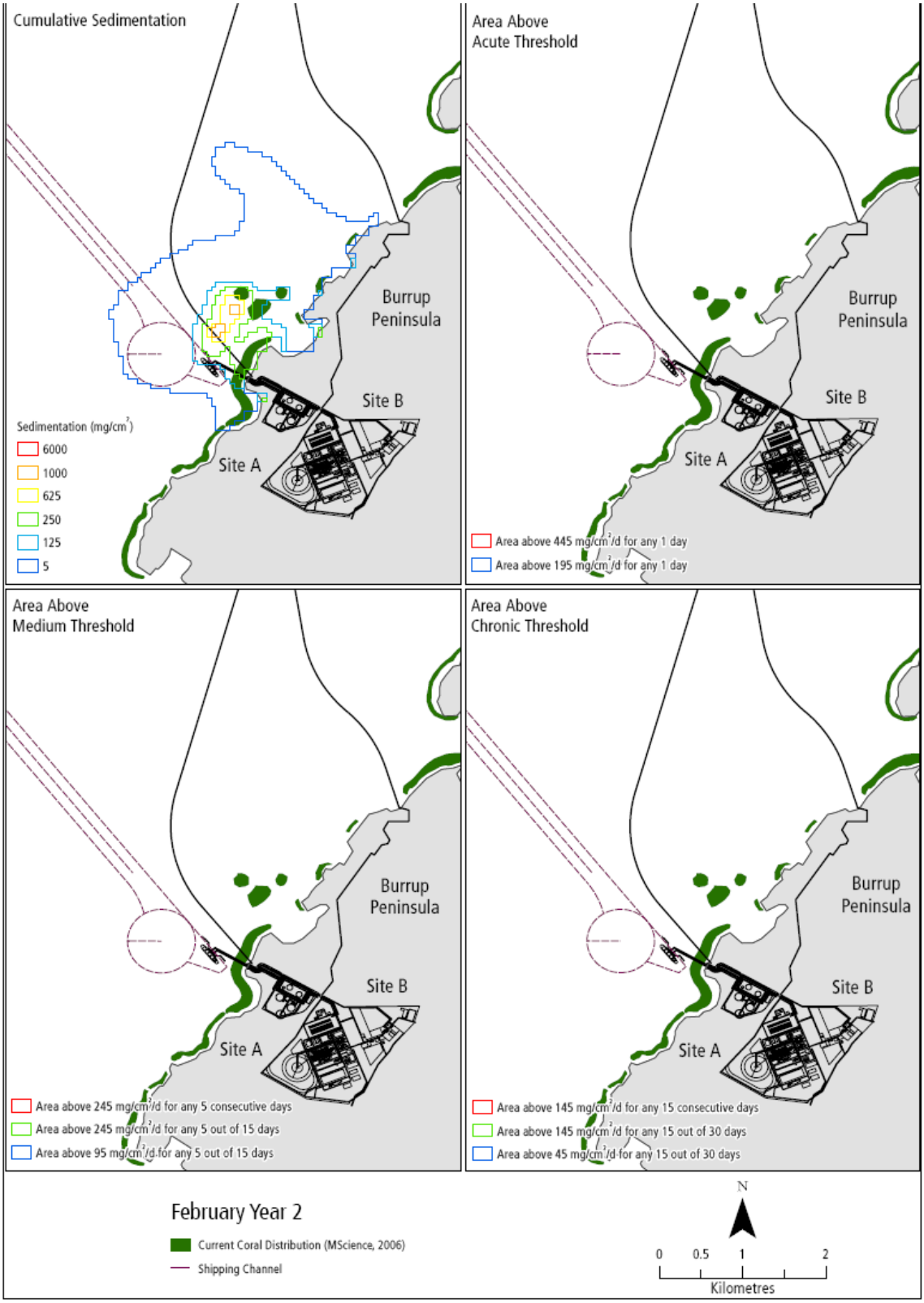
- **Figure A 10 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for December Year 1.**



