APPENDIX G DEPARTMENT OF ABORIGINAL AFFAIRS HERITAGE SEARCH RESULTS

Aboriginal Heritage Inquiry System

List of Other Heritage Places

Search Criteria

40 Other Heritage Places in Shapefile - EMBA_20210901. Warning: Search area complex so results may be inaccurate. Contact DPLH for assistance.

Disclaimer

The *Aboriginal Heritage Act 1972* preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.

The information provided is made available in good faith and is predominately based on the information provided to the Department of Planning, Lands and Heritage by third parties. The information is provided solely on the basis that readers will be responsible for making their own assessment as to the accuracy of the information. If you find any errors or omissions in our records, including our maps, it would be appreciated if you email the details to the Department at AboriginalHeritage@dplh.wa.gov.au and we will make every effort to rectify it as soon as possible.

Coordinate Accuracy

Coordinates (Easting/Northing metres) are based on the GDA 94 Datum. Accuracy is shown as a code in brackets following the coordinates.

Terminology (NB that some terminology has varied over the life of the legislation)

Place ID/Site ID: This a unique ID assigned by the Department of Planning, Lands and Heritage to the place.
Status:
- **Registered Site**: The place has been assessed as meeting Section 5 of the *Aboriginal Heritage Act 1972.*
- **Other Heritage Place which includes:**
  - **Stored Data / Not a Site:** The place has been assessed as not meeting Section 5 of the *Aboriginal Heritage Act 1972.*
  - **Lodged:** Information has been received in relation to the place, but an assessment has not been completed at this *stage* to determine if it meets Section 5 of the *Aboriginal Heritage Act 1972.*

Access and Restrictions:
- **File Restricted = No:** Availability of information that the Department of Planning, Lands and Heritage holds in relation to the place is not restricted in any way.
- **File Restricted = Yes:** Some of the information that the Department of Planning, Lands and Heritage holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Planning, Lands and Heritage receives written approval from the informants who provided the information. To request access please contact AboriginalHeritage@dplh.wa.gov.au.
- **Boundary Restricted = No:** Place location is shown as accurately as the information lodged with the Registrar allows.
- **Boundary Restricted = Yes:** To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least 4km²) provides a general indication of where the place is located. If you are a landowner and wish to find out more about the exact location of the place, please contact the Department of Planning, Lands and Heritage.
- **Restrictions:**
  - **No Restrictions:** *Anyone* can view the information.
  - **Male Access Only:** Only *males* can view restricted information.
  - **Female Access Only:** *Only* females can view restricted information.

Legacy ID: This is the former unique number that the former Department of Aboriginal Sites assigned to the place. This has been replaced by the Place ID / Site ID.

Aboriginal Heritage Inquiry System

List of Other Heritage Places

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
883	BARROW ISLAND 01	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	334950mE 7692667mN Zone 50 [Reliable]	P07291
884	BARROW ISLAND 02	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	331673mE 7691987mN Zone 50 [Reliable]	P07292
885	BARROW ISLAND 03	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	326224mE 7689495mN Zone 50 [Reliable]	P07293
886	BARROW ISLAND 04	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	325227mE 7694610mN Zone 50 [Reliable]	P07294
887	BARROW ISLAND 05	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	337603mE 7713680mN Zone 50 [Reliable]	P07295
888	BARROW ISLAND 06 A-F	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	337202mE 7710824mN Zone 50 [Unreliable]	P07296
889	BARROW ISLAND 07	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	337957mE 7709368mN Zone 50 [Reliable]	P07297
890	BARROW ISLAND 08	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	326487mE 7695727mN Zone 50 [Reliable]	P07298
891	BARROW ISLAND 09	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	326270mE 7691185mN Zone 50 [Reliable]	P07299
892	BARROW ISLAND 10	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	331892mE 7691082mN Zone 50 [Reliable]	P07300
893	BARROW ISLAND 11	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	326145mE 7695108mN Zone 50 [Reliable]	P07301
894	BARROW ISLAND 12	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	326347mE 7699332mN Zone 50 [Reliable]	P07302

Aboriginal Heritage Inquiry System

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ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
6783	28 MILE CREEK NORTH 2	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	795452mE 7546377mN Zone 49 [Reliable]	P06141
6786	LAKESIDE COASTAL PLAIN	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	801642mE 7560649mN Zone 49 [Unreliable]	P06144
6789	TURQUOISE BAY NORTH	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	798642mE 7554649mN Zone 49 [Unreliable]	P06147
7208	MILYERING ROCKS.	No	No	No Gender Restrictions	Lodged	Hunting Place	*Registered Knowledge Holder names available from DAA	800842mE 7560649mN Zone 49 [Reliable]	P05712
8951	BARROW ISLAND	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	335137mE 7705156mN Zone 50 [Unreliable]	P03542
11801	COASTAL MIDDEN, 5 MILE	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	195638mE 7582655mN Zone 50 [Unreliable]	P00345
20621	Bedout Island	No	No	No Gender Restrictions	Lodged	Mythological, Natural Feature, Other: Island	*Registered Knowledge Holder names available from DAA	720197mE 7832653mN Zone 50 [Reliable]	
22943	Flacourt Bay 01	No	No	No Gender Restrictions	Lodged	Rockshelter	*Registered Knowledge Holder names available from DAA	331540mE 7705613mN Zone 50 [Reliable]	
29549	Boodie Soak	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	333058mE 7702494mN Zone 50 [Reliable]	
31762	Site 1	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	332664mE 7694168mN Zone 50 [Reliable]	
31763	Site 2	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	332528mE 7694213mN Zone 50 [Reliable]	
36199	Boodie Cave	No	No		Lodged	Artefacts / Scatter, Rockshelter	*Registered Knowledge Holder names available from DAA	329709mE 7703887mN Zone 50 [Reliable]	

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ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
36234	South End structures, Barrow Island.	No	No		Lodged	Historical, Man-Made Structure	*Registered Knowledge Holder names available from DAA	326057mE 7689365mN Zone 50 [Unreliable]	
36261	G-13-S0001	No	No		Lodged	Quarry	*Registered Knowledge Holder names available from DAA	329032mE 7702259mN Zone 50 [Reliable]	
36262	H-24-S0001	No	No		Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	330962mE 7691480mN Zone 50 [Reliable]	
36263	H-24-S0002	No	No		Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	330959mE 7691251mN Zone 50 [Reliable]	
36264	I-23-S0001	No	No		Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	331260mE 7692010mN Zone 50 [Reliable]	
36265	I-23-S0002	No	No		Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	331643mE 7692090mN Zone 50 [Reliable]	
36266	I-24-S0003	No	No		Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	331552mE 7691950mN Zone 50 [Reliable]	
36267	J-23-S0001	No	No		Lodged	Grinding Patches / Grooves	*Registered Knowledge Holder names available from DAA	332215mE 7692570mN Zone 50 [Reliable]	
36268	J-23-S0002	No	No		Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	332208mE 7692431mN Zone 50 [Reliable]	
36269	J-23-S0003	No	No		Lodged	Modified Tree	*Registered Knowledge Holder names available from DAA	332193mE 7692286mN Zone 50 [Reliable]	
36270	M-03-S0001	No	No		Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	335996mE 7712066mN Zone 50 [Reliable]	
36271	N-02-S0001	No	No		Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	336855mE 7713004mN Zone 50 [Reliable]	

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36272	O-02-S0002	No	No		Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	337100mE 7713272mN Zone 50 [Reliable]	
36273	O-05-S0003	No	No		Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	337727mE 7710822mN Zone 50 [Reliable]	
36348	P-04-S0001	No	No		Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	338193mE 7711023mN Zone 50 [Reliable]	
38763	Wapet Shell Midden	No	No		Stored Data / Not a Site	Shell	*Registered Knowledge Holder names available from DAA	340812mE 7707336mN Zone 50 [Reliable]	

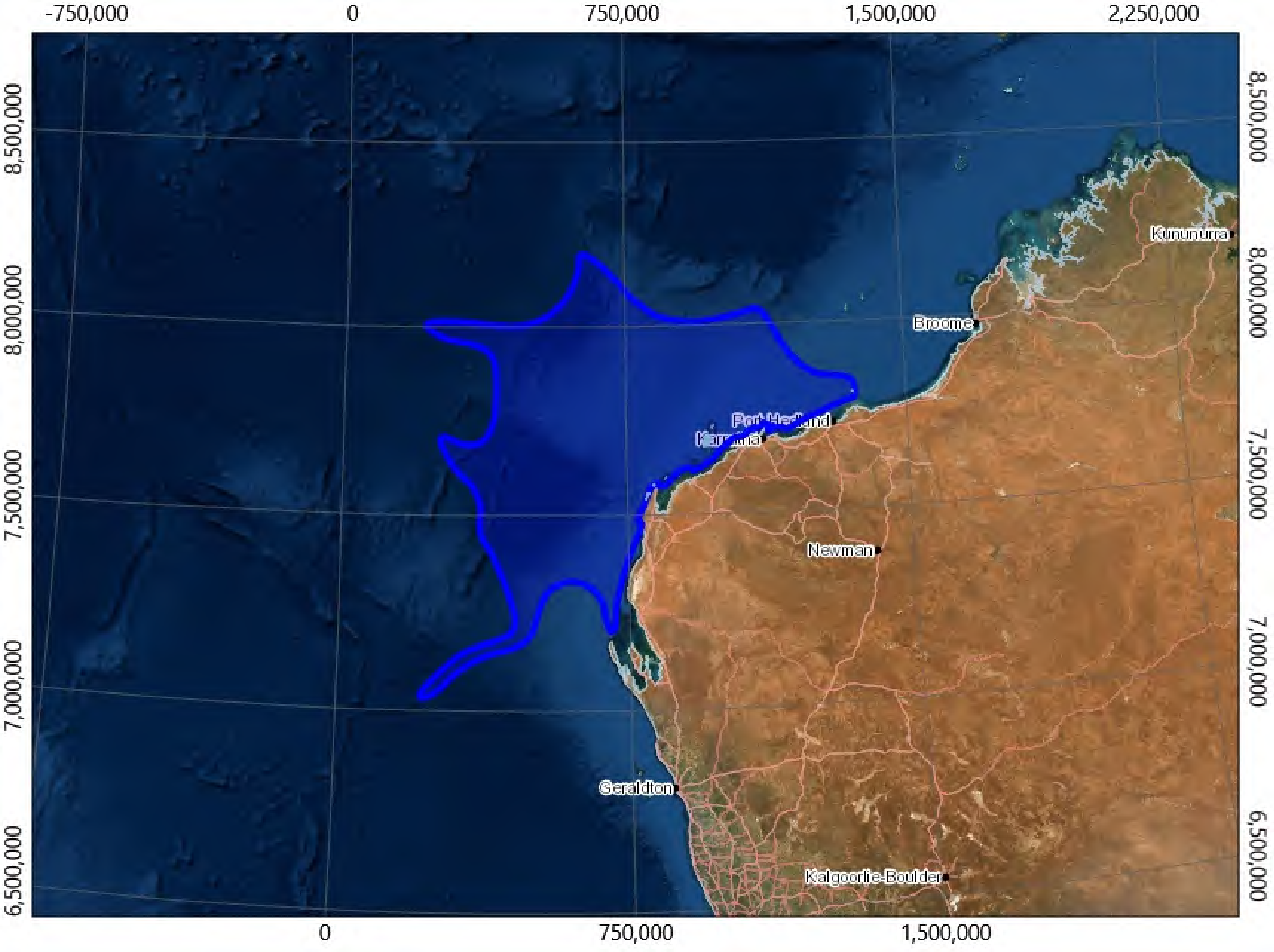
Department of Planning, Lands and Heritage

GOVERNMENT OF WESTERN AUSTRALIA

Aboriginal Heritage Inquiry System

Map of Other Heritage Places

For further important information on using this information please see the Department of Planning, Lands and Heritage's Disclaimer statement at https://www.dplh.wa.gov.au/about-this-website



Legend

- Other Heritage Place
- Search Area
- Town
- Road
- River
- Local Government Authority

546.06 kilometres

Map Scale 1 : 16,550,000

MGA Zone 49 (GDA94)

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

Search Criteria

54 Registered Aboriginal Sites in Shapefile - EMBA_20210901. Warning: Search area complex so results may be inaccurate. Contact DPLH for assistance.

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Copyright

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Basemap Copyright

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
563	POINT MURAT 01	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	208716mE 7585665mN Zone 50 [Reliable]	P07501
564	POINT MURAT 02	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	209079mE 7585539mN Zone 50 [Reliable]	P07502
628	CAMP THIRTEEN BURIAL	No	No	No Gender Restrictions	Registered Site	Skeletal Material / Burial	*Registered Knowledge Holder names available from DAA	800392mE 7559449mN Zone 49 [Reliable]	P07434
873	MONTEBELLO IS: NOALA CAVE.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Rockshelter, BP Dating: 27,220 +/- 640	*Registered Knowledge Holder names available from DAA	348188mE 7741053mN Zone 50 [Reliable]	P07287
926	MONTEBELLO IS: HAYNES CAVE.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Rockshelter, Arch Deposit	*Registered Knowledge Holder names available from DAA	348289mE 7741005mN Zone 50 [Reliable]	P07286
966	ROSEMARY IS.11: CHOOKIE BAY	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	459339mE 7736355mN Zone 50 [Unreliable]	P07219
967	ROSEMARY IS.12: CHOOKIE BAY	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Quarry	*Registered Knowledge Holder names available from DAA	458839mE 7736655mN Zone 50 [Unreliable]	P07220
968	ROSEMARY IS.13	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Grinding Patches / Grooves, Midden / Scatter	*Registered Knowledge Holder names available from DAA	458839mE 7736955mN Zone 50 [Unreliable]	P07221
969	ROSEMARY IS.14	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Grinding Patches / Grooves, Midden / Scatter	*Registered Knowledge Holder names available from DAA	458939mE 7736855mN Zone 50 [Unreliable]	P07222
970	ROSEMARY IS.15: AIRSTRIP	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Grinding Patches / Grooves, Midden / Scatter	*Registered Knowledge Holder names available from DAA	458739mE 7737855mN Zone 50 [Unreliable]	P07223
971	ROSEMARY IS.16: AIRSTRIP	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Quarry	*Registered Knowledge Holder names available from DAA	458539mE 7737855mN Zone 50 [Unreliable]	P07224
972	ROSEMARY IS.17: AIRSTRIP	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Quarry	*Registered Knowledge Holder names available from DAA	458139mE 7737655mN Zone 50 [Unreliable]	P07225

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
973	ROSEMARY IS.18: DEEP WATER	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	457039mE 7736655mN Zone 50 [Unreliable]	P07226
974	ROSEMARY IS.19: CHITON	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	456839mE 7736355mN Zone 50 [Unreliable]	P07227
978	ROSEMARY IS.23: WADJURU R/H	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Engraving, Grinding Patches / Grooves, Man-Made Structure, Midden / Scatter, Water Source	*Registered Knowledge Holder names available from DAA	455839mE 7734355mN Zone 50 [Unreliable]	P07231
6754	OSPREY BAY 6	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	792942mE 7538749mN Zone 49 [Reliable]	P06165
6755	OSPREY BAY INTERDUNAL 1	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	792342mE 7537149mN Zone 49 [Unreliable]	P06166
6757	BLOODWOOD CREEK MIDDEN 1	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	794942mE 7544549mN Zone 49 [Reliable]	P06168
6758	BLOODWOOD CREEK MIDDEN 2	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	794942mE 7545049mN Zone 49 [Reliable]	P06169
6759	BLOODWOOD CREEK MIDDEN 3	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	795142mE 7544949mN Zone 49 [Reliable]	P06170
6760	BLOODWOOD CREEK SHORELINE	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	794942mE 7545249mN Zone 49 [Reliable]	P06171
6761	LOW POINT MIDDEN	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	802992mE 7566299mN Zone 49 [Reliable]	P06172
6762	MILYERING MIDDEN	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	801342mE 7561449mN Zone 49 [Reliable]	P06173
6764	CAMP 17 SOUTH MIDDENS	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	799042mE 7555649mN Zone 49 [Unreliable]	P06175

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
6765	CAMP 17 NORTH MIDDENS	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	799042mE 7555849mN Zone 49 [Unreliable]	P06176
6782	28 MILE CREEK NORTH 1	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	795242mE 7545949mN Zone 49 [Unreliable]	P06140
6784	MANDU MANDU CREEK SOUTH	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	796642mE 7548649mN Zone 49 [Unreliable]	P06142
6785	MANDU MANDU CREEK NORTH	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	796642mE 7548649mN Zone 49 [Unreliable]	P06143
6790	YARDIE CREEK SOUTH 1	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	788942mE 7527749mN Zone 49 [Reliable]	P06148
6799	YARDIE BEACH MIDDEN	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	789842mE 7529049mN Zone 49 [Reliable]	P06157
6800	OYSTER STACKS MIDDEN	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	797042mE 7549849mN Zone 49 [Reliable]	P06158
6801	NORTH T-BONE BAY	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	801666mE 7562059mN Zone 49 [Reliable]	P06159
6802	OSPREY BAY 1	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	792742mE 7538149mN Zone 49 [Reliable]	P06160
6803	OSPREY BAY 2	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	792742mE 7538049mN Zone 49 [Reliable]	P06161
6804	OSPREY BAY 3	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	792542mE 7537849mN Zone 49 [Reliable]	P06162
6805	OSPREY BAY 4	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	792342mE 7537049mN Zone 49 [Reliable]	P06163

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
6806	OSPREY BAY 5	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	792742mE 7538149mN Zone 49 [Reliable]	P06164
7124	DORRE ISLAND	No	No	No Gender Restrictions	Registered Site	Skeletal Material / Burial	*Registered Knowledge Holder names available from DAA	711750mE 7220260mN Zone 49 [Unreliable]	P05790
7126	MESA CAMP	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	798442mE 7554749mN Zone 49 [Unreliable]	P05792
7206	WEALJUGOO MIDDEN.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Camp, Hunting Place	*Registered Knowledge Holder names available from DAA	776584mE 7504740mN Zone 49 [Reliable]	P05710
7254	SANDY BAY NORTH	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	793442mE 7539949mN Zone 49 [Reliable]	P05652
7265	LAKE SIDE VIEW	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	800942mE 7560549mN Zone 49 [Reliable]	P05664
7299	YARDIE CREEK	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	789642mE 7528649mN Zone 49 [Unreliable]	P05645
7300	MANDU MANDU CK ROCKSHELTERS	Yes	Yes	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	Not available when location is restricted	P05646
7303	TULKI WELL MIDDEN	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	798642mE 7554249mN Zone 49 [Reliable]	P05649
7304	PILGRAMUNNA BAY MIDDEN	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	794642mE 7543349mN Zone 49 [Reliable]	P05650
7305	MANGROVE BAY.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Skeletal Material / Burial, Hunting Place	*Registered Knowledge Holder names available from DAA	804142mE 7568149mN Zone 49 [Reliable]	P05651
10381	VLAMING HEAD	Yes	Yes	No Gender Restrictions	Registered Site	Ceremonial, Mythological	*Registered Knowledge Holder names available from DAA	Not available when location is restricted	P01799