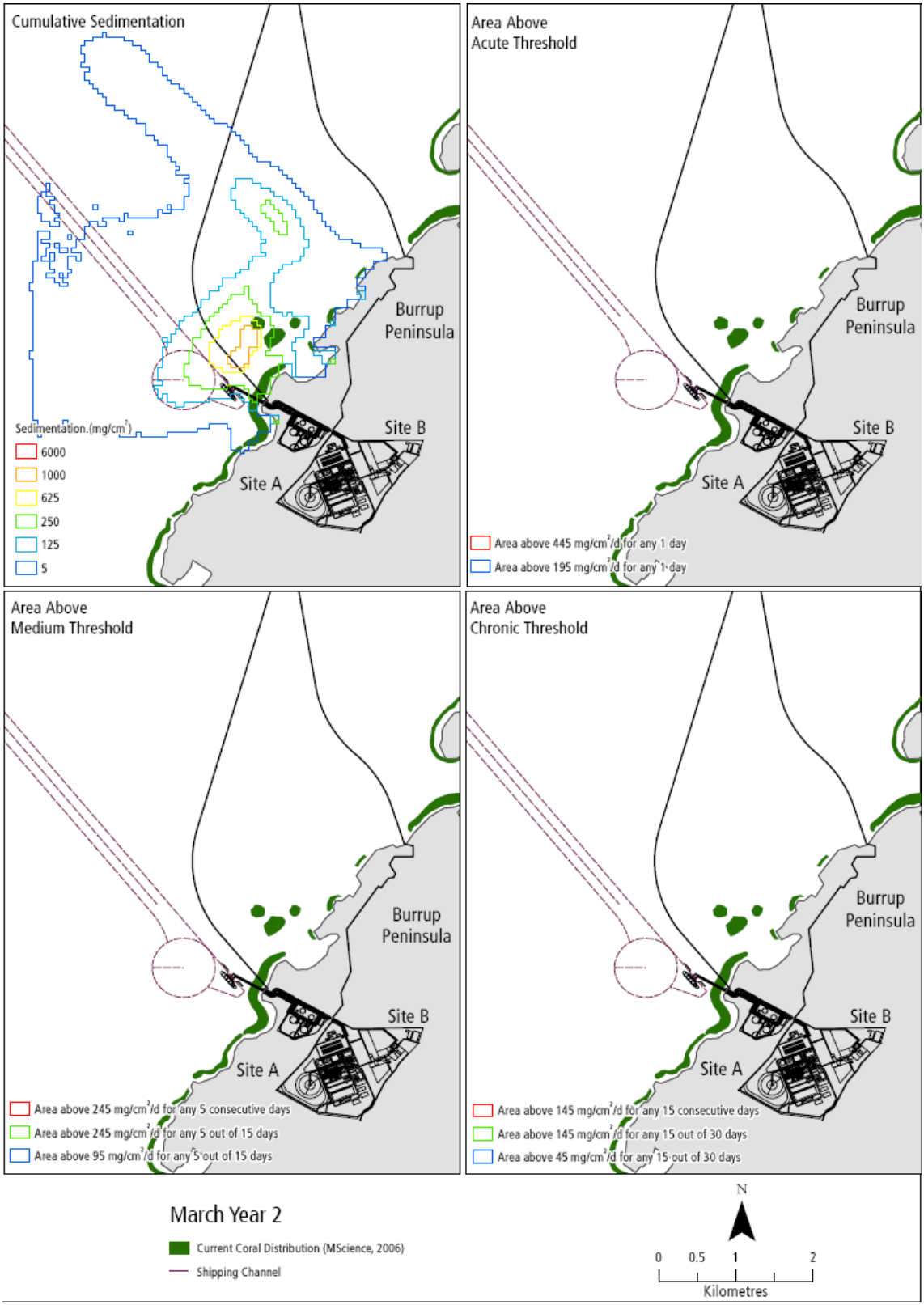
- **Figure A 11 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for January Year 2.**



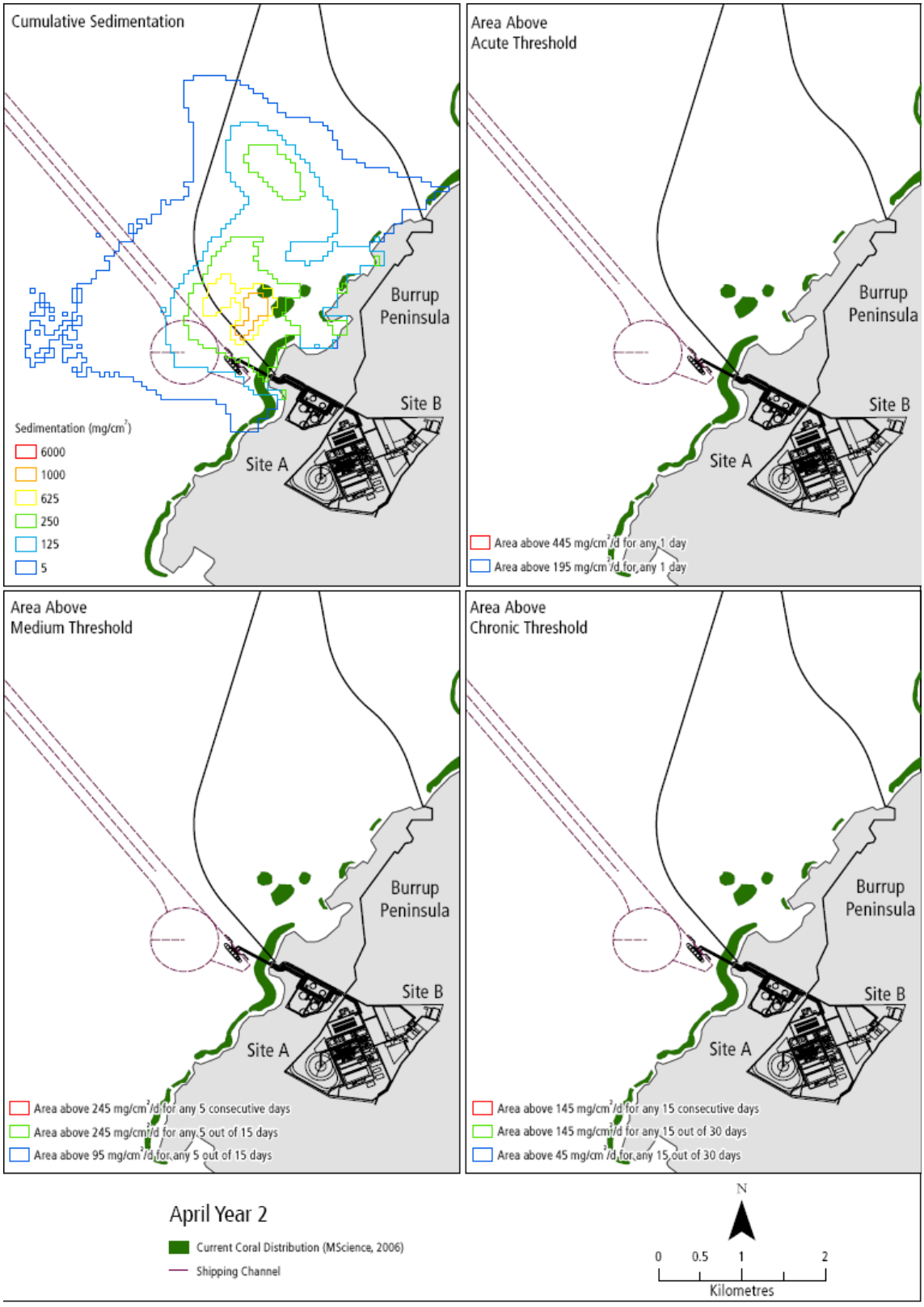
- **Figure A 12 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for January Year 2 – Dredging the Outer Channel.**