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
11328	GAP WELL	No	No	No Gender Restrictions	Registered Site	Engraving	*Registered Knowledge Holder names available from DAA	458639mE 7736755mN Zone 50 [Unreliable]	P00836
11458	NINGALOO (near)	No	No	No Gender Restrictions	Registered Site	Painting	*Registered Knowledge Holder names available from DAA	781642mE 7511649mN Zone 49 [Unreliable]	P00701
11775	ROSEMARY ISLAND 06	No	No	No Gender Restrictions	Registered Site	Engraving	*Registered Knowledge Holder names available from DAA	457839mE 7737256mN Zone 50 [Unreliable]	P00372
11789	ROSEMARY ISLAND 01	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Engraving, Midden / Scatter, Quarry	*Registered Knowledge Holder names available from DAA	458889mE 7737155mN Zone 50 [Unreliable]	P00386
11820	ENDERBY ISLAND 01	No	No	No Gender Restrictions	Registered Site	Engraving	*Registered Knowledge Holder names available from DAA	445137mE 7725156mN Zone 50 [Unreliable]	P00364
17193	Ningaloo Station	No	No	No Gender Restrictions	Registered Site	Skeletal Material / Burial	*Registered Knowledge Holder names available from DAA	775891mE 7489149mN Zone 49 [Unreliable]	

Aboriginal Heritage Inquiry System

Department of Planning, Lands and Heritage

GOVERNMENT OF WESTERN AUSTRALIA

Map of Registered Aboriginal Sites

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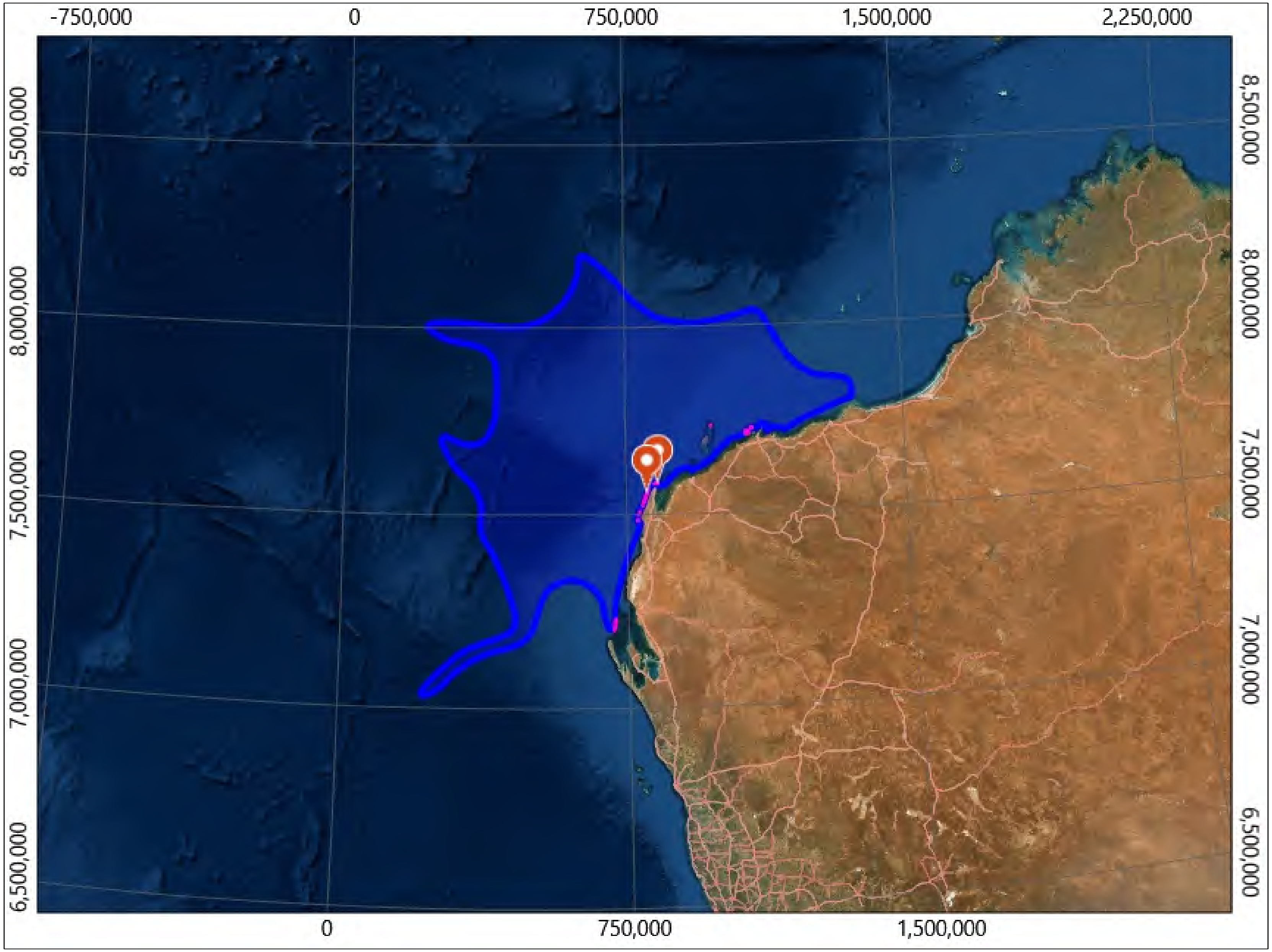

Legend

- Registered Aboriginal Site
- Search Area
- Town
- Road
- River
- Local Government Authority

546.06 kilometres

Map Scale 1 : 16,550,000

MGA Zone 49 (GDA94)

Aboriginal Heritage Inquiry System

List of Other Heritage Places

Search Criteria

No Other Heritage Places in Shapefile - Scarb_SIPLE_Ops_Area

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Legend

- Other Heritage Place
- Search Area
- Town
- Road
- River
- Local Government Authority

132.19 kilometres

Map Scale 1 : 4,010,000

MGA Zone 50 (GDA94)

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

Search Criteria

No Registered Aboriginal Sites in Shapefile - Scarb_SIPLE_Ops_Area

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Legend

- Registered Aboriginal Site
- Search Area
- Town
- Road
- River
- Local Government Authority

132.19 kilometres

Map Scale 1 : 4,010,000

MGA Zone 50 (GDA94)

APPENDIX H MASTER EXISTING ENVIRONMENT

Description of the Existing Environment

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1. INTRODUCTION

1.1 Purpose

This document applies, where indicated in the relevant Environment Plan, to Woodside Energy Ltd. (Woodside) activities and operations.

1.2 Scope

This document describes the existing environment within the Woodside areas of activity located in Commonwealth waters off north-western Western Australia (WA), with a focus on the North-west Marine Region (NWMR) (**Figure 1-1**). This document includes details of the particular and relevant values and sensitivities of the environment as required by the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 in order to inform the impact and risk evaluation of Woodside's activities within the NWMR. Furthermore, the key values of the South-west Marine Region (SWMR) and the North Marine Region (NMR) are summarised to encompass areas outside the NWMR. This is with reference to the environment that may be affected (EMBA), as defined and described in individual EPs, for unplanned hydrocarbon spill risks. Additional information appropriate to the nature and scale of the impacts and risks of activities that may interact with the environment will be used to further inform impact and risk assessments and included in the Description of the Existing Environment of individual EPs.

This document is informed by a variety of resources that includes: a search of the Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (PMST) for the marine bioregions (NWMR, SWMR and NMR) and the three PMST reports provided in **Appendix A**; State (WA)/Commonwealth Marine Park Management Plans, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Species Profile and Threats Database (SPRAT), Part 13 statutory instruments (recovery plans, conservation advices and wildlife conservation plans for listed threatened and migratory species); and peer reviewed scientific publications, as well as Woodside and Joint Venture (JV) funded studies and other titleholder funded study findings available in the public domain.

1.3 Review and Revision

The information presented in this document is reviewed and updated, where relevant, on at least an annual basis to address any relevant changes, which includes but is not limited to the status of EPBC Act listed species, Part 13 Instruments, policies and guidelines and recently published scientific literature.

1.4 Regional Context

Where relevant, the physical, biological and social environments within the areas of interest are discussed with reference to the three marine bioregions of Australia—NWMR, SWMR and NMR (**Table 1-1)**. The NWMR is the focal marine bioregion for the Description of the Existing Environment as this is currently the location of most of Woodside's activities.

Table 1-1. Description of the Marine Bioregions

Marine Bioregion	Description
North-west	The NWMR includes all Commonwealth waters (from 3 nautical mile [nm] from the Territorial Sea Baseline [TSB] to the 200 nm Exclusive Economic Zone [EEZ] boundary) extending from the WA/Northern Territory (NT) border to Kalbarri, south of Shark Bay in WA, covering an area of approximately 1.07 million square kilometres and includes extensive areas of shallower waters on the continental shelf, as well as deep areas of abyssal plain where water depths are 5000 m or greater.
South-west	The SWMR comprises Commonwealth waters from the eastern end of Kangaroo Island in SA to Shark Bay in WA. The region spans approximately 1.3 million square kilometres of temperate and subtropical waters and abuts the coastal waters of SA and WA.
North	The NMR comprises Commonwealth waters from west Cape York Peninsula to the NT/WA border). The region covers approximately 625,689 square kilometres of tropical waters in the Gulf of Carpentaria and Arafura and Timor seas, and abuts the coastal waters of Queensland and the NT.

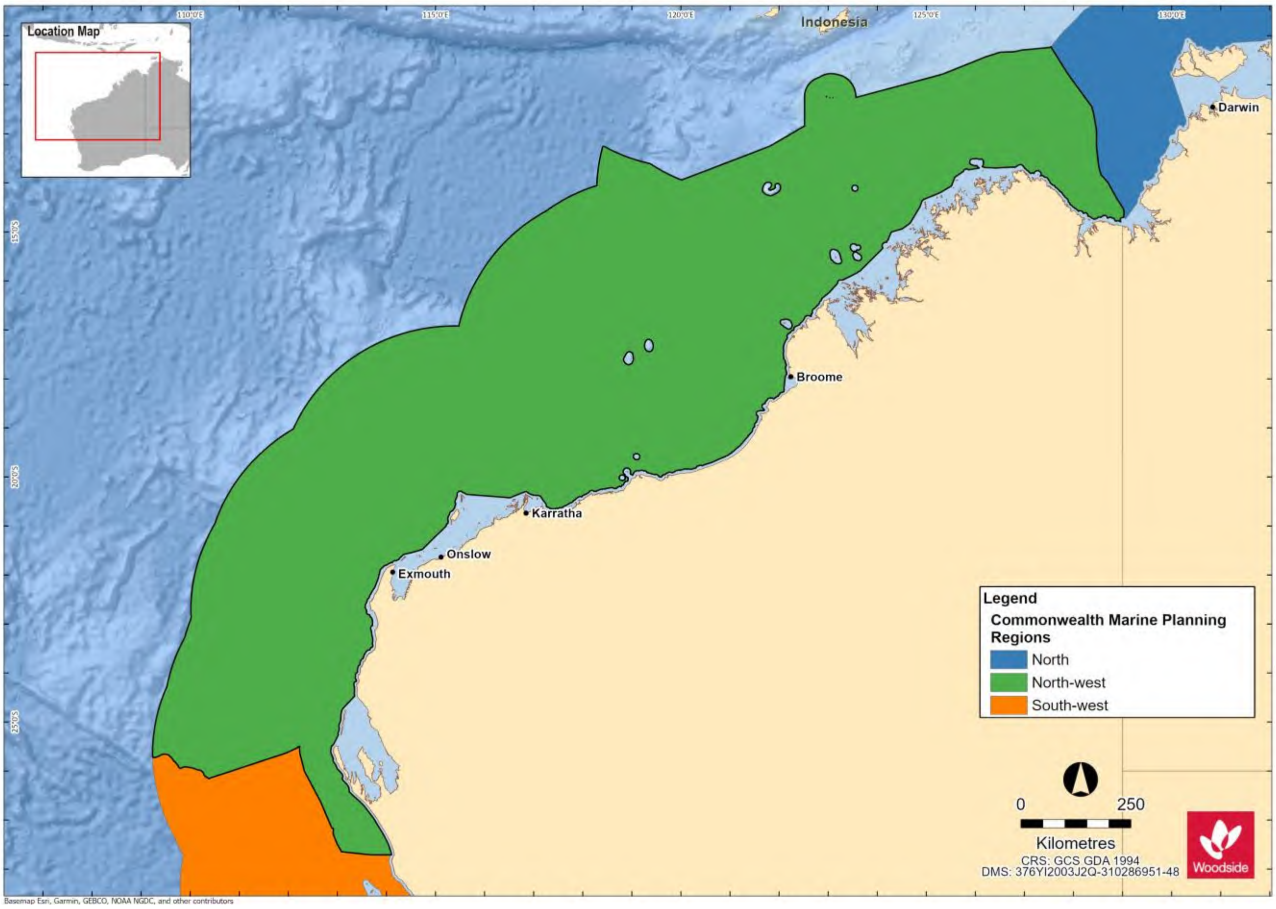

Figure 1-1. Marine Bioregions: North-west (NWMR), South-west (SWMR) and North (NMR)

2. PHYSICAL ENVIRONMENT

2.1 Regional Context

The key physical characteristics of the NWMR, SWMR and NMR are presented in **Table 2-1**.

Table 2-1 Key physical characteristics of the NWMR, SWMR and NMR

Bioregion	Key Characteristics
North-west Marine Region	The NWMR experiences a tropical monsoonal climate towards the northern extent of the region, transitioning to tropical arid and subtropical arid within the central and southern areas of the region (DSEWPAC, 2012a).
	The NWMR is part of the Indo-Australian Basin, the ocean region between the north-west coast of Australia and the Indonesian islands of Java and Sumatra. Dominant currents in the Region include: the South Equatorial Current, the Indonesian Throughflow; the Eastern Gyral Current, and the Leeuwin Current (DEWHA, 2007a).
	The seafloor of the NWMR consists of four general feature types: continental shelf; continental slope; continental rise; and abyssal plain and is distinguished by a range of topographic features including canyons, plateaus, terraces, ridges, reefs, and banks and shoals.
South-west Marine Region	The SWMR contains both subtropical and temperate climates, with overall light climatic cycles.
	The SWMR experiences complex and unusual oceanographic patterns, driven largely by the Leeuwin Current and its associated currents that have a significant influence on biodiversity distribution and abundance.
	The major seafloor features of the SWMR include a narrow continental shelf on the west coast to the waters off south-west WA, and a wide continental shelf dominated by sandy carbonate sediments of marine origin in the Great Australian Bight, the region also contains a steep, muddy continental slope, many canyons and large tracts of abyssal plains (DSEWPAC, 2012b).
North Marine Region	The NMR experiences a tropical monsoonal climate with complex weather cycles, including high temperatures and heavy seasonal yet variable rainfall and cyclones, which can be both destructive (loss of seagrass and mangroves) and constructive (mobilisation of sediment into coastal habitats).
	The NMR comprises Commonwealth waters from west Cape York Peninsula to the NT–WA border, covering tropical waters in the Gulf of Carpentaria and Arafura and Timor seas. Currents in the NMR are driven largely by strong winds and tides, with only minor influences from oceanographic currents such as the Indonesian Throughflow and the South Equatorial Current (DSEWPAC, 2012c).
	The seafloor of the NMR consists mainly of a wide continental shelf, as well as other geomorphological features such as shoals, banks, terraces, valleys, shallow canyons and limestone pinnacles.

2.2 Marine Systems of the North-west Marine Region.

The NWMR can be divided into three large scale ecological marine systems on the basis of the influence of major ocean currents, seafloor features and eco-physical processes (e.g. climate, tides, freshwater inflow) upon the Region (DSEWPAC, 2012a). The three large scale marine systems approximate the Woodside activity areas within the NWMR (**Figure 2-1**). The key characteristics of each marine system are outlined below in **Table 2-2**.

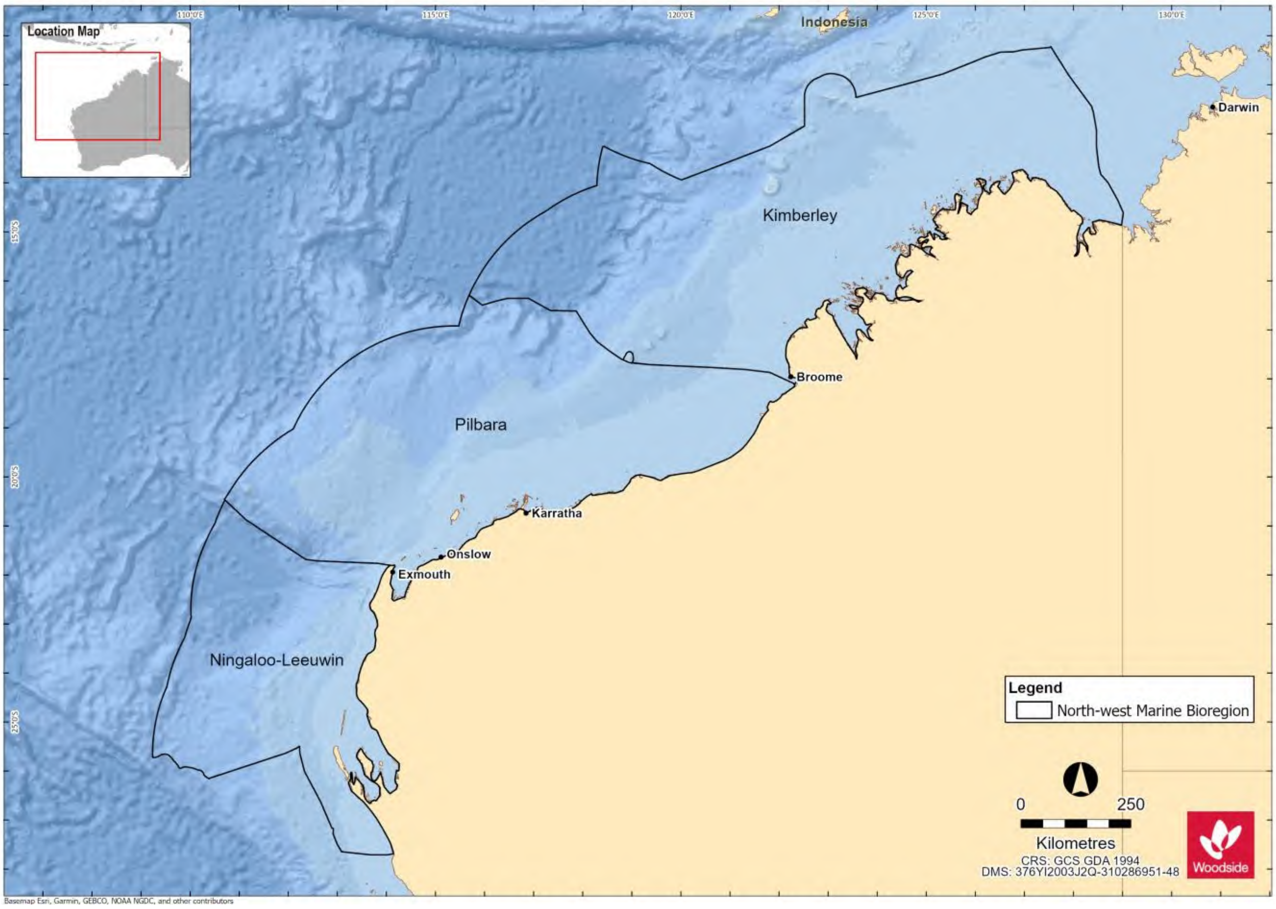

Figure 2-1. The marine systems of the North-west Marine Region (NWMR)

Table 2-2. Key characteristics of the Marine Systems of the NWMR

Note: Woodside areas align with the marine systems as described in DEWHA (2007a)

Marine System	Woodside Activity Area	Key Characteristics
Kimberley	Browse	Tropical monsoonal climate Strong influence from Indonesian Throughflow Predominantly tropical Indo-Pacific species Subject to episodic offshore cyclonic activity, rarely crossing the coast Large tidal regimes Freshwater input from terrestrial monsoonal run-off Turbid coastal waters (i.e. light limited systems) Dominated by shelf environments Predominantly hard substrates in inner to mid-shelf environments Includes a number of shelf-edge atolls (i.e. Scott Reef, Rowley Shoals)
Pilbara	North-west Shelf (NWS) / Scarborough	Tropical arid climate Transition between Indonesian Throughflow and Leeuwin Current dominated areas Predominantly tropical species High cyclone activity with frequent crossing of the coast Transitional tidal zone Internal tide activity Large areas of shelf and slope Dry coast with ephemeral freshwater inputs
Ningaloo-Leeuwin	North-west Cape	Subtropical arid climate Leeuwin Current consolidates Transitional tropical/temperate faunal area Higher water clarity in near-shore and offshore environments Narrow shelf and slope Marginal tidal range Seasonal wind forcing more dominant influence on marine environment

2.3 Meteorology and Oceanography

This section describes the general meteorological conditions and oceanography for the NWMR and provides further detail for the three Woodside activity areas. The NWMR is influenced by a complex system of ocean currents that change between seasons and between years, which generally result in its surface waters being warm and nutrient-poor, and of low salinity (DEWHA, 2007a). The mix of bathymetric features, complex topography and oceanography across the whole north-west marine environment has created and supports a globally important marine biodiversity hotspot (Wilson, 2013).