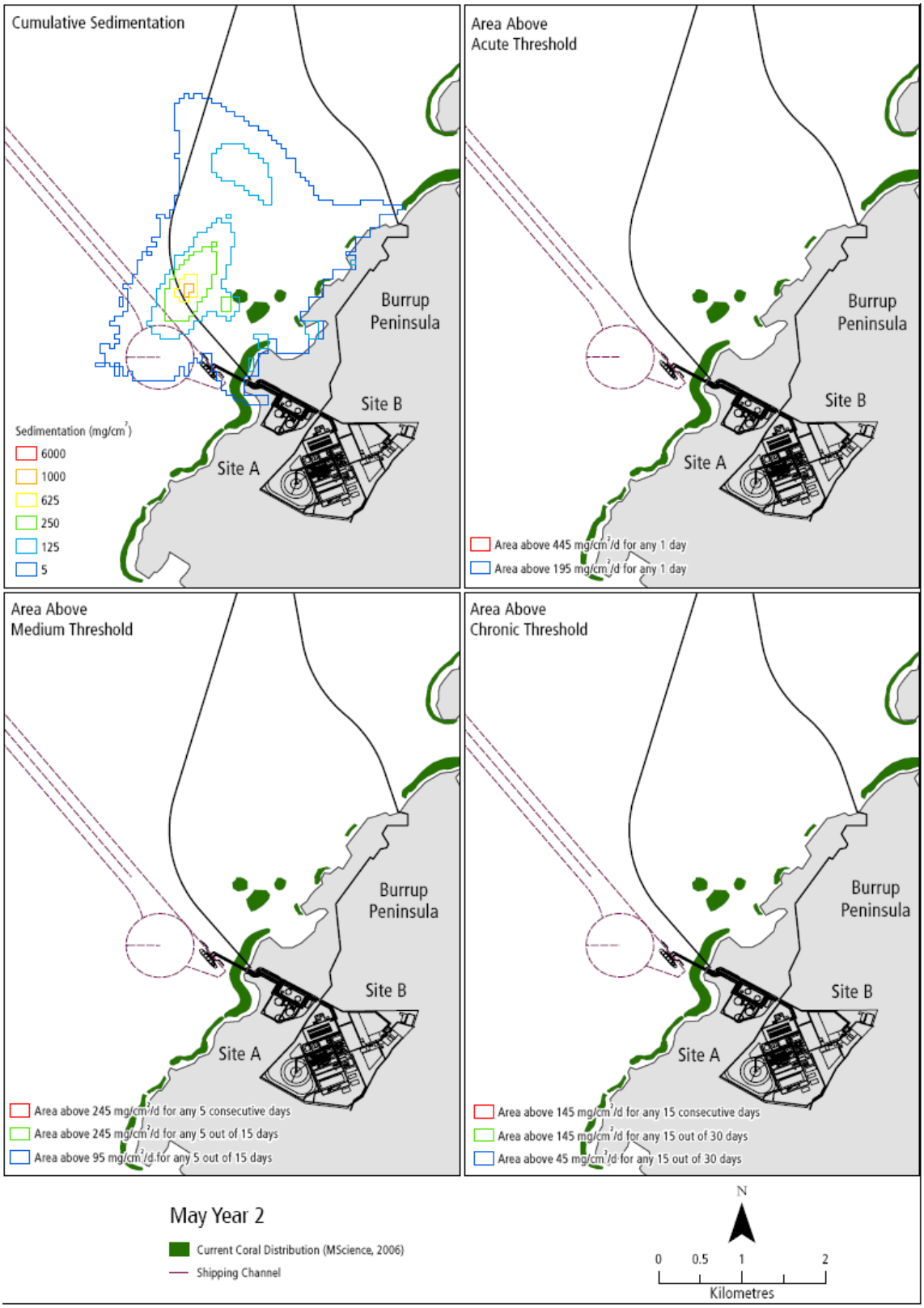
- **Figure A 13 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for February Year 2.**