Table 2-3 NWMR climate and oceanography summary

Receptor	Description
	Meteorology
Seasonal patterns	The NWMR associated land mass of the Australian continent is characterised as a hot and humid summer climate zone. The broader NWMR experiences variations of a tropical or monsoon climate. In the far north-west (Kimberley), there is a hot summer season from December to March and a milder winter season between April and November. The Pilbara area is described as having a tropical arid climate with high cyclone activity (DEWHA, 2007a). The Pilbara and North-west Cape has a hot summer season from October to April and a milder winter season between May and September with transition periods between the summer and winter regimes.
Air temperature and rainfall	In summer (between September and March), maximum daily temperatures range from 31ºC to 33ºC. During winter (May to July), mean daily temperatures range from 18ºC to 31ºC (BOM[1]), refer to **Figure 2-2a** and **b**. Rainfall in the region typically occurs during the summer, with highest falls observed late in the season. This is often associated with the passage of tropical low-pressure systems and cyclones.
Wind	Wind patterns in north-west WA are dictated by the seasonal movement of atmospheric pressure systems. During summer, high-pressure cells produce prevailing winds from the north-west and south-west, which vary between 10 and 13 ms^{-1}. During winter, high-pressure cells over central Australia produce north-easterly to south-easterly winds with average speeds of between 6 and 8 ms^{-1}. Refer to **Figure 2-3a** and **b**.
Tropical cyclones	The NWS and Pilbara coast (within the NWMR) experiences more cyclonic activity than any other region of the Australian mainland coast (BOM, 2021a). Tropical cyclone activity typically occurs between November and April and is most frequent in the region during December to March (i.e. considered the peak period), with an average of about one cyclone per month (BOM, 2021a). Refer to **Figure 2-4**.
	Oceanography
Ocean temperature	Waters in NWMR are tropical year-round, with sea surface temperature in open shelf waters reaching ~26°C in summer and dropping to ~22°C in winter. Nearshore temperatures (as recorded for the NWS area) fluctuate more widely on an annual basis from ~17°C in winter to ~31°C in summer (Chevron Australia, 2010). Refer to **Figure 2-5a** and **b**.
Currents	The major surface currents influencing north-west WA flow towards the poles and include the Indonesian Throughflow, the Leeuwin Current, the South Equatorial Current, and the Eastern Gyral Current. The Ningaloo Current, the Holloway Current, the Shark Bay Outflow, and the Capes Current are seasonal surface currents in the region. Below these surface currents are several subsurface currents, the most important of which are the Leeuwin Undercurrent and the West Australian Current. These subsurface currents flow towards the equator in the opposite direction to surface currents (DEWHA, 2007a). Refer to **Figure 2-6**. The offshore waters of the NWMR are characterised by surface and subsurface boundary currents that flow along the continental shelf/slope and are enhanced through inflows from the ocean basins and are an important conduit for the poleward heat and mass transport along the west coast (Wijeratne *et al.*, 2018). Local physical oceanography is strongly influenced by the large-scale water movements of the Indonesian Throughflow (Liu *et al*. 2015; Sutton *et al*. 2019). Typically, a warm and well-mixed oligotrophic surface layer and a cooler and more nutrient rich, deeper water layer (Menezes *et al*. 2013).
Waves	Sea surface waves within the NWMR, generally reflect the direction of the synoptic winds and flow predominately from the south-west in the summer and east in winter (Pearce *et al.*, 2003). The NWS within the NWMR is a known area of internal wave generation. Both internal tides and internal waves are thought to be more prevalent during summer months due to the increased stratification of the water column (DEWHA, 2007a). Along the continental slope of the NWMR, strong internal waves and interaction between semi-diurnal tidal currents and seabed topographic features facilitates upwelling events and localised productivity events (Holloway, 2001).
Tides	Tides on the NWS (NWMR) increase as the water moves from deep towards the shallower coast. The highest offshore tides are experienced at the border of the Browse and Canning basins. The smallest tides are experienced at the Exmouth Plateau, near the coast. Tides of NWS (NWMR) are predominantly semi-diurnal (two highs and two lows each day), but with increasing importance of the diurnal (once per day) inequality at the southern and northern extremities of the NWS.

[1] http://www.bom.gov.au/jsp/ncc/climate_averages/temperature/index.jsp, accessed 21 January 2021.

Receptor	Description
	The tide range—represented by the Mean Spring Range (MSR)—increases northwards along the coast from 1.4 m at North-west Cape (Point Murat) to 7.7 m at Broome, before decreasing again (apart from local amplification in King Sound and Collier Bay) to about 5 m off Cape Londonderry. The MSR then increases again through Joseph Bonaparte Gulf and on up 5.5 m at Darwin (RPS, 2016).

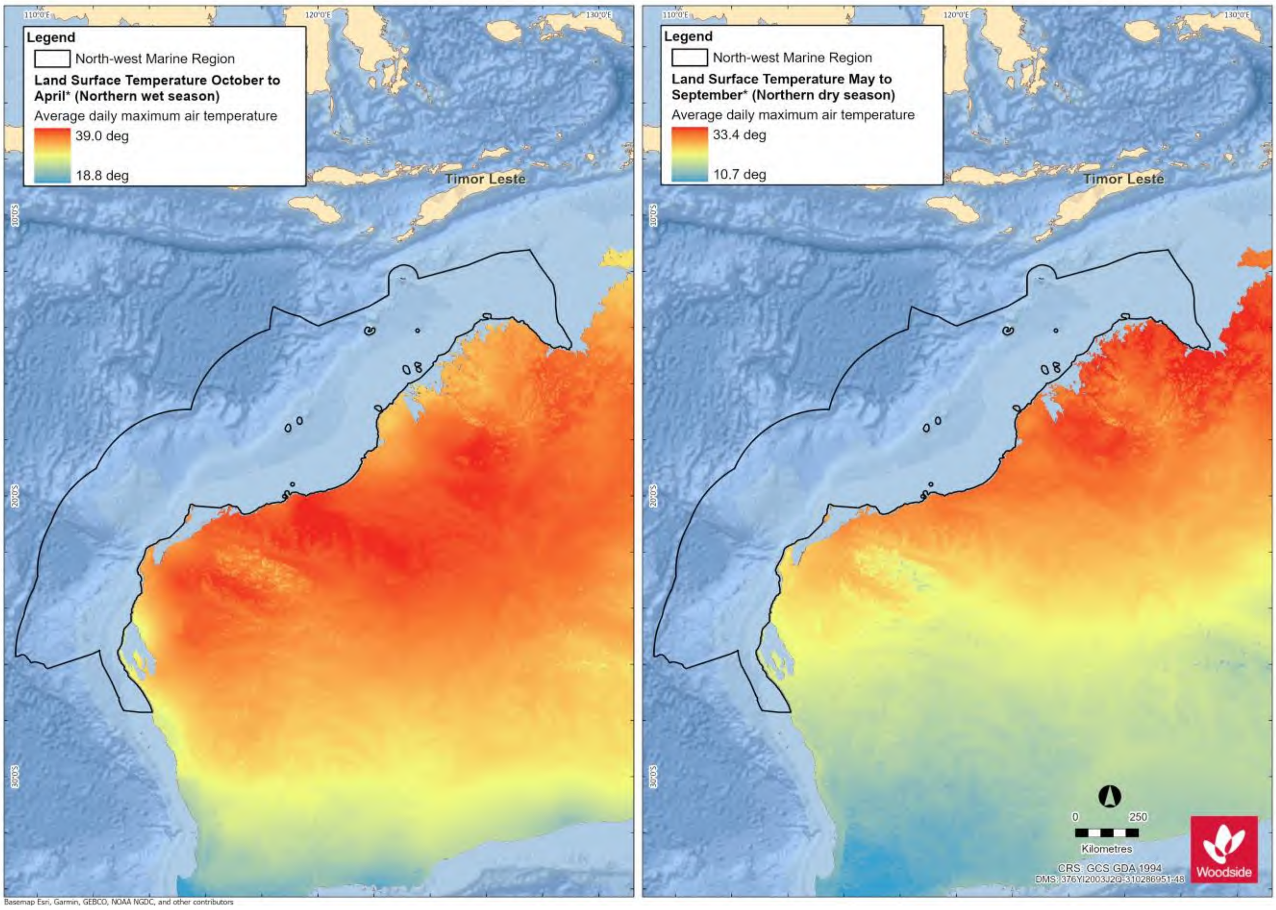

Figure 2-2. Average daily maximum air temperature for land surface adjacent to NWMR: (a) summer (northern wet season) and (b) winter (northern dry season)

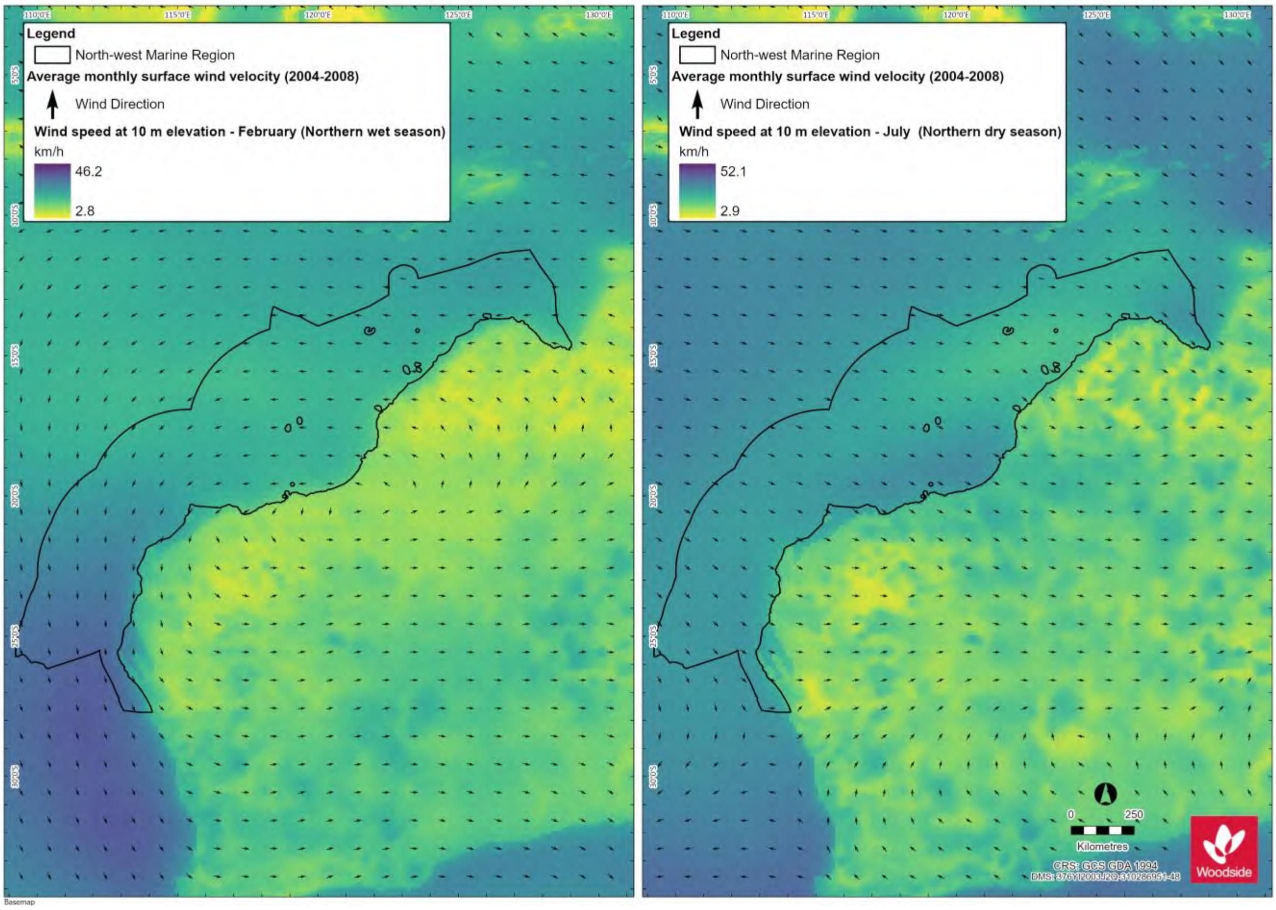

Figure 2-3. Average monthly surface wind direction and velocity for NWMR: (a) summer (February, northern wet season) and (b) winter (July, northern dry season)

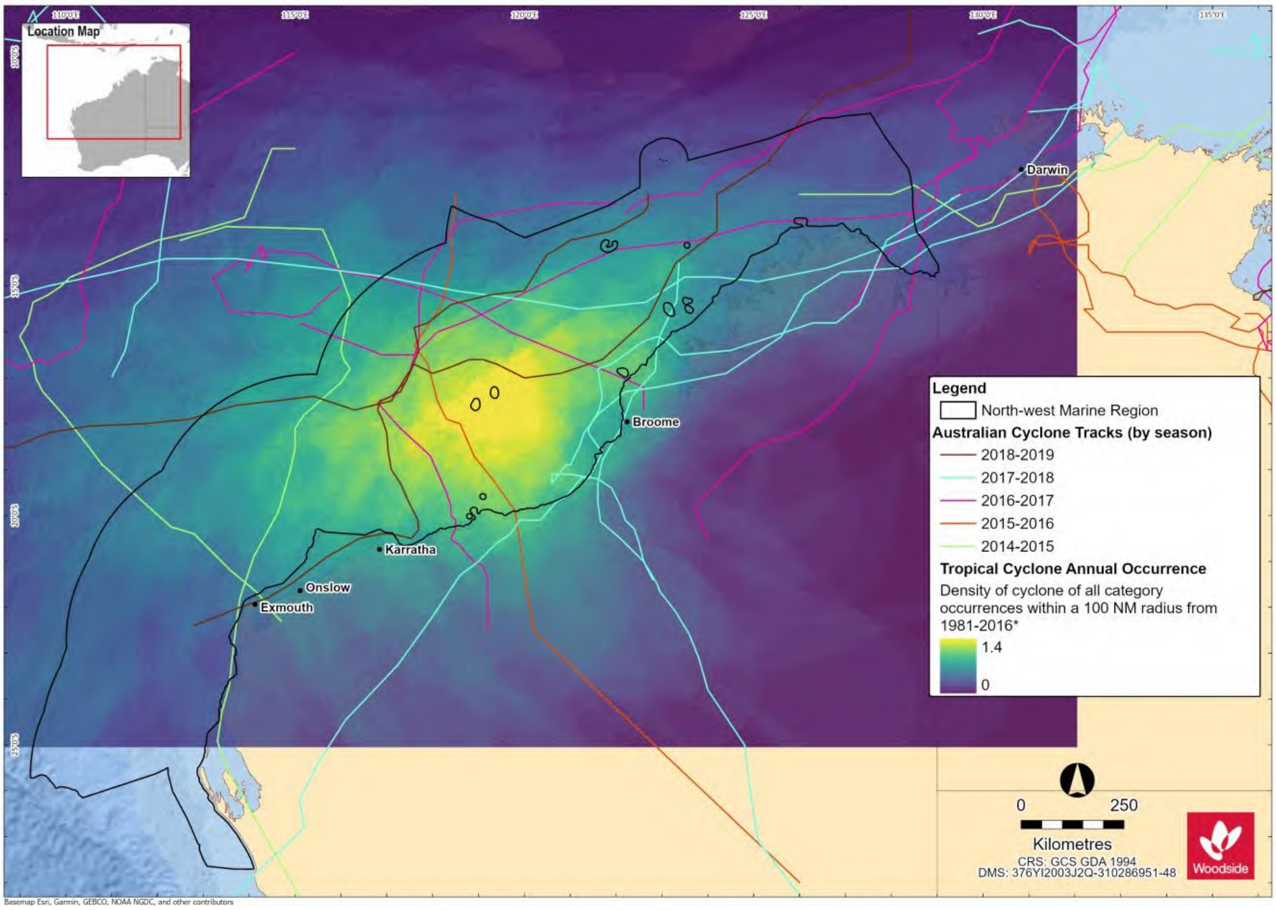

Figure 2-4. Tropical cyclone annual occurrence and cyclone tracks for NWMR

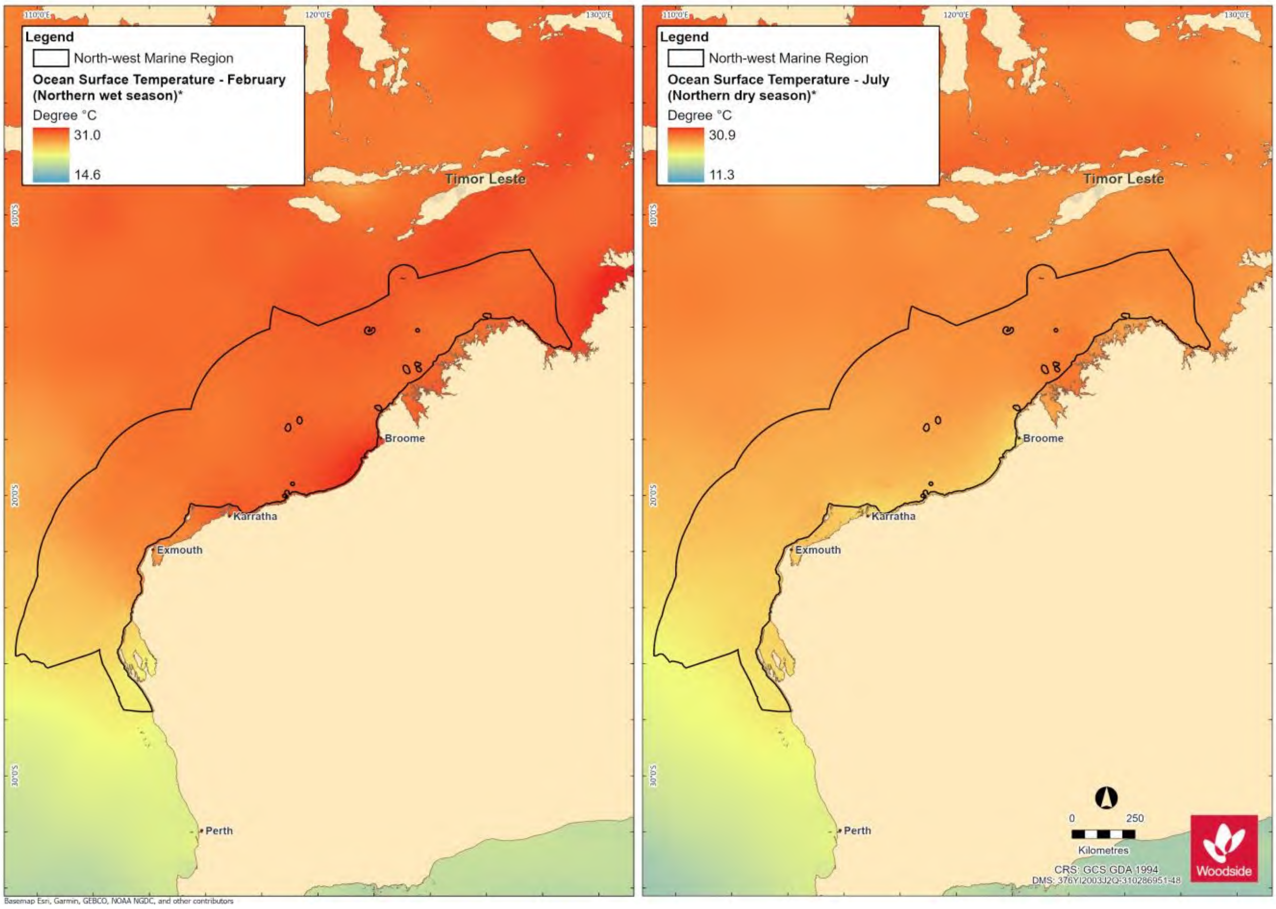

Figure 2-5. Ocean surface temperature for NWMR: (a) summer (February, northern wet season) and (b) winter (July, northern dry season)