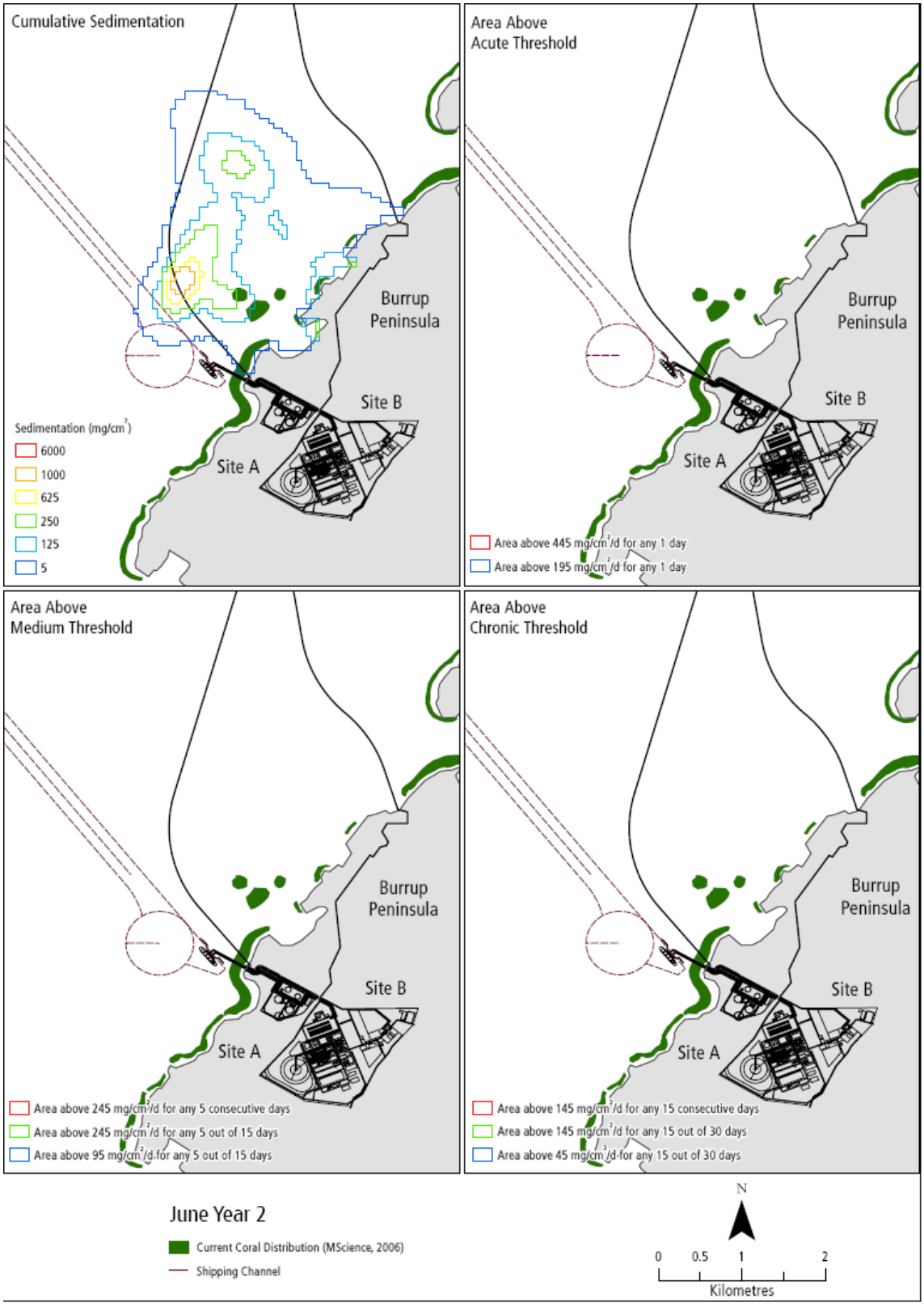
- **Figure A 14 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for March Year 2.**