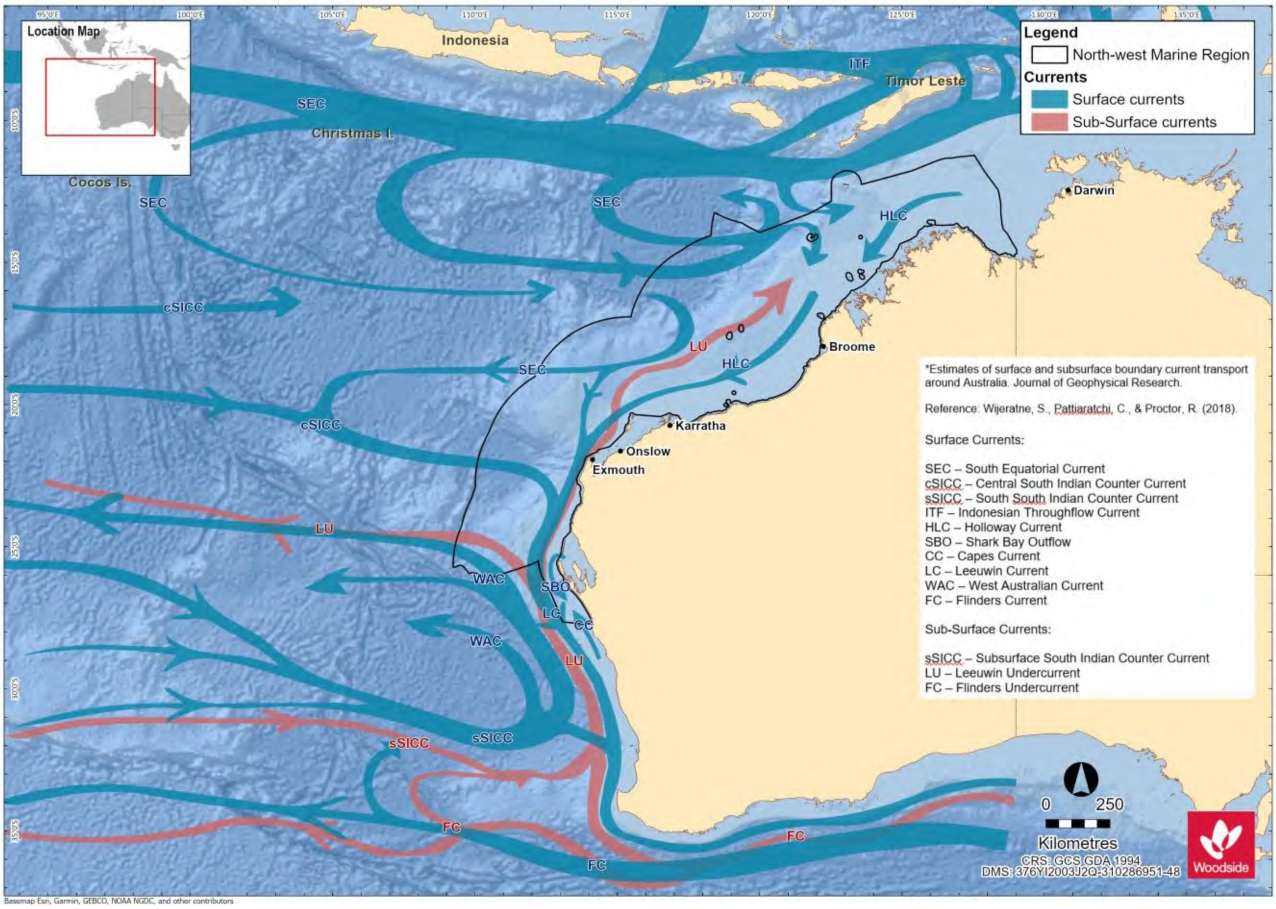

Figure 2-6. Ocean surface and sub-surface currents of the NWMR and wider region

2.3.1 Browse

Table 2-4 Summary meteorology and oceanography for Browse (refer to Appendix B for supporting metocean figures)

Receptor	Description
Meteorology	
Seasonal patterns	The Browse area overlapping the Kimberley marine system experiences tropical monsoon climate with two distinct seasons: the wet season from December to March and dry season from April to November.
Air temperature	The mean annual air temperature recorded at Troughton Island between 2010 and 2020 ranged from 30.1ºC in 2011 to 32.6ºC in 2016 and highest mean monthly air temperatures were recorded for the months of November and December (BOM, 2021b).
Rainfall	Rainfall recorded from Troughton Island in the Browse basin ranged from barely detectable (<1 mm) mean monthly level to >100 mm in December to March, with the highest rainfall recorded for January. Reflecting the wet monsoon season of the Kimberley marine system (BOM, 2021c).
Wind	The dry season experiences high pressure systems that bring east to south-easterly winds with average wind speeds during the season of approximately 16.6 km/hr and maximum wind gusts of 65 km/hr. In contrast the wet season brings predominately westerly winds with average wind speeds approximately 17 km/hr and maximum gusts exceeding 100 km/hr (generally associated with tropical cyclones (MetOcean Engineers, 2005).
Oceanography	
Currents	Surface currents exhibit seasonal directionality, with flow to the south-west during March to June and more variable outside this period (Woodside, 2019). This is consistent with the stronger Leeuwin Current flow during winter months, with more variable currents driven by local wind stress during periods of weaker Leeuwin Current flow.

2.3.2 North West Shelf / Scarborough

Table 2-5 Summary meteorology and oceanography for the North West Shelf and Scarborough (refer to Appendix B for supporting metocean figures)

Receptor	Description
Meteorology	
Seasonal patterns	The NWS and Scarborough areas experience the monsoonal climate of the wider NWMR with a distinct wet and dry seasonal regime and transitions periods between seasons.
Air temperature	Air temperatures as measured at the North Rankin A platform on NWS ranged from a maximum average of 39.5ºC in summer to a minimum average temperature of 15.6ºC in winter (Woodside, 2012).
Rainfall	Rainfall patterns annually reveal the wet season with highest rainfalls during the late summer, often associated with the passage of tropical low-pressure systems and cyclones. Rainfall in the dry season is typically extremely low. (Pearce *et al.* 2003).
Wind	Winds are typically from the southwest during the wet season (summer) and tending from the south-east during the dry season (winter). The summer south-westerly winds are driven by high pressure cells that pass from west to east over the Australian continent. During the winter period, the relative position of the high-pressure cells shifts further north, leading to prevailing south-easterly winds from the mainland (Pearce *et al.* 2003).
Oceanography	
Currents	The large-scale ocean currents of the NWMR, primarily the Indonesian Throughflow and Leeuwin Current (and Holloway Current), are the primary influence on the NWS and Scarborough areas. The ITF and Leeuwin Current are strongest during the late summer and winter and flow reversals to the north-east, typically short-lived and weak, when there are strong south-westerly winds can generate localised upwelling on the shelf edge (Holloway and Nye, 1985; James *et al.* 2004 and Condie *et al.* 2006).

2.3.3 North-west Cape

Table 2-6 Summary meteorology and oceanography for the North-west Cape (refer to Appendix B for supporting metocean figures)

Receptor	Description
Meteorology	
Seasonal patterns	The climate of the NWMR is dry tropical exhibiting a hot summer season and a mild winter season. There are often distinct transition periods between the summer and winter regimes, characterised by periods of relatively low winds.
Air temperature	Air temperatures in the North-west Cape area range from high summer temperatures (maximum average of 37.5ºC) and mild winter temperatures (minimum average of 12.2ºC).
Rainfall	Rainfall typically occurs during the summer, with highest rainfall during later summer and autumn, often associated with the passage of tropical low-pressure systems and cyclones. Rainfall is typically low in winter.
Wind	Winds vary seasonally, generally from the south-west quadrant during summer months and the south, south-east quadrant during the autumn and winter months. The summer south-westerly winds are driven by high pressure cells that pass from west to east over the Australian continent. Winds typically weaken and are more variable during the transitional period between the summer and winter seasons, generally between April to August.
Oceanography	
Currents	Surface currents exhibit seasonal directionality, with flow to the south-west during March to June and more variable outside this period (Woodside, 2016). This is consistent with the stronger Leeuwin Current flow during winter months, with more variable currents driven by local wind stress during periods of weaker Leeuwin Current flow.

2.4 Physical Environment of NWMR

Based on the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) Version 4.0, there are eight provincial bioregions that occur within the NWMR, which are based on patterns of demersal fish diversity, benthic habitat and oceanographic data (Commonwealth of Australia, 2006), **Figure 2-7**. Of the eight provincial bioregions that occur within the NWMR, these include four offshore (~65% of total NWMR area) and four shelf (~35% of total NWMR area) bioregions (Baker *et al.,* 2008).

The NWMR is a tropical carbonate margin that comprises an extensive area of shelf, slope and abyssal plain/deep ocean floor, as well as complex areas of bathymetry such as plateau, terraces and major canyons (Harris *et al.*, 2005). A series of reefs are located on the outer shelf/slope of the NWMR, including Ashmore, Cartier, Scott and Seringapatam reefs (Baker *et al*., 2008). The distribution of seafloor geomorphic features has been systematically mapped over much of the Australian margin and adjacent seafloor. The mapped area can be divided into 10 geomorphic regions, of which the NWMR overlays two; the Western Margin and Northern Margin (Harris *et al.*, 2005). Most of the region consists of either continental slope (61%) or continental shelf (28%) (DEWHA, 2007a) with more than 40% of the NWMR having a water depth less than 200 m. The shallow shelf is contrasted by features such as the Cuvier and Argo abyssal plains, which reach depths more than five kilometres. A unique feature of the region is the significant narrowing of the continental shelf around North-west Cape (approximately 7 km wide) from the broad continental shelf in the north of the region (approximately 400 km wide at Joseph Bonaparte Gulf) (DEWHA, 2007a), **Figure 2-8.**

The geological history of the region, as well as its geomorphology and oceanography, has influenced the composition and distribution of sediments (DEWHA, 2007a). The sedimentology of the NWMR is dominated by marine carbonates, which show a broad zoning and fining with water depth. Main trends of the NWMR sediments include a tropical carbonate shelf that is dominated by sand and gravel, an outer shelf/slope zone that is dominated by mud and a relatively homogenous rise and abyssal plain/deep ocean floor that is dominated by non-carbonate mud (Baker *et al.,* 2008), **Figure 2-9**.

The distribution and resuspension of sediments on the inner shelf is strongly influenced by the strength of tides across the continental shelf as well as episodic events such as cyclones. Further offshore, on the mid to outer shelf and on the slope itself, sediment movement is primarily influenced by ocean currents and internal tides (DEWHA, 2007a).

This variation in bathymetry and interactions with oceanographic processes provides a diversity of habitats to marine fauna and flora within the NWMR.

2.5 Air quality

The ambient air quality of all three marine regions is largely unpolluted due to the extent of the open ocean area, the activities currently carried out in each and the relative remoteness of each region.

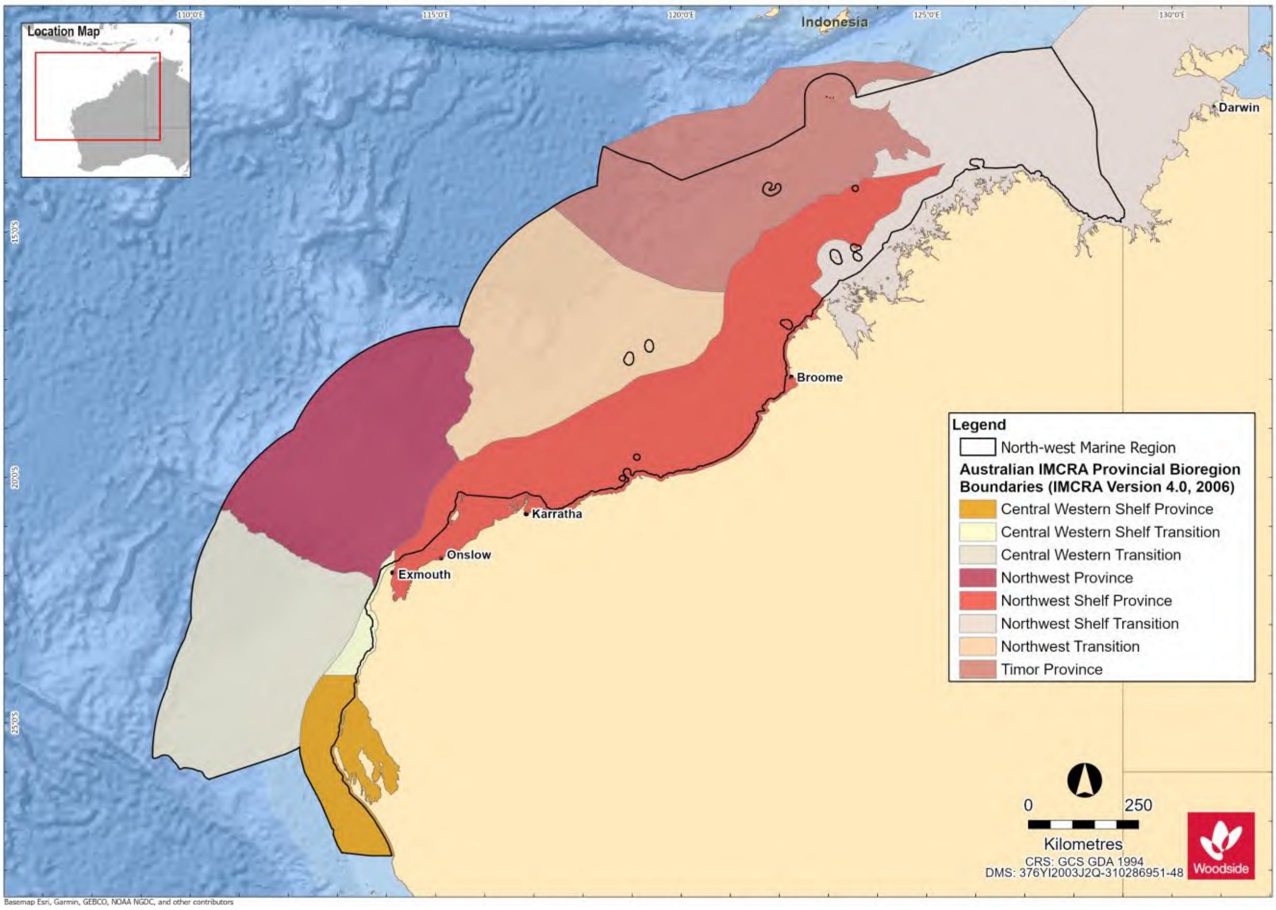

Figure 2-7. The eight provincial bioregions of the NWMR (Commonwealth of Australia, 2006)