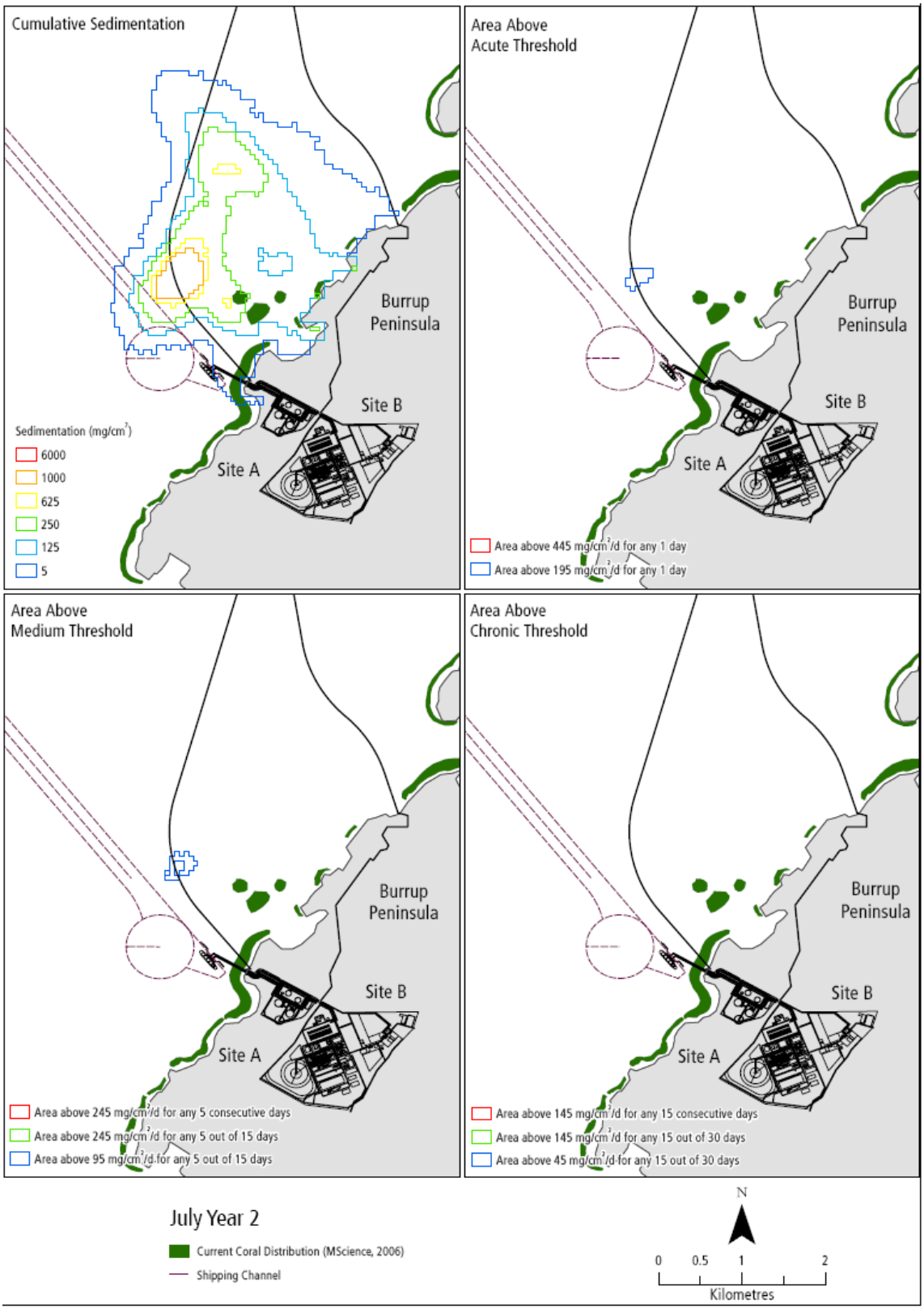
- **Figure A 15 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for April Year 2.**