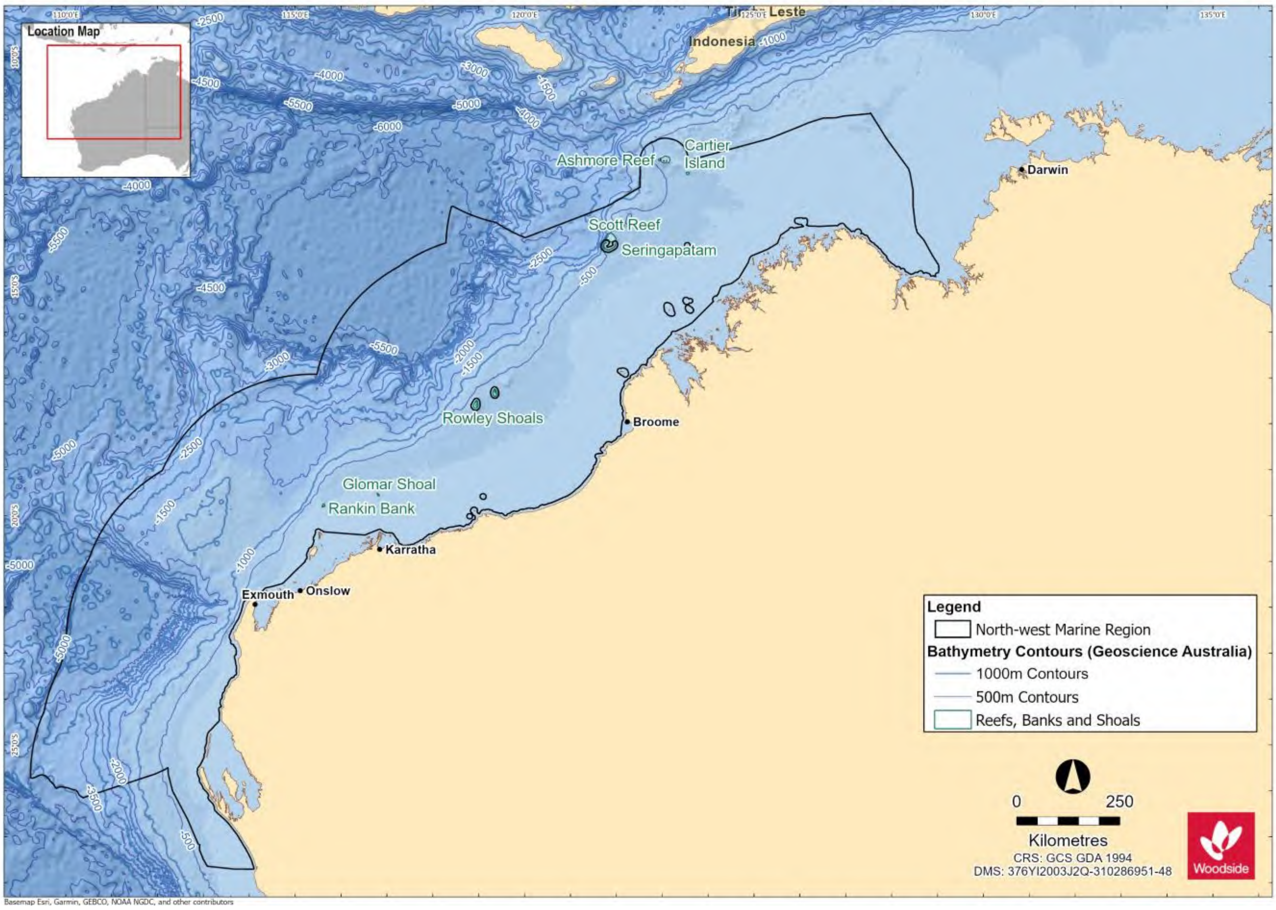

Figure 2-8. Bathymetry of the NWMR

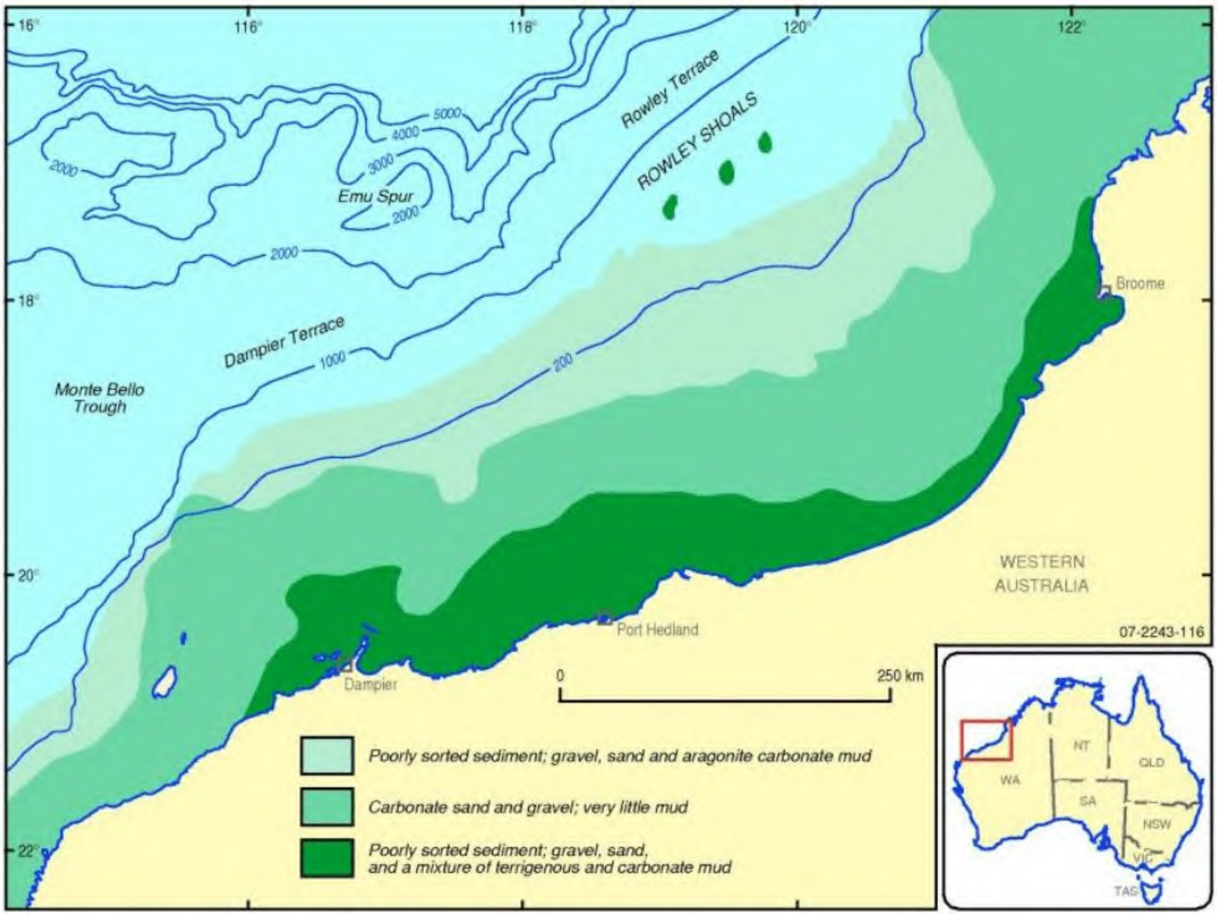

Figure 2-9. Overview of the seabed sediments of the NWMR (Baker *et al*., 2008)

3. MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE (EPBC ACT)

3.1 Summary of Matters of National Environmental Significance (MNES)

This section summarises the matters of national environmental significance (MNES) reported for the three bioregions; NWMR **(Table 3-1),** SWMR (**Table 3-2**) and NMR (**Table 3-3**), based on the Protected Matters search reports (**Appendix A**).

Additional information on these MNES are provided in subsequent sections (referenced below).

Table 3-1 Summary of MNES identified by the EPBC Act Protected Matters Search Tool (PMST) as potentially occurring within the NWMR

MNES	Number	Description	Section of this Document
World Heritage Properties	2	Shark Bay The Ningaloo Coast	**Section 10**
National Heritage Places	5	Shark Bay The Ningaloo Coast The West Kimberley The Dampier Archipelago (including Burrup Peninsula) Dirk Hartog Landing Site 1616	**Section 10**
Wetlands of International Importance (Ramsar)	3	Ashmore Reef National Nature Reserve Eighty Mile Beach Roebuck Bay[1]	**Section 10**
Commonwealth Marine Area	2	EEZ and Territorial Sea Key Ecological Features (KEFs) Australian Marine Parks (AMPs) Australian Whale Sanctuary Extended Continental Shelf	**Section 9** **Section 10**
Listed Threatened Ecological Communities	1	Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	Terrestrial community and not considered further
Listed Threatened Species	70	Refer NWMR PMST report (**Appendix A**)	**Section 5 – Section 8**
Listed Migratory Species	84	Refer NWMR PMST report (**Appendix A**)	**Section 5 – Section 8**

[1] *Roebuck Bay is a designated Wetland of International Importance (Ramsar site), which was not included in the PMST Report (**Appendix A**).*

Table 3-2 Summary of MNES identified by the EPBC Act Protected Matters Search Tool (PMST) as potentially occurring within the SWMR

MNES	Number	Description	Section of this Document
World Heritage Properties	0	N/A	N/A
National Heritage Places	3	Cheetup Rock Shelter Batavia Shipwreck Site and Survivor Camps Area 1629 – Houtman Abrolhos HMAS Sydney II and HSK Kormoran Shipwreck Sites	**Section 10**
Wetlands of International Importance (Ramsar)	4	Becher Point Wetlands Forrestdale and Thomsons Lakes Peel-Yalgorup System Vasse-Wonnerup System	**Section 10**
Commonwealth Marine Area	2	EEZ and Territorial Sea KEFs AMPs Australian Whale Sanctuary Extended Continental Shelf	**Section 9** **Section 10**
Listed Threatened Ecological Communities	3	Banksia Woodlands of the Swan Coastal Plain ecological community Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community	Terrestrial communities and not considered further
Listed Threatened Species	65	Refer SWMR PMST report (**Appendix A**)	N/A
Listed Migratory Species	67	Refer SWMR PMST report (**Appendix A**)	N/A

Table 3-3 Summary of MNES identified by the EPBC Act Protected Matters Search Tool (PMST) as potentially occurring within the NMR

MNES	Number	Description	Section of this Document
World Heritage Properties	0	N/A	N/A
National Heritage Places	0	N/A	N/A
Wetlands of International Importance (Ramsar)	0	N/A	N/A
Commonwealth Marine Area	2	EEZ and Territorial Sea KEFs AMPs Australian Whale Sanctuary Extended Continental Shelf	**Section 9** **Section 10**
Listed Threatened Ecological Communities	0	N/A	N/A
Listed Threatened Species	33	Refer NMR PMST report (**Appendix A**)	N/A
Listed Migratory Species	70	Refer NMR PMST report (**Appendix A**)	N/A

3.2 Part 13 Statutory Instruments for EPBC Act Listed Threatened and Migratory Species in the NWMR, SWMR and NMR

A screening process was conducted to identify which EPBC Act listed threatened and migratory species, and associated Part 13 statutory instruments, are relevant in the context of the assessment of impacts and risks associated with petroleum activities in each of the Woodside activity areas, using the following criteria:

- overlap between the Woodside activity areas with habitat critical for the survival of marine turtles, and with BIAs (overlapping the marine environment) for any listed threatened species as reported in the PMST searches;
- published literature, unpublished reports and/or credible anecdotal information (e.g. feedback from stakeholders) indicating species presence/occurrence within the Woodside activity areas;
- temporal overlap between the likely timing of petroleum activities and peak periods for key behaviours (e.g. breeding, nesting, calving, resting, foraging, migration); and
- environmental aspects associated with petroleum activities have been identified as a key threat to a species in a Part 13 statutory instrument (e.g. anthropogenic noise, light emissions, marine debris).

Relevant EPBC Act threatened and migratory species and their Part 13 statutory instruments are listed in **Table 3-4**. For the full list of EPBCA Act listed species for each marine bioregion refer to the PMST reports (**Appendix A**).

Table 3-4 Summary of MNES identified by the EPBC Act Protected Matters Search Tool (PMST) to be considered for impact or risk evaluation for Woodside operations

Species	EPBC Act Part 13 Statutory Instrument
All vertebrate marine fauna	Threat Abatement Plan for the impacts of marine debris on vertebrate marine life (Commonwealth of Australia, 2018)
Marine Mammals	
Blue whale	Conservation Management Plan for the Blue Whale: A Recovery Plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2015–2025 (Commonwealth of Australia, 2015a)
Southern right whale	Conservation Management Plan for the Southern Right Whale: A Recovery Plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2011–2021 (DSEWPAC, 2012d)
Sei whale	Conservation Advice *Balaenoptera borealis* sei whale (Threatened Species Scientific Committee, 2015a)
Humpback whale	Conservation Advice *Megaptera novaeangliae* humpback whale (Threatened Species Scientific Committee, 2015b)
Fin whale	Conservation Advice *Balaenoptera physalus* fin whale (Threatened Species Scientific Committee, 2015c)
Australian sea lion	Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) 2013 (DSEWPAC, 2013a) (due to expire in October 2023) Conservation Advice *Neophoca cinerea* Australian Sea Lion (Threatened Species Scientific Committee, 2020a) (in effect under the EPBC Act from 23-Dec-2020)
Marine Reptiles	
All marine turtle species (loggerhead, green, leatherback, hawksbill, flatback, olive ridley)	Recovery Plan for Marine Turtles in Australia 2017-2027 (Commonwealth of Australia, 2017)
Short-nosed sea snake	Approved Conservation Advice for *Aipysurus apraefrontalis* (Short-nosed Sea Snake) (DSEWPAC, 2011a)
Leaf-scaled sea snake	Approved Conservation Advice for *Aipysurus foliosquama* (Leaf-scaled Sea Snake) (DSEWPAC, 2011b)
Fishes, Sharks, Rays and Sawfishes	
Grey nurse shark (west coast population)	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) 2014 (DOE, 2014)
White shark	Recovery Plan for the White Shark (*Carcharodon carcharias*) 2013 (DSEWPAC, 2013b)
Whale shark	Conservation Advice *Rhincodon typus* whale shark (Threatened Species Scientific Committee, 2015d)
All sawfishes (largetooth, green, dwarf, speartooth, narrow)	Sawfish and River Sharks Multispecies Recovery Plan (Commonwealth of Australia, 2015b)

Species	EPBC Act Part 13 Statutory Instrument
Seabirds	
Migratory seabird species	Draft Wildlife Conservation Plan for Migratory Seabirds (Commonwealth of Australia, 2019)
Southern giant petrel	National recovery plan for threatened albatrosses and giant petrels 2011–2016 (DSEWPAC, 2011c)
Indian yellow-nosed albatross	National recovery plan for threatened albatrosses and giant petrels 2011–2016 (DSEWPAC, 2011c)
Abbott's booby	Conservation Advice for the Abbott's booby - *Papasula abbotti* (Threatened Species Scientific Committee, 2020b)
Australian fairy tern	Approved Conservation Advice for *Sterna nereis nereis* (Fairy Tern) (DSEWPAC, 2011d)
Australian lesser noddy	Conservation Advice *Anous tenuirostris melanops* Australian lesser noddy (Threatened Species Scientific Committee, 2015e)
Soft-plumaged petrel	Conservation Advice *Pterodroma mollis* soft-plumaged petrel (Threatened Species Scientific Committee, 2015f)
Shorebirds	
Migratory shorebird species	Wildlife Conservation Plan for Migratory Shorebirds (Commonwealth of Australia, 2015c)
Eastern curlew, far eastern curlew	Conservation Advice *Numenius madagascariensis* eastern curlew (DOE, 2015a)
Curlew sandpiper	Conservation Advice *Calidris ferruginea* curlew sandpiper (DOE, 2015b)
Great knot	Conservation Advice *Calidris tenuirostris* Great knot (Threatened Species Scientific Committee, 2016a)
Red knot, knot	Conservation Advice *Calidris canutus* Red knot (Threatened Species Scientific Committee, 2016b)
Bar-tailed godwit (*menzbieri*)	Conservation Advice *Limosa lapponica menzbieri* Bar-tailed godwit (northern Siberia) (Threatened Species Scientific Committee, 2016c)
Greater sand plover	Conservation Advice *Charadrius leschenaultii* Greater sand plover (Threatened Species Scientific Committee, 2016d)
Lesser sand plover	Conservation Advice *Charadrius mongolus* Lesser sand plover (Threatened Species Scientific Committee, 2016e)

4. HABITAT AND BIOLOGICAL COMMUNITIES

4.1 Regional context

The NWMR habitats range from nearshore benthic primary producer habitats such as seagrass beds, coral communities and mangrove forests, to offshore soft sediment seabed habitats and submerged and emergent reef systems. These habitats support biological communities that range from low density sessile and mobile benthos, such as sponges, molluscs and echinoids (with noted areas of sponge hotspot diversity) in offshore soft sediment habitat (DSEWPAC, 2012a) to complex, diverse, remote coral reef systems.

Benthic primary producer habitats, such as seagrass beds, coral communities and mangrove forests within the SWMR, are described as a mixture of tropical and temperate species, due to the seasonal influences of the tropical waters carried south by the Leeuwin Current and the temperate waters carried north by the Capes Current (DSEWPAC, 2012b).

The NMR shares similar habitat types to the NWMR. The predominant habitat of the region includes soft muddy sediments on relatively flat terrain. Other habitat types include seagrasses, reefs, shoals and coastal habitats such as mangroves and coastal wetlands (Rochester *et al.*, 2007).

The summary of key habitats and biological communities provided in the following sub-sections is focused on the primary features of relevance to the activity areas within the NWMR – primarily the offshore habitats of the continental shelf and slope, submerged shoals and banks, and remote oceanic reef systems of recognised conservation value.

4.2 Biological Productivity of NWMR

Primary productivity of the NWMR is generally low and appears to be largely driven by offshore influences (Brewer *et al.*, 2007), with periodic upwelling events and cyclonic influences driving coastal productivity with nutrient recycling and advection. Seasonal weather patterns also influence the delivery of nutrients from deep-water to shallow water. Cyclones and north-westerly winds during the North-west monsoon (approximately November–March) and the strong offshore winds of the South-east monsoon (approximately April–September) facilitate the upwelling and mixing of nutrients from deep-water to shallow water environments (Brewer *et al.*, 2007).

The Indonesian Throughflow (ITF) has an important effect on productivity in the northern areas of the Region. Generally, its deep, warm and low nutrient waters suppress upwelling of deeper comparatively nutrient-rich waters, thereby forcing the highest rates of primary productivity to occur at depths associated with the thermocline. When the ITF is weaker, the thermocline lifts bringing deeper, more nutrient-rich waters into the photic zone and hence resulting in conditions favourable to increased productivity (DEWHA, 2007a). Similarly, the Leeuwin Current has a significant role in determining primary productivity in the southern areas of the NWMR. As with the ITF, the overlying warm oligotrophic waters of the Leeuwin Current suppress upwelling. A subsurface chlorophyll maximum is therefore formed at a depth in the water column where nutrients and light are sufficient for photosynthesis to proceed. Seasonal changes in the strength of the Leeuwin Current influence primary productivity levels and seasonal interactions between the Leeuwin and Ningaloo currents in the south of the NWMR are believed to be particularly important (DEWHA, 2007a).

Internal tides (defined as internal waves generated by the barotropic tide) are a striking characteristic of many parts of the NWMR and are associated with highly stratified water columns. Internal waves (solitons), which can raise cooler, generally more nutrient rich water higher in the water column, are generated between water depths of 400 m and 1000 m where bottom topography results in a significant change in water depth over a relatively short distance. Cyclones are episodic events in the NWMR that contribute to spikes in productivity through enrichment of surface water layers due to enhanced vertical mixing of the water column. Temporary increases in primary productivity as a result of cyclones generally last between one and two weeks, and it is believed that the impacts of cyclones are generally limited to waters less than 100 m deep and affect benthic communities more substantially than pelagic systems (DEWHA, 2007a).

Water depth also has a significant overriding influence over productivity in the marine environment, due to its influence on light availability. This is reflected by distinct onshore and offshore assemblages of major pelagic groups of phytoplankton, microzooplankton, mesoplankton and ichthyoplankton. Productivity booms are thought to be triggered by seasonal changes to physical drivers or episodic events, as detailed above, which result in rapid increases in primary production over short periods, followed by extended periods of lower primary production. The trophic systems in the NWMR are able to take advantage of blooms in primary production, enabling nutrients generated to be used by different groups of consumers over long periods (DEWHA, 2007a).

Little detailed information is available about the trophic systems in the NWMR. The utilisation of available nutrients is thought to differ between pelagic and benthic environments, influenced by water depth and vertical migration of some species groups in the water column. In the pelagic system, it is thought that approximately half of the nutrients available are utilised by microzooplankton (e.g. protozoa) with the remainder going to macro/meso-zooplankton (e.g. copepods). As primary and secondary consumers, gelatinous zooplankton (e.g. salps, coelenterates) and jellyfish are thought to play an important role in the food web, contributing a significant proportion of biomass in the marine system during and for periods after booms in primary productivity. Salps are semi-transparent, barrel-shaped marine animals that can reproduce quickly in response to bursts in primary productivity and provide a food source for many pelagic fish species (DEWHA, 2007a).

4.3 Planktonic Communities in the NWMR

The NWMR has two distinct phytoplankton assemblages; a tropical oceanic community in offshore waters and a tropical shelf community confined to the NWS (Hallegraeff, 1995). MODIS (Moderate Resolution Imaging Spectrometer) satellite datasets from the NWMR indicates that chlorophyll (and thus phytoplankton) levels are low in summer months (December to March) and higher in the winter months (Schroeder *et al.*, 2009). Low chlorophyll levels during summer months may be a result of lower plankton productivity during the wet season or lower nutrient inputs from warm surface waters dominant during summer. However, it is likely that much of the primary production is taking place below the surface, where the MODIS imagery does not penetrate (Schroeder *et al.*, 2009). The winter months are relatively cloud free and surface chlorophyll is high throughout most of the region.