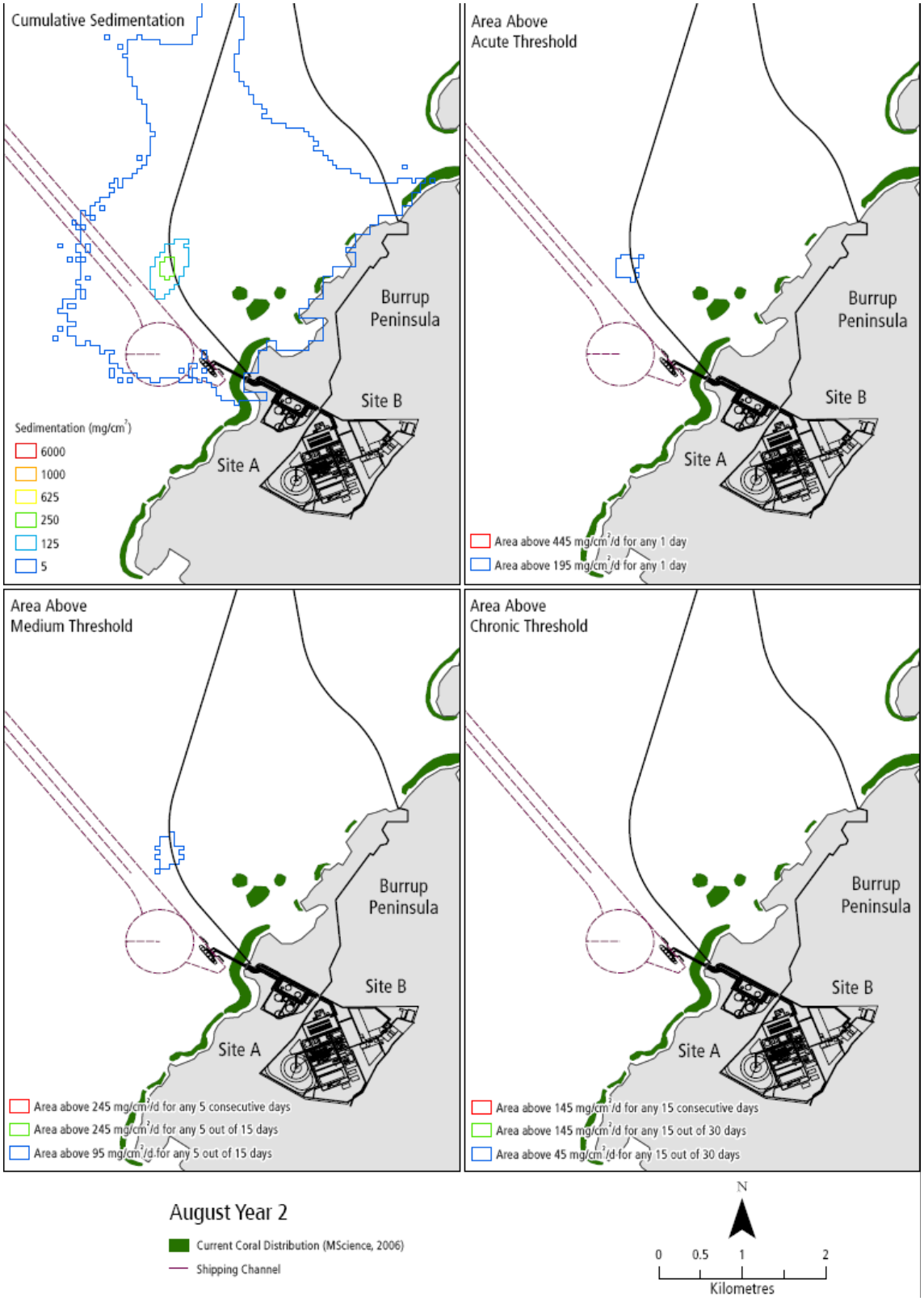
- **Figure A 16 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for May Year 2.**



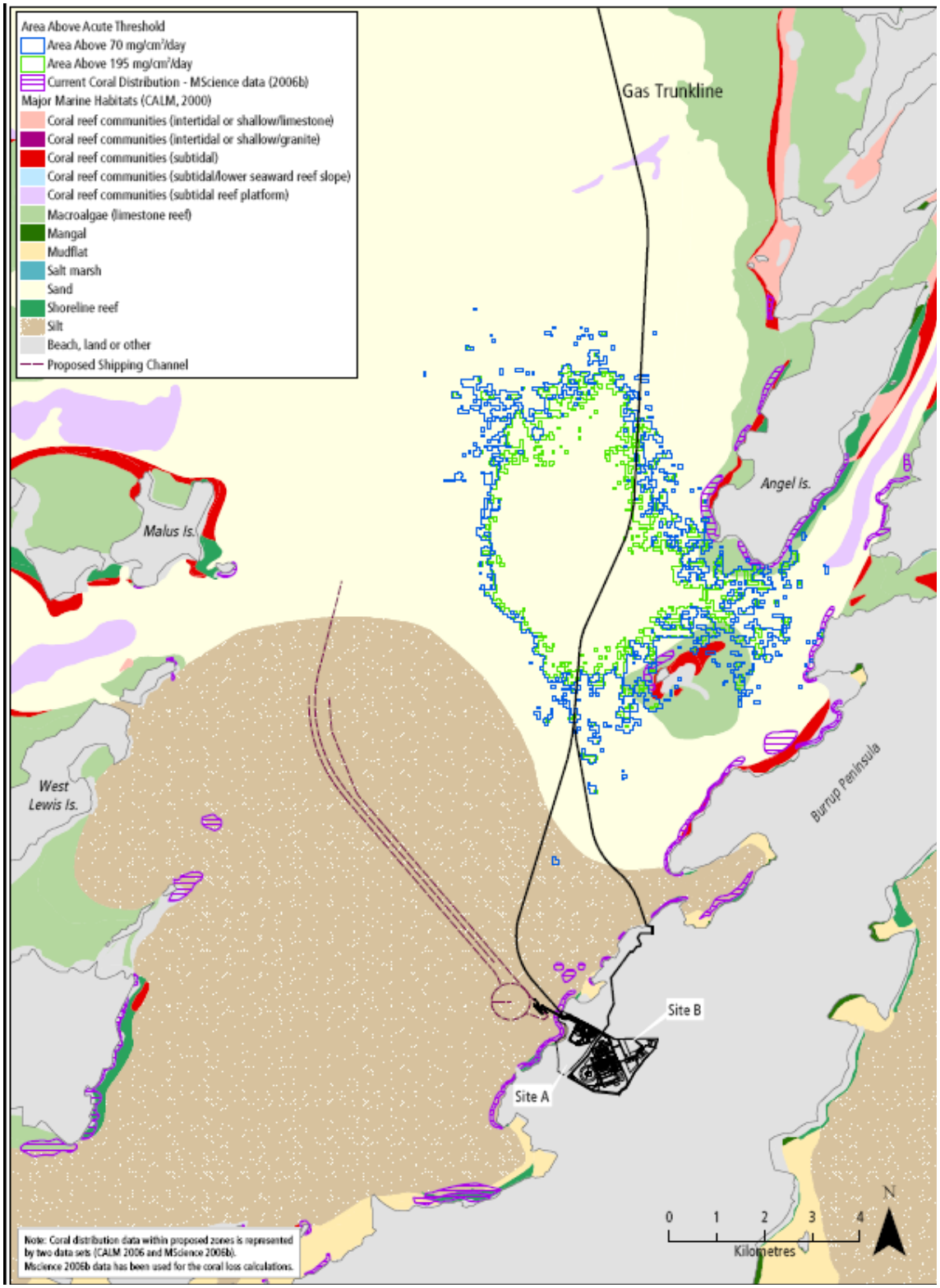
- **Figure A 17 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for June Year 2.**