Zooplankton and may include organisms that complete their lifecycle as plankton (e.g. copepods, euphausiids) as well as larval stages of other taxa such as fishes, corals and molluscs. Peaks in zooplankton such as mass coral spawning events (typically in March and April) (Rosser and Gilmour, 2008) and fish larvae abundance (CALM, 2005a) can occur throughout the year. Spatial and temporal patterns in the distribution and abundance of macro-zooplankton on the North-west Shelf are influenced by sporadic climatic and oceanographic events, with large inter-annual changes in assemblages (Wilson *et al.*, 2003). Amphipods, euphausiids, copepods, mysids and cumaceans are among the most common components of the zooplankton in the region (Wilson *et al.*, 2003).

4.3.1 Browse

Phytoplankton within the Browse activity area is expected to reflect the conditions of the NWMR. There is a tendency for offshore phytoplankton communities in the NWMR to be characterised by smaller taxa (e.g. bacteria), whereas shelf waters are dominated by larger taxa such as diatoms (Hanson *et al.*, 2007).

Zooplankton within the activity area may include organisms that complete their lifecycle as plankton (e.g. copepods, euphausiids) as well as larval stages of other taxa such as fishes, corals and molluscs. Peaks in zooplankton such as mass coral spawning events (typically in March and April) (Rosser and Gilmour, 2008; Simpson *et al.*, 1993) and fish larvae abundance (CALM, 2005a) can occur throughout the year.

The influence of the Indonesian Throughflow restricts upwelling across the Kimberley System (approximately equates to the Browse activity area). However, small-scale topographically associated current movements and upwellings are thought to occur, which inject nutrients into specific locations within the system and result in ‘productivity hot-spots’. Similarly, internal waves, generated at the shelf break (e.g. west of Browse Island and around submerged cliffs) play a role in making nutrients available in the photic zone. Productivity within shallow nearshore waters is driven primarily by tidal movement and terrestrial runoff whereby nutrients are mixed by tidal action and new inputs of organic matter come from the land.

4.3.2 North-west Shelf / Scarborough

Plankton communities within the NWS / Scarborough activity area are expected to reflect conditions of the NWMR. Within the Pilbara system of the NWMR (approximately equates to the NWS / Scarborough activity area). Internal tides along the NWS and Exmouth Plateau result in the drawing of deeper cooler waters into the photic zone, stirring up nutrients and triggering primary productivity. Broadly the greatest productivity within this sub-system is found around the 200 m isobath associated with the shelf break.

4.3.3 North-west Cape

Waters of the North-west Cape experience a relatively high diversity of phytoplankton groups including diatoms, coccolithophorids and dinoflagellates. During the warmer months blooms of *Trichodesmium* occur in the region, these have been observed particularly on the frontal systems around Point Murat (Heyward *et al*., 2000).

Average Leeuwin Current phytoplankton biomass is characteristic of low productivity oceanic waters like the Indian, Pacific and Atlantic Oceans (Hanson *et al.*, 2005). However, the Canyons linking the Cuvier Abyssal Plain and Cape Range Peninsula KEF are connected to the Commonwealth waters adjacent to Ningaloo Reef, and may also have connections to Exmouth Plateau. The canyons are thought to interact with the Leeuwin Current to produce eddies inside the heads of the canyons, resulting in waters from the Antarctic intermediate water mass being drawn into shallower depths and onto the shelf (Brewer *et al.* 2007). These waters are cooler and richer in nutrients and strong internal tides may also aid upwelling at the canyon heads (Brewer *et al.* 2007). The narrow shelf width (about 10 kilometres) near the canyons facilitates nutrient upwelling and relatively high productivity. This high primary productivity leads to high densities of primary consumers, such as micro and macro-zooplankton, such as amphipods, copepods, mysids, cumaceans, euphausiids (Brewer *et al.*, 2007).

4.4 Habitats and Biological Communities in the NWMR

4.4.1 Offshore Habitats and Biological communities

The NWMR has a large area of continental shelf and continental slope, with a range of bathymetric features such as canyons, plateaus, terraces, ridges, reefs, banks and shoals. The marine environment in this region is typified by tropical to sub-tropical marine ecosystems with diverse habitats from soft sediments, canyons, remote coral reefs and limestone pavement.

The key habitats and biological communities representative of the broader NWMR are summarised in **Table 4-1**.

The key habitats and biological communities representative of the broader SWMR and NMR are summarised in **Table 4-2** and **Table 4-3**.

4.4.2 Shoreline habitats and biological communities

The NWMR encompasses offshore and coastal waters, islands and mainland shoreline habitats typified by mangroves, tidal flats, saltmarshes, sandy beaches, and smaller areas of rocky shores. Each of these shoreline types has the potential to support different flora and fauna assemblages due to the different physical factors (e.g. waves, tides, light, etc.) influencing the habitat.

The key shoreline habitats representative of the broader NWMR are summarised in **Table 4-1**.

The key shoreline habitats representative of the broader SWMR and NMR are summarised in **Table 4-2** and **Table 4-3**.

Table 4-1 Habitats and biological communities within the NWMR

Habitat/Community	Browse	NWS / Scarborough	North-west Cape	Reference
Offshore habitats and biological communities				
Soft sediment with infauna	The offshore environment of the NWMR comprises predominately of seabed habitats dominated by soft sediments (sandy and muddy substrata with occasional patches of coarser sediments) and sparse benthic biota. The benthic communities inhabiting the predominantly soft, fine sediments of the offshore habitats are characterised by infauna such as polychaetes, and sessile and mobile epifauna such as crustacea (shrimp, crabs and squat lobsters) and echinoderms (starfish, cucumbers).The density of benthic fauna is typically lower in deep-sea sediment habitats (greater than 200 m) than in shallower coastal sediment habitats, but the diversity of communities may be similar.			
Soft sediment with hard substrate outcropping	A unique seafloor feature combining both soft sediment and hard substrates, including outcrops, terraces, continental slope, and escarpments. This habitat is found in offshore areas of the NWMR, often associated with key ecological features such as the Ancient coastline at 125 m depth contour KEF.			**Section 9**
	Ancient Coastline at 125 m Depth Contour KEF Continental Slope Demersal Fish Communities KEF	Ancient Coastline at 125 m Depth Contour KEF Continental Slope Demersal Fish Communities KEF	Ancient Coastline at 125 m Depth Contour KEF Continental Slope Demersal Fish Communities KEF	**Section 9**
Coral Reef	Coral reef habitats within the NWMR have a high species diversity that includes corals, and associated reef species such as fishes, crustaceans, invertebrates, and algae. Coral reef habitats of the offshore environment of the NWMR include remote oceanic reef systems, large platform reefs, submerged banks and shoals.			
	Browse Island Scott Reef Seringapatam Reef Ashmore Reef Cartier Island Hibernia Reef	Rowley Shoals (including Mermaid Reef, Clerke Reef, Imperieuse Reef) Glomar Shoal Rankin Bank	-	**Section 10**
Seagrass and Macroalgae communities	Seagrass beds and benthic macroalgae reefs are a main food source for many marine species and also provide key habitats and nursery grounds (Heck Jr. *et al.*, 2003; Wilson *et al.*, 2010). In the northern half of Western Australia, these habitats are restricted to sheltered and shallow waters, including around offshore reef systems, due to large tidal movement, high turbidity, large seasonal freshwater run-off and cyclones.			
	Scott Reef Seringapatam Reef Ashmore Reef	Rowley Shoals (including; Mermaid Reef, Clerke Reef, Imperieuse Reef)		**Section 10**
Filter Feeders/ heterotrophic	Filter feeder epifauna such as sponges, ascidians, soft corals and gorgonians are animals that feed by actively filtering suspended matter and food particles from water, by passing the water over specialised filtration structures (DEWHA, 2008). Filter feeders generally live in areas that have strong currents and hard substratum, often associated with deeper environments of the shoals and banks in the offshore NWMR.			
	Lower outer reef slopes of the oceanic reef	Glomar Shoal Rankin Bank	Cape Range canyon system	**Section 10**

Habitat/Community	Browse	NWS / Scarborough	North-west Cape	Reference
	systems such as Scott Reef	Ancient coastline at 125 m depth contour KEF		
Sandy Beaches	Sandy beaches are dynamic environments, naturally fluctuating in response to external forcing factors (e.g. waves, currents, etc). Sandy beaches vary in length, width and gradient, and in sediment type, composition, and grain size throughout the NWMR, being found around islands and reefs in the offshore areas of the region.			
	Browse Island Scott Reef (Sandy Islet) Ashmore Reef Cartier Island	Montebello Islands Lowendal Islands Barrow Island	Muiron Islands	**Section 10**
Nearshore/coastal habitats and biological communities				
Coral Reef	Coral reef habitats typically found in nearshore regions of the NWMR include the fringing reefs around coastal islands and the mainland shore.			
	Kimberley East Holothuria and Long reefs Bonaparte and Buccaneer Archipelagos Montgomery Reef Adele complex (Beagle, Mavis, Albert, Churchill reefs, Adele Island)	Dampier Archipelago Montebello, Lowendal and Barrow Island Groups	Ningaloo Reef Exmouth Gulf Shark Bay	**Section 10**
Seagrass and Macroalgae communities	Seagrass beds and benthic macroalgae reefs are a main food source for many marine species and also provide key habitats and nursery grounds (Heck Jr. *et al.*, 2003; Wilson *et al.*, 2010). In the nearshore areas of the NWMR, these habitats are restricted to sheltered and shallow waters due to large tidal movement, high turbidity, large seasonal freshwater run-off and cyclones. These areas include in bays and sounds and around reef and island groups.			
	King Sound	Roebuck Bay Dampier Archipelago Montebello, Lowendal and Barrow Island Groups	Ningaloo Reef Exmouth Gulf Shark Bay	**Section 10**
Filter Feeders/ heterotrophic	Filter feeder epifauna such as sponges, ascidians, soft corals and gorgonians are animals that feed by actively filtering suspended matter and food particles from water, by passing the water over specialised filtration structures (DEWHA, 2007a). Filter feeders generally live in areas that have strong currents and hard substratum. Conversely, higher diversity infauna are mainly associated with soft unconsolidated sediment and infauna communities are considered widespread and well represented along the continental shelf and upper slopes of the NWMR. In nearshore areas of the NWMR, these species are generally found around reef systems.			
	-	Deeper habitats of Rankin Bank and Glomar Shoal	Deeper habitats of Ningaloo Reef and the protected sponge zone in the south	

Habitat/Community	Browse	NWS / Scarborough	North-west Cape	Reference
Mangroves	Mangroves grow in intertidal mud and sand, with specially adapted aerial roots (pneumatophores) that provide for gas exchange during low tide (McClatchie *et al.*, 2006). Mangrove forests can help stabilise coastal sediments, provide a nursery ground for many species of fish and crustacean, and provide shelter or nesting areas for seabirds (McClatchie *et al.*, 2006). Mangroves are confined to shoreline habitats, in nearshore areas of the NWMR.			
	Dampier Peninsula (including Carnot Bay, Beagle Bay and Pender Bay)	Pilbara Coastline (including; Ashburton River Delta, Coolgra Point, Robe River Delta, Yardie Landing, Yammadery Island and the Mangrove Islands) Montebello, Lowendal and Barrow Island Groups Roebuck Bay	Shark Bay Mangrove Bay, Cape Range Peninsula Exmouth Gulf	
Saltmarshes	Saltmarshes communities are confined to shoreline habitats and are typically dominated by dense stands of halophytic plants such as herbs, grasses, and low shrubs. The diversity of saltmarsh plant species increases with increasing latitude (in contrast to mangroves). The vegetation in these environments is essential to the stability of the saltmarsh, as they trap and bind sediments. The sediments are generally sandy silts and clays and can often have high organic material content.			
	-	Eighty Mile Beach Roebuck Bay	Shark Bay	
Sandy Beaches	Sandy beaches are dynamic environments, naturally fluctuating in response to external forcing factors (e.g. waves, currents, etc). Sandy beaches vary in length, width and gradient, and in sediment type, composition, and grain size throughout the NWMR. Sandy beaches are important for both resident and migratory seabirds and shorebirds and can also provide an important habitat for turtle nesting and breeding. They are located along many coastlines of the nearshore environments of the NWMR.			
	Cape Domett Lacrosse Island	Eighty Mile Beach Eco Beach Dampier Archipelago Inshore Pilbara Islands (Northern, Middle, and Southern)	Ningaloo coast Muiron Islands Exmouth Gulf	

Table 4-2 Habitats within the SWMR

Habitat/Community	Location
Offshore	
Soft sediment with infauna	Most of the SWMR seafloor is composed of soft unconsolidated sediments, but due to large variations in bathymetry there are marked differences in sedimentary composition and benthic assemblage structure across the region. Despite the prevalence of these habitats in the SWMR, very little is known about the composition or distribution of the region's sedimentary infauna (DEWHA, 2008b)
Soft sediment with hard substrate outcropping	A unique seafloor feature combining both soft sediment and hard substrates, including outcrops, terraces, continental slope, and escarpments.
	Perth Canyon Marine Park Ancient coastline at 90-120 m depth contour KEF Diamantina Fracture Zone Naturaliste Plateau
Coral Reef	To date, studies and understanding of the corals within the SWMR have concentrated on the shallow water areas in State Waters. Within the deeper Commonwealth waters of the SWMR little is known of the distribution of corals.
Filter Feeders/ heterotrophic	Filter feeder epifauna such as sponges, ascidians, soft corals and gorgonians are animals that feed by actively filtering suspended matter and food particles from water, by passing the water over specialised filtration structures (DEWR, 2007). Filter feeders generally inhabit deeper habitat (below the photic zone) that have strong currents and hard substratum
	Ancient coastline at 90-120 m depth Diamantina Fracture Zone Naturaliste Plateau Perth Canyon Marine Park South-west Corner Marine Park
Nearshore	
Coral Reef	The northern extent of the SWMR coincides loosely with the disappearance of abundant and diverse coral from coastal habitats. To the south of Shark Bay, abundant corals occur predominantly around offshore islands, with corals at inshore sites occurring in very isolated patches of non-reef coral communities, usually of reduced species richness.
	Houtman Abrolhos Islands Rottnest Island
Seagrass and Macroalgae communities	Within the SWMR, macroalgae and seagrass communities are noted for their extent, species richness and endemism. The clear waters of the region allow light to reach greater depths, with some species found at much greater depths than usual (down to 120 m) (DEWR, 2007). Of the known species there are more than 1000 species of macro-algae and 22 species of seagrass consisting of tropical and temperate species. Seagrass and macro-algae occur in areas with sheltered bays and in the inter-reef lagoons along exposed sections of the coast.
	Houtman Abrolhos Islands Jurien Marine Park Shoalwater Islands Marine Park Geographe Marine Park Cockburn Sound Rottnest Island

Habitat/Community	Location
	Commonwealth marine environment within and adjacent to the west-coast inshore lagoons KEF Commonwealth marine environment within and adjacent to Geographe Bay KEF Commonwealth marine environment surrounding the Recherche Archipelago KEF
Filter Feeders/ heterotrophic	Filter feeder epifauna such as sponges, ascidians, soft corals and gorgonians are animals that feed by actively filtering suspended matter and food particles from water, by passing the water over specialised filtration structures (DEWR, 2007). Filter feeders generally live in areas that have strong currents and hard substratum.
	Houtman Abrolhos Islands Recherche Archipelago
Mangroves	Mangroves grow in intertidal mud and sand, with specially adapted aerial roots (pneumatophores) that provide for gas exchange during low tide (McClatchie *et al.*, 2006). Mangrove forests can help stabilise coastal sediments, provide a nursery ground for many species of fish and crustacean, and provide shelter or nesting areas for seabirds (McClatchie *et al.*, 2006). Mangroves are confined to shoreline habitats, in nearshore areas of the SWMR.
	Houtman Abrolhos Islands
Sandy Beaches	Sandy beaches within the SWMR are important for both resident and migratory seabirds and shorebirds and can also host breeding populations of the Australian sea lion. They are found along many coastlines of the nearshore environments of the SWMR. In addition to this, beaches in the SWMR provide a variety of socio-economic values including tourism, commercial and recreational fishing, and support other recreational activities.
	Houtman Abrolhos Islands Marmion Marine Park Ngari Capes Marine Park Walpole and Nornalup Inlets Marine Park

Table 4-3 Habitats and Biological Communities within the NMR

Habitat/Community	Location
Offshore habitats and biological communities	
Soft sediment with infauna	Most of the offshore environment of the NMR is characterised by relatively flat expanses of soft sediment seabed. The soft sediments of the region are characterised by moderately abundant and diverse communities of infauna and mobile epifauna dominated by polychaetes, crustaceans, molluscs, and echinoderms.
Soft sediment with hard substrate outcropping	A unique seafloor feature combining both soft sediment and hard substrates, including outcrops, terraces, continental slope, and escarpments. The variability in substrate composition may contribute to the presence of unique ecosystems. Species present include sponges, soft corals and other sessile filter feeders associated with hard substrate sediments.
	Carbonate bank and terrace system of the Van Diemen Rise KEF Pinnacles of the Bonaparte Basin KEF
Coral Reef	Offshore coral reefs within the NMR is generally associated with a series of submerged shoals and banks. The shoals/banks in the region support tropical marine biota consistent with that found on emergent reef systems of the Indo West Pacific region such as Ashmore Reef, Cartier Island, Seringapatam Reef and Scott Reef (Heyward *et al.,* 1997)
	Pinnacles of the Bonaparte Basin KEF Evans Shoal Tassie Shoal Blackwood Shoal
Filter Feeders/ heterotrophic	Filter feeder epifauna such as sponges, ascidians, soft corals and gorgonians are animals that feed by actively filtering suspended matter and food particles from water, by passing the water over specialised filtration structures (DEWHA, 2007b). Filter feeders generally live in areas that have strong currents and hard substratum and typically associated with the deeper habitats of the submerged shoals and banks, and canyon features.
	Carbonate bank and terrace system of the Van Diemen Rise KEF Pinnacles of the Bonaparte Basin KEF Tributary Canyons of the Arafura Depression KEF Evans Shoal Tassie Shoal Goodrich Bank
Nearshore	
Coral Reef	Within the NMR corals occur both as reefs and in non-reef coral communities. Nearshore reefs include patch reefs and fringing reefs sparsely distributed within the region. Coral reefs within the NMR provides breeding and aggregation areas for many fish species including mackerel and snapper and offer refuges for sea snakes and apex predators such as sharks.
	Submerged coral reefs of the Gulf of Carpentaria KEF Darwin Harbour
Seagrass and Macroalgae communities	Seagrasses provide key habitats in the NMR. They stabilise coastal sediments and trap and recycle nutrients. They provide nursery grounds for commercially harvested fish and prawns and provide feeding grounds for dugongs and green turtles. Seagrass distribution in the region is largely associated with sheltered small bays and inlets including shallow waters surrounding inshore islands.
	Field Island The mainland coastline adjacent to Kakadu National Park

Habitat/Community	Location
Filter Feeders/ heterotrophic	Filter feeder epifauna such as sponges, ascidians, soft corals, and gorgonians are animals that feed by actively filtering suspended matter and food particles from water, by passing the water over specialised filtration structures (DEWHA, 2007b). Filter feeders generally live in areas that have strong currents and hard substratum.
	Cape Helveticus
Mangroves	Mangroves grow in intertidal mud and sand, with specially adapted aerial roots (pneumatophores) that provide for gas exchange during low tide (McClatchie *et al.*, 2006). Mangroves provide habitat for waterbirds and support many commercially and recreationally important fish and crustacean species for parts of their life cycles. They buffer the coast from large tidal movements, storm surges and flooding.
	Tiwi Islands Darwin Harbour The mainland coastline adjacent to the Daly River
Sandy Beaches	Sandy beaches vary in length, width and gradient, and in sediment type, composition, and grain size throughout the NMR and are important for both resident and migratory seabirds and shorebirds. Sandy beaches can also provide an important habitat for turtle nesting. They are located along many coastlines of the nearshore environments of the islands and mainland shores of the NMR.
	Tiwi Islands Cobourg Peninsula Joseph Bonaparte Gulf

5. FISHES, SHARKS AND RAYS

5.1 Regional Context

Western Australian waters provide important habitat for listed fishes, sharks, and rays including areas that support key life stages such as breeding, foraging, and migration routes for fish species. Pelagic and demersal fishes occupy a range of habitats throughout each of the regions, from coral reefs to open offshore waters, and are an extremely important component of ecosystems, providing a link between primary production and higher predators, with many species being of conservation value and important for commercial and recreational fishing.