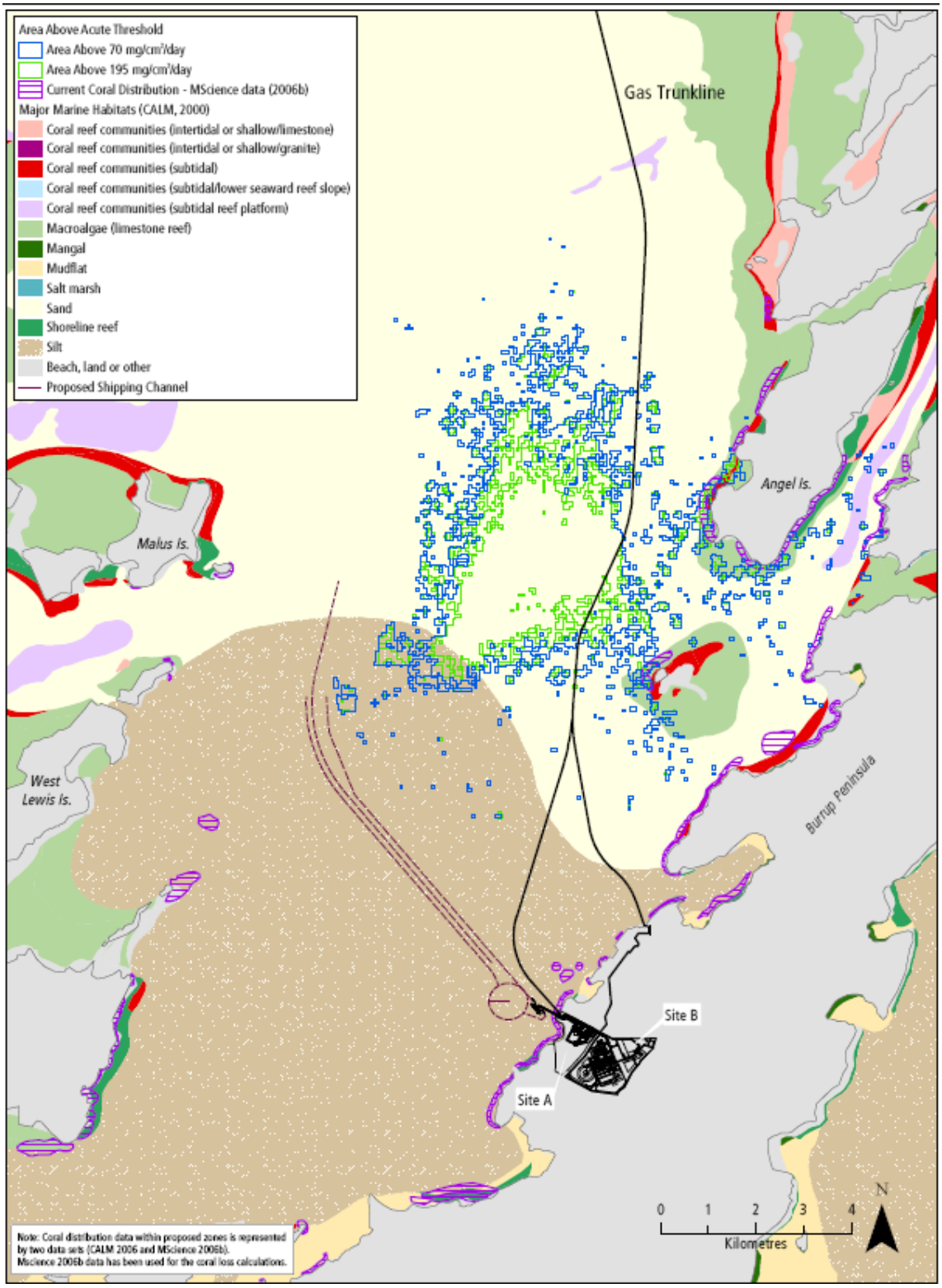
- **Figure A 18 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for July Year 2.**