The fish fauna in the NWMR is diverse. Of the approximately 500 shark species found worldwide, 94 are found in the region (DEWHA, 2008). Approximately 54 species of syngnathids (seahorses, seadragons, pipehorses and pipefishes) and one species of solenostomids (ghostpipefishes) are also known to occur in the NWMR or adjacent State waters (DSEWPAC, 2012a).

The fish fauna of the SWMR includes more than 900 species occupying a large variety of habitats. However, only three species of bony fishes known to occur in the region are listed under the EPBC Act as threatened or marine species, and seven listed species of shark (DSEWPAC, 2012b).

The NMR is considered an important area for the sawfish and river shark species group, with five species of sawfishes and river sharks listed under the EPBC Act known to occur in the region (DSEWPAC, 2012c). Approximately 28 species of syngnathids and two species of solenostomids are listed marine and known to occur in the NMR, however there is a paucity of knowledge on the distribution, relative abundance and habitats of these species in the region (DEWHA, 2008).

The following sections focus on the fish species (including sharks and rays) listed as threatened or migratory that are known to occur within the NWMR. In addition, listed, conservation dependent fish and shark species for the NWMR are described. A detailed account of commercial and recreational fisheries that operate in the region is provided in **Section 11**.

Table 5-1 outlines the threatened and migratory fish species that may occur within the NWMR, with their conservation status and relevant recovery plans and/or conservation advice. **Table 5-2** provides information for species of fish that are listed as conservation dependent that may occur within the NWMR, NMR and SWMR. Note that currently there are no approved Conservation Advices in place for any of these five species.

Table 5-1 Fish species (including sharks and rays) identified by the EPBC Act PMST for the NWMR

Species Name	Common Name	*Environment Protection and Biodiversity Conservation Act 1999*			WA *Biodiversity Conservation Act 2016*	EPBC Act Part 13 Statutory Instrument
		Threatened Status	Migratory Status	Listed	Conservation Status	
Rhincodon typus	Whale shark	Vulnerable	Migratory	Marine	Other specially protected fauna	Conservation Advice *Rhincodon typus* whale shark. (Threatened Species Scientific Committee, 2015d)
Carcharias taurus	Grey nurse shark (west coast population)	Vulnerable	N/A	Marine	Vulnerable	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DOE, 2014a)
Carcharodon carcharias	White shark	Vulnerable	Migratory	Marine	Vulnerable	Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPAC, 2013b)
Isurus oxyrinchus	Shortfin mako	N/A	Migratory	Marine	N/A	N/A
Isurus paucus	Longfin mako	N/A	Migratory	Marine	N/A	N/A
Lamna nasus	Porbeagle shark Mackerel shark	N/A	Migratory	Marine	N/A	N/A
Carcharhinus longimanus	Oceanic whitetip shark	N/A	Migratory	Marine	N/A	N/A
Anoxypristis cuspidata	Narrow sawfish	N/A	Migratory	Marine	N/A	N/A
Pristis clavata	Dwarf sawfish	Vulnerable	Migratory	Marine	Priority	Sawfish and River Sharks Multispecies Recovery Plan (Commonwealth of Australia, 2015b)
Pristis pristis	Largetooth (Freshwater) sawfish	Vulnerable	Migratory	Marine	Priority	
Pristis zijsron	Green sawfish	Vulnerable	Migratory	Marine	Vulnerable	
Glyphis garricki	Northern river shark	Endangered	N/A	Marine	Priority	
Manta alfredi	Reef manta ray	N/A	Migratory	Marine	N/A	N/A
Manta birostris	Giant manta ray	N/A	Migratory	Marine	N/A	N/A

Table 5-2 EPBC Act listed Conservation Dependent species of fishes and sharks that may occur in the NWMR, NMR and SWMR

Species Name	Common Name	Likely Occurrence / Distribution	Listing Advice
Hoplostethus atlanticus	Orange roughy, Deep-sea perch, Red roughy	SWMR	No conservation listing advice for this species. Refer to the Marine bioregional plan for the SWMR (DSEWPAC, 2012b) for further information
Thunnus maccoyii	Southern bluefin tuna	NWMR and SWMR	Threatened Species Scientific Committee (2010)
Sphyrna lewini	Scalloped hammerhead	NWMR, NMR and SWMR	Threatened Species Scientific Committee (2018)
Centrophorus zeehaani	Southern dogfish, Endeavour dogfish, Little gulper shark	SWMR	Threatened Species Scientific Committee (2013)
Galeorhinus galeus	School shark, Eastern school shark, Snapper shark, Tope, Soupfin shark	SWMR	Threatened Species Scientific Committee (2009)

5.2 Protected Sharks, Sawfishes and Rays in the NWMR

The EPBC Act Protected Matters search (**Appendix A**) identified seven species of shark and five species of river shark or sawfish listed as threatened and/or migratory within the NWMR. In addition, two species of ray (the reef manta ray and giant manta ray) are listed as migratory within the region (refer **Table 5-2**).

5.2.1 Sharks and Sawfishes

The shark species known to occur within the NWMR include: the whale shark, grey nurse shark, white shark, shortfin mako, and longfin mako (**Table 5-2**).

Five species of river shark or sawfish known to occur in the NWMR and include: the narrow sawfish, northern river shark, freshwater sawfish, green sawfish and dwarf sawfish (**Table 5-2**).

There are identified BIAs within the NWMR for the whale shark, freshwater sawfish, green sawfish, and dwarf sawfish (refer **Section 5.3.2**).

Table 5-2 Information on the threatened shark and sawfish species within the NWMR

Species	Preferred Habitat and Diet	Habitat Location
Whale shark	Preferred habitat: They have a widespread distribution in tropical and warm temperate seas, both oceanic and coastal (Last and Stevens, 2009). The species is widely distributed in Australian waters. Diet: Whale sharks are planktivorous sharks and feed on a variety of planktonic organisms including krill, jellyfish, and crab larvae (Last and Stevens, 2009).	Ningaloo Reef is the main known aggregation site for whale sharks in Australian waters and has the largest density of whale sharks per kilometre in the world (Martin, 2007). Refer **Table 5-3** for the BIA summary for the whale shark.
Grey nurse shark (west coast population)	Preferred habitat: Most commonly found in temperate waters on, or close to, the bottom of the continental shelf, from close inshore to depths of about 200 m (McAuley, 2004). Diet: A variety of teleost and elasmobranch fishes and some cephalopods (Gelsleichter *et al.*, 1999; Smale, 2005).	Details of movement patterns of the western sub-population are unclear (McAuley, 2004) and key aggregation sites have not been formally identified within the NWMR (Chidlow *et al.*, 2006). The NWMR represents the northern limit of the west coast population.

Species	Preferred Habitat and Diet	Habitat Location
White shark	Preferred habitat: The species typically occurs in temperate coastal waters between the shore and the 100 m depth contour; however, adults and juveniles have been recorded diving to depths of 1000 m (Bruce *et al.*, 2006; Bruce, 2008). Diet: Smaller white sharks (less than 3 m in length) feed primarily on teleost and elasmobranch fishes, broadening their diet as larger sharks to include marine mammals (Last and Stevens, 2009).	There are no known aggregation sites for white sharks in the NWMR, and this species is most often found south of North-west Cape, in low densities (DSEWPAC, 2012a). Given the migratory nature of the species, most likely has a broad distribution within the NWMR. No BIAs identified for NWMR.
Shortfin mako	Preferred habitat: The shortfin mako shark is a pelagic species with a circumglobal, wide-ranging oceanic distribution in tropical and temperate seas (Mollet *et al.*, 2000). Tagging studies indicate shortfin makos spend most of their time in water less than 50 m deep but with occasional dives up to 880 m (Abascal *et al.*, 2011; Stevens *et al.*, 2010). Diet: Feeds on a variety of prey, such as teleost fishes, other sharks, marine mammals, and marine turtles (Campana *et al.*, 2005).	Given the migratory nature of the species, most likely has a broad distribution within the NWMR. No BIAs identified for NWMR.
Longfin mako	Preferred habitat: A pelagic species with a wide-ranging oceanic distribution in tropical and temperate seas (Mollet *et al.*, 2000). Diet: Primarily teleost fishes and cephalopods (primarily squid) (Last and Stevens, 2009).	Records on longfin mako sharks are sporadic and their complete geographic range is not well known (Reardon *et al.*, 2006). Given the migratory nature of the species, most likely has a broad distribution within the NWMR. No BIAs identified for NWMR.
Mackerel/Porbeagle shark	Preferred habitat: The porbeagle shark primarily inhabits offshore waters around the edge of the continental shelf. They occasionally move into coastal waters, but these movements are temporary (Campana and Joyce, 2004; Francis *et al.*, 2002). The porbeagle shark is known to dive to depths exceeding 1300 m (Campana *et al.*, 2010; Saunders *et al.*, 2011). Diet: Primarily teleost fish, elasmobranchs, and cephalopods (primarily squid) (Joyce *et al.*, 2002; Last and Stevens, 2009).	In Australia, the species occurs in waters from southern Queensland to south-west Australia (Last and Stevens, 2009). Distribution within the NWMR is unknown, but there are several records for this species on the NWS in the Atlas of Living Australia (ALA).
Oceanic whitetip shark	Preferred habitat: The oceanic whitetip shark is globally distributed in warm-temperate and tropical oceans (Andrzejaczek *et al.*, 2018). The species may occur in tropical and sub-tropical offshore and coastal waters around Australia. They primarily occupy pelagic waters in the upper 200 m of the water column; however, they have been observed diving to depths of around 1000 m, potentially associated with foraging behaviour (Howey-Jordan *et al.*, 2013; D'Alberto *et al.*, 2017). The species is highly migratory, travelling large distances between shallow reef habitats in coastal waters and oceanic waters (Howey-Jordan *et al.*, 2013). The species does exhibit a strong preference for warm and shallow waters above 120 m. Diet: Opportunistic feeders and generally target a variety of finfishes and pelagic squid, depending on habitat. Target pelagics such as tuna in open ocean as noted by the large bycatch numbers in the long line fisheries.	Given the migratory nature of the species, most likely has a broad distribution within the NWMR. No BIAs identified for NWMR.

Species	Preferred Habitat and Diet	Habitat Location
Narrow sawfish	Preferred habitat[1]: Shallow coastal, estuarine, and riverine habitats, however it may occur in waters up to 40 m deep (D'Anastasi *et al.*, 2013). Diet: Shoaling fishes, such as mullet, as well as molluscs and small crustaceans (Cliff and Wilson, 1994).	Shallow coastal waters of the Pilbara and Kimberly coasts (Last and Stevens, 2009).
Northern river shark	Preferred habitat[1]: Rivers, tidal sections of large tropical estuarine systems and macrotidal embayments, as well as inshore and offshore marine habitats (Pillans *et al.*, 2009; Thorburn and Morgan, 2004). Adults have been recorded only in marine environments. Juveniles and sub-adults have been recorded in freshwater, estuarine and marine environments (Pillans *et al.*, 2009). Diet: Variety of fish and crustaceans (Stevens *et al.*, 2005)	Within the NWMR records have come from both the west and east Kimberley, including King Sound, the Ord and King rivers, West Arm of Cambridge Gulf and also from Joseph Bonaparte Gulf (Thorburn and Morgan, 2004; Stevens *et al.*, 2005; Thorburn, 2006; Field *et al.*, 2008; Pillans *et al.*, 2008, Whitty *et al.*, 2008; Wynen *et al.*, 2008).
Largetooth (Freshwater) sawfish	Preferred habitat: Sandy or muddy bottoms of shallow coastal waters, estuaries, river mouths and freshwater rivers, and isolated water holes. Diet: Shoaling fishes, such as mullet, as well as molluscs and small crustaceans (Cliff and Wilson, 1994).	Refer **Table 5-3** for the BIA summary for the freshwater sawfish.
Green sawfish	Preferred habitat[1]: Inshore coastal environments including estuaries, river mouths, embayments, and along sandy and muddy beaches, as well as offshore marine habitat (Stevens *et al.*, 2005; Thorburn *et al.*, 2003). Diet: Schools of baitfish and prawns (Poganoski *et al.*, 2002), molluscs and small crustaceans (Cliff and Wilson, 1994).	Refer **Table 5-3** for the BIA summary for the green sawfish.
Dwarf sawfish	Preferred habitat[1]: Shallow (2 to 3 m) silty coastal waters and estuarine habitats, occupying relatively restricted areas and moving only small distances (Stevens *et al.*, 2008) Diet: Shoaling fish such as mullet, molluscs, and small crustaceans (Cliff and Wilson, 1994).	Refer **Table 5-3** for the BIA summary for the dwarf sawfish.

1 Preferred habitat as described within the Sawfish and River Sharks Multispecies Recovery Plan (Commonwealth of Australia, 2015b).

5.2.2 Rays

Rays are commonly found in the NWMR. Two listed and migratory species of ray known to occur within the NWMR: the reef manta ray and giant manta ray.

No BIAs for either the reef or giant manta ray species have been identified in the NWMR.

Table 5-3 Information on migratory ray species within the NWMR

Species	Preferred Habitat and Diet	Habitat Location
Reef manta ray	Preferred habitat: The reef manta ray is commonly sighted within productive nearshore environments, such as island groups, atolls or continental coastlines. However, the species has also been recorded at offshore coral reefs, rocky reefs, and seamounts (Marshall *et al.*, 2009). Diet: Feed on planktonic organisms including krill and crab larvae.	A resident population of reef manta rays has been recorded at Ningaloo Reef. No BIAs identified for NWMR.
Giant manta ray	Preferred habitat: The species primarily inhabits near-shore environments along productive coastlines with regular upwelling, but they appear	The Ningaloo Coast is an important area for giant manta rays from March to August (Preen *et al.*, 1997).

Species	Preferred Habitat and Diet	Habitat Location
	to be seasonal visitors to coastal or offshore sites including offshore island groups, offshore pinnacles and seamounts (Marshall *et al.*, 2011). Diet: Feed on planktonic organisms including krill and crab larvae.	No BIAs identified for NWMR.

5.3 Fish, Shark and Sawfish Biological Important Areas in the NWMR

A review of the National Conservation Values Atlas identified Biologically Important Areas (BIAs) for four species of shark and sawfish (whale shark, freshwater sawfish, green sawfish and dwarf sawfish) within the NWMR. The BIAs for the whale shark and the sawfish species include foraging, nursing and pupping areas. These are described in **Table 5-4**.

Table 5-4 Fish, whale shark and sawfish BIAs within the NWMR

Species	Woodside Activity Area			BIAs		
	Browse	NWS/S	NWC	Pupping	Nursing	Foraging
Whale shark	✓	✓	✓	No pupping BIA identified within the NWMR	No nursing BIA identified within the NWMR	Foraging (high density) in Ningaloo Marine Park and adjacent Commonwealth waters (March–July) Foraging northward from Ningaloo along the 200 m isobath (July – Nov).
Green sawfish	✓	✓	-	Pupping in Cape Keraudren (pupping occurs in summer in a narrow area adjacent to shoreline) Pupping in Willie Creek Pupping in Roebuck Bay Pupping in Cape Leveque Pupping in waters adjacent to Eighty Mile Beach Pupping (likely) in Camden Sound.	Nursing in Cape Keraudren Nursing in waters adjacent to Eighty Mile Beach	Foraging in Cape Keraudren Foraging in Roebuck Bay Foraging in Cape Leveque Foraging in Camden Sound
Largetooth (freshwater) sawfish	✓	✓	-	Pupping in the mouth of the Fitzroy River (January to May) Roebuck Bay (Jan – May) Pupping likely in waters adjacent to Eighty Mile Beach	Nursing (likely) in King Sound Roebuck Bay (Jan – May)	Foraging in the mouth of the Fitzroy River (January to May) Foraging in King Sound Roebuck Bay (Jan – May) Foraging in waters adjacent to Eighty Mile Beach
Dwarf sawfish	✓	✓	-	Pupping in King Sound Pupping in waters adjacent to Eighty Mile Beach	Nursing in King Sound Nursing waters adjacent to Eighty Mile Beach	Foraging in King Sound Foraging in Camden Sound Foraging in waters adjacent to Eighty Mile Beach

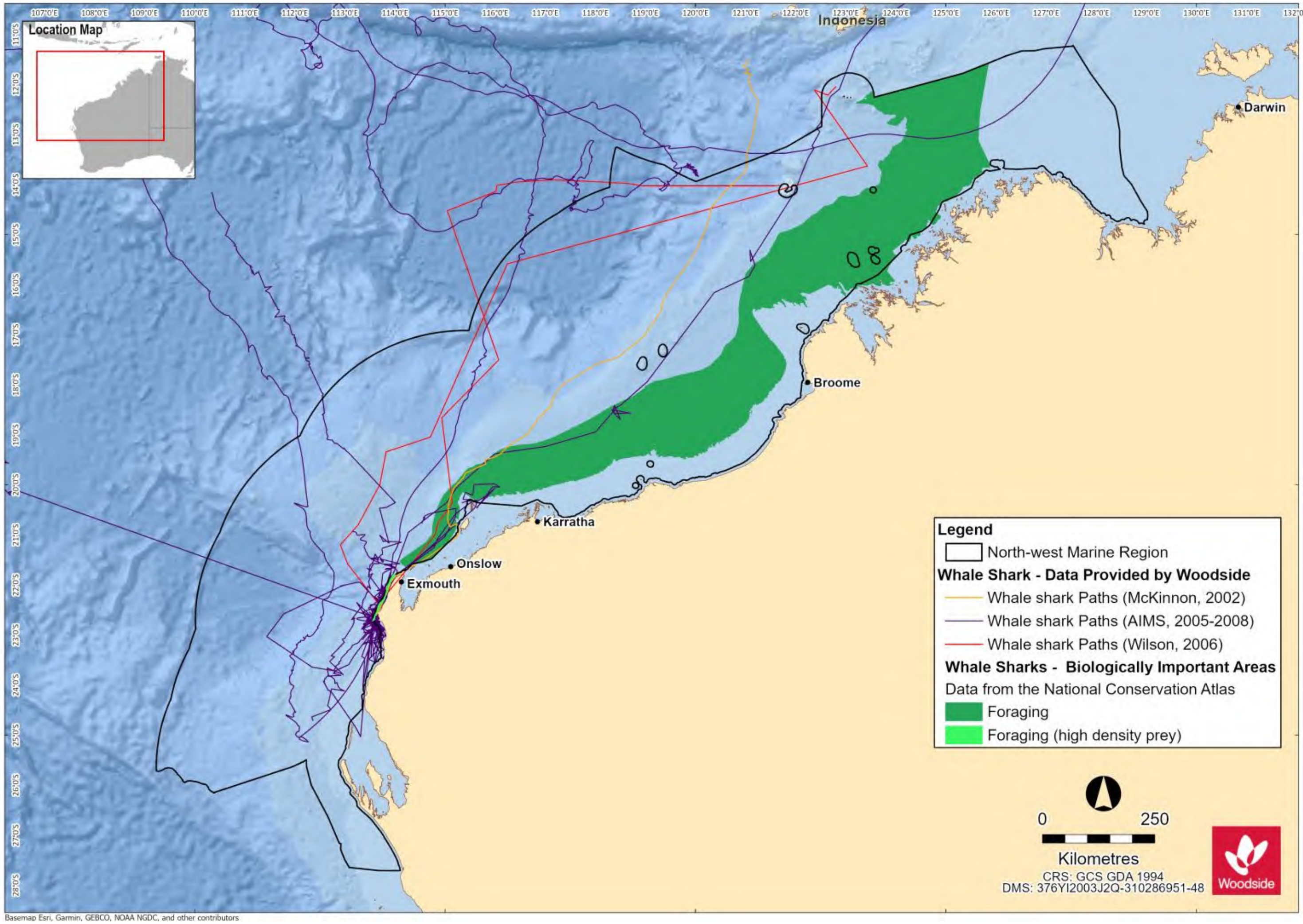

Figure 5-1 Whale shark BIAs for the NWMR and tagged whale shark tracks

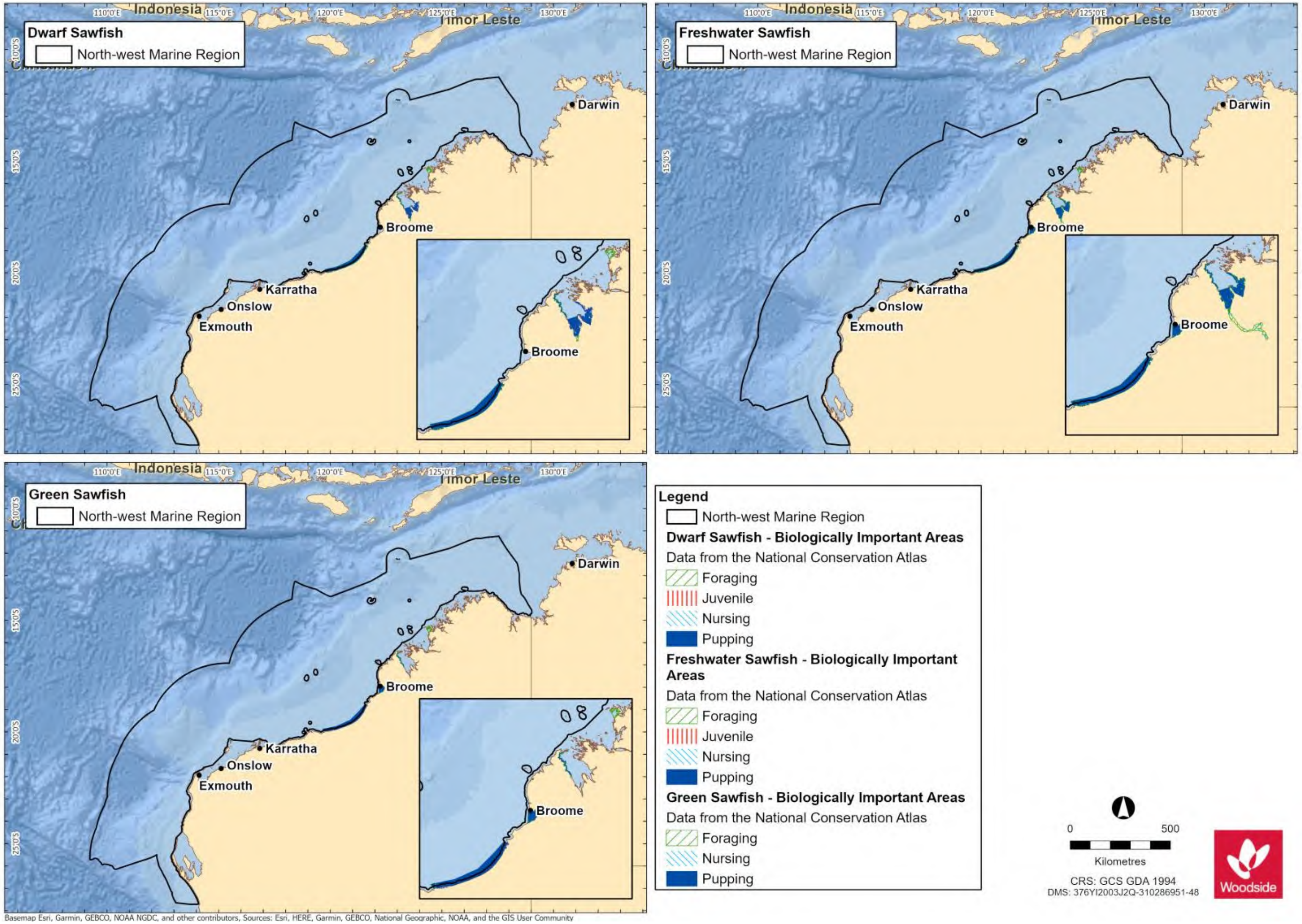

Figure 5-2 Sawfish BIAs for the NWMR

5.4 Fish Assemblages of the NWMR

5.4.1 Regional Context for Fish Assemblages of NWMR

The NWMR contains a diverse range of fishes of tropical Indo-west Pacific affinity (Allen *et al.*, 1988). The region is characterised by the highest level of endemism and species diversity compared with other areas of the Australian continental slope. Last *et al.* (2005) recorded 1431 species from the three bioregions encompassing the continental slope, whilst also acknowledging some information gaps.

The NWMR is known for its demersal slope fish assemblages; the continental slope of the Timor Province and the North-west Transition supports more than 418 and 505 species of demersal fishes respectively, of which 64 are considered to be endemic. This is the second richest area for demersal fish species across the entire Australian continental slope. Conversely, the broad Southern Province, which covers most of southern Australia, supports 463 species, only 26 possibly being endemic. The continental slope demersal fish assemblages of the NWMR have been identified as a KEF (DEWHA, 2008), as described in **Section 9**.

The NWMR also features a diversity of pelagic fishes (those living in the pelagic zone) and bentho-pelagic fishes, including tuna, billfish, bramids, lutjanids, serranids and some sharks (DEWHA, 2007a). These species feed on salps and jellyfish, and more often on secondary consumers such as squid and bait fish. Water depth provides an indication of the level of interaction between pelagic and benthic communities within the NWMR; in waters deeper than 1000 m, for instance, the trophic system is pelagically-driven and benthic communities rely on particulates that fall to the seafloor (DEWHA, 2007a).

Pelagic fishes play an important ecological role within the NWMR; small pelagic fishes, such as lantern fish, inhabit a range of marine environments, including inshore and continental shelf waters and form a vital link in and between many of the region’s trophic systems, feeding on pelagic phytoplankton and zooplankton and providing a food source for a wide variety of predators including large pelagic fishes, sharks, seabirds and marine mammals (Bulman, 2006; Mackie *et al.*, 2007). Large pelagic fishes, such as tuna, mackerel, swordfish, sailfish and marlin, are found mainly in oceanic waters and occasionally on the continental shelf (Brewer *et al.*, 2007). Both juvenile and adult phases of the large pelagic species are highly mobile and have a wide geographic distribution, although the juveniles more frequently inhabit warmer or coastal waters (DEWHA, 2008).

5.4.2 Listed Fish Species in the NWMR

The family Syngnathidae is a group of bony fishes that includes seahorses, pipefishes, pipehorses and seadragons. Along with syngnathids, members of the related Solenostomidae family (ghost pipefishes) are also found in the NWMR (DSEWPAC, 2012a).

There are 44 solenostomid and syngnathid species that are listed marine species that may occur within the NWMR, although no species is currently listed as threatened or migratory, according to the PMST report (**Appendix A**).

Syngnathids live in nearshore and inner shelf habitats, usually in shallow coastal waters, among seagrasses, mangroves, coral reefs, macroalgae dominated reefs, and sand or rubble habitats (Dawson, 1985; Lourie *et al.*, 1999, Lourie *et al.*, 2004; Vincent, 1996). Two species, the winged seahorse (*Hippocampus alatus*) and western pipehorse (*Solegnathus sp. 2*) have been identified in deeper waters of the NWMR (up to 200 m) (DSEWPAC, 2012a), however, these species were not identified by the Protected Matters search of the NWMR.

Knowledge about the distribution, abundance and ecology of both syngnathids and solenostomids in the NWMR is limited. No BIAs for syngnathids and solenostomids have been identified in the NWMR.

5.4.3 Browse

The proposed Browse activity area includes biologically important habitat for the whale shark and three sawfish species:

- whale shark (foraging northward from Ningaloo along the 200 m isobath (July – Nov),
- freshwater sawfish (pupping, nursing and foraging areas),
- green sawfish (pupping, nursing and foraging areas); and
- dwarf sawfish (pupping, nursing and foraging areas).

BIAs for the shark and sawfish species are outlined in **Table 5-4** and **Figure 5-1**.

The proposed Browse activity area has partial overlap with the Continental slope demersal fish communities KEF.

5.4.4 NWS / Scarborough

The NWS / Scarborough activity area includes biologically important habitat for the whale shark and three sawfish species:

- whale shark (foraging northward from Ningaloo along the 200 m isobath (July – Nov),
- freshwater sawfish (pupping, nursing and foraging areas),
- green sawfish (pupping, nursing and foraging areas); and
- dwarf sawfish (pupping, nursing and foraging areas).

BIAs for the whale shark and sawfish species are outlined in **Table 5-4** and **Figure 5-1**.

The NWS / Scarborough activity area has partial overlap with the Continental slope demersal fish communities KEF. The continental slope between North-west Cape and the Montebello Trough has more than 500 fish species, 76 of which are endemic, which makes it the most diverse slope bioregion in Australia (Last *et al.*, 2005).

5.4.5 North-west Cape

The North-west Cape activity area includes biologically important foraging habitat for the whale shark:

- whale shark, including:
  - Foraging (high density) in Ningaloo Marine Park and adjacent Commonwealth waters (March–July); and
  - Foraging northward from Ningaloo along the 200 m isobath (July – Nov).

BIAs for the whale shark are outlined in **Table 5-4** and **Figure 5-1**.

The North-west Cape activity area coincides with part of the Continental slope demersal fish communities KEF.

6. MARINE REPTILES

6.1 Regional Context for Marine Reptiles

The NWMR contains important habitat for listed marine reptiles, including areas that support key life stages such as nesting, internesting, migration and foraging for marine turtle species, and habitats supporting resident sea snake and crocodile populations.

Six of the seven marine turtle species occur in Australian waters, and all six (the green turtle, hawksbill turtle, loggerhead turtle, flatback turtle, leatherback turtle and olive ridley turtle) occur in the NWMR and NMR.

There are 25 listed species of sea snake reported within or adjacent to the NWMR (Guinea, 2007a; Udyawer *et al*., 2016), of which four are endemic to reef habitats in the remote parts of the region. Nineteen (19) listed sea snake species are known to occur in the NMR, as reported in the Protected Matters search (**Appendix A**).

There are significantly fewer marine reptile species that frequently occur within the SWMR and presently include three species of listed marine turtle and one sea snake species. Other species of sea snake may occur because of the southward-flowing Leeuwin Current, as vagrants in the region (DSEWPAC, 2012b).

The following sections focus on the listed marine reptile species known to occur within the NWMR.

Table 6-1 outlines the threatened and migratory marine reptile species that occur within the NWMR, with their conservation status and relevant recovery plans and/or conservation advice.

Table 6-1 Marine reptile species identified by the EPBC Act PMST as potentially occurring within or utilising habitats in the NWMR for key life cycle stages

Species Name	Common Name	*Environment Protection and Biodiversity Conservation Act 1999*			WA *Biodiversity Conservation Act 2016*	EPBC Act Part 13 Statutory Instrument
		Threatened Status	Migratory Status	Listed	Conservation Status	
Caretta caretta	Loggerhead turtle	Endangered	Migratory	Marine	Endangered	Recovery Plan for Marine Turtles in Australia 2017-2027 (Commonwealth of Australia, 2017)
Chelonia mydas	Green turtle	Vulnerable	Migratory	Marine	Vulnerable	
Dermochelys coriacea	Leatherback turtle	Endangered	Migratory	Marine	Vulnerable	
Eretmochelys imbricata	Hawksbill turtle	Vulnerable	Migratory	Marine	Vulnerable	
Natator depressus	Flatback turtle	Vulnerable	Migratory	Marine	Vulnerable	
Lepidochelys olivacea	Olive ridley turtle	Endangered	Migratory	Marine	Vulnerable	
Aipysurus apraefrontalis	Short-nosed sea snake	Critically endangered	N/A	Marine	Critically endangered	Approved Conservation Advice for *Aipysurus apraefrontalis* (Short-nosed Sea Snake) (DSEWPAC, 2011a)
Aipysurus foliosquama	Leaf-scaled sea snake	Critically endangered	N/A	Marine	Critically endangered	Approved Conservation Advice for *Aipysurus foliosquama* (Leaf-scaled Sea Snake) (DSEWPAC, 2011b)
Crocodylus porosus	Salt-water crocodile	N/A	Migratory	Marine	Other protected fauna	N/A

6.2 Marine Turtles in the NWMR

According to the Protected Matters search (**Appendix A**) six species of marine turtle known to occur within the NWMR are listed as threatened and migratory (three Vulnerable and three Endangered) under the EPBC Act—the green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), flatback (*Natator depressus*), loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*) and olive ridley (*Lepidochelys olivacea*) turtle (DSEWPAC, 2012a) (refer **Table 6-1**).

The NWMR supports globally significant breeding populations of four marine turtle species: the green, hawksbill, flatback and loggerhead turtle. Olive ridley turtles are known to forage within the NWMR, but there are only occasional records of the species nesting in the region. Leatherback turtles regularly forage over Australian continental shelf waters within the NWMR but there are also no records of the species nesting in the region (DSEWPAC, 2012a).

The six marine turtle species reported for the NWMR also occur within the NMR.

Three marine turtle species; the green, loggerhead, and leatherback turtle, have presumed feeding areas within the SWMR; however, no known nesting areas exist within the region (DSEWPAC, 2012b).

Discrete genetic stocks have evolved within each marine turtle species. This is the result of marine turtles returning to the location where they hatched. These genetically distinct stocks are defined by the presence of regional breeding aggregations. Stocks are composed of multiple rookeries in a region and are delineated by where there is little or no migration of individuals between nesting areas. Turtles from different stocks typically overlap at feeding grounds (Commonwealth of Australia, 2017). There are 17 genetic stocks across both the NWMR and NMR (nine in the NWMR, six in the NMR, and two overlapping both regions). Of these 17 genetic stocks, nine are known to occur within Woodside's three areas of activity (**Table 6-2**).

6.2.1 Life Cycle Stages

Marine turtles are highly migratory during non-reproductive life phases and have high site fidelity during breeding and nesting life phases. Majority of their lives are spent in the ocean, but the adult female marine turtles will come ashore to lay eggs in the sand above the high water mark on natal beaches (Commonwealth of Australia, 2017). **Figure 6-1** summarises the generalised life cycle of marine turtles. Species-specific life cycle information is outlined within the Recovery Plan for Marine Turtles of Australia (Commonwealth of Australia, 2017).

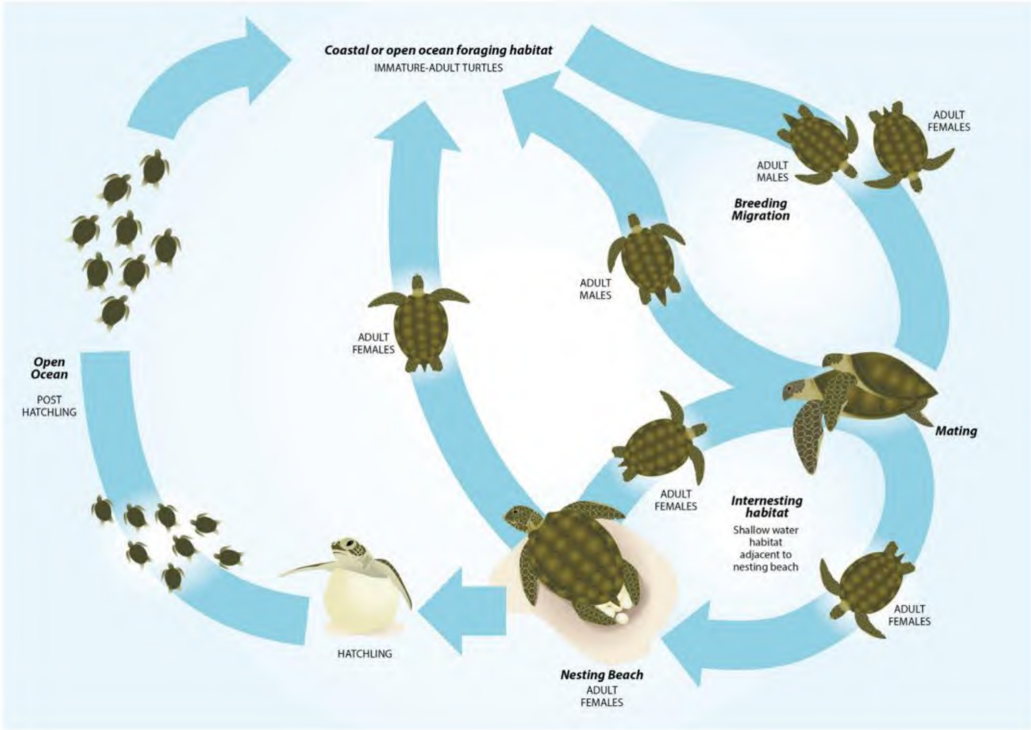

Figure 6-1 Generalised life cycle of marine turtles (Commonwealth of Australia, 2017)

6.2.2 Habitat Critical to Survival for Marine Turtles in the NWMR

The Recovery Plan for Marine Turtles of Australia (Commonwealth of Australia, 2017) identifies habitat critical to the survival of a species for marine turtle stocks under the EPBC Act. Habitat critical to survival is defined by the EPBC Act *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* as areas necessary:

- for activities such as foraging, breeding or dispersal;
- for the long-term maintenance of the species (including the maintenance of species essential to the survival of the species);
- to maintain genetic diversity and long term evolutionary development; and
- for the reintroduction of populations or recovery of the species.

The Recovery Plan for Marine Turtles of Australia (Commonwealth of Australia, 2017) has identified nesting locations and associated internesting areas as habitat critical to survival for four marine turtle species within the NWMR and these are identified, described and mapped in **Table 6-2** and **Figure 6-2**. No habitat critical to survival has been identified within the NWMR for olive ridley or leatherback turtles.

Table 6-2 outlines the relevant genetic stock