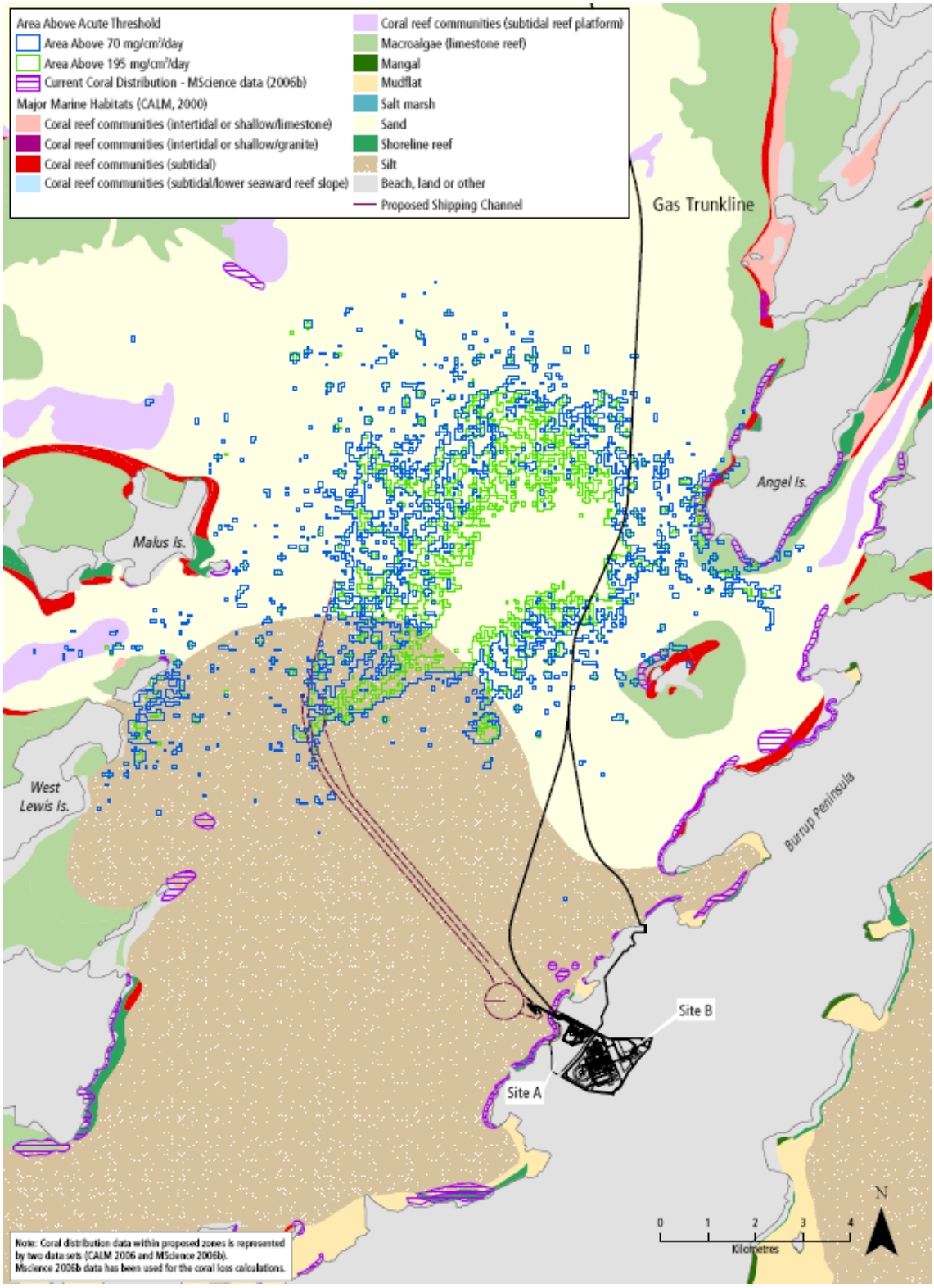
- **Figure A 19 Monthly Cumulative Sedimentation, Areas Above Thresholds and Threshold Sensitivity Analysis for August Year 2.**



- **Figure A 20 Sensitivity Analysis of the Sedimentation Threshold for Sensitive Species. Spoil Disposal into Spoil Ground A/B During Summer.**



- **Figure A 21 Sensitivity Analysis of the Sedimentation Threshold for Sensitive Species. Spoil Disposal into Spoil Ground A/B During Transitional Period.**



- **Figure A 22 Sensitivity Analysis of the Sedimentation Threshold for Sensitive Species. Spoil Disposal into Spoil Ground A/B During Winter.**

WOODSIDE

Pluto LNG Development

Public Environment Report / Public Environmental Review

Supplement and Response to Submissions

EPBC Referral 2006/2968
Assessment No. 1632

March 2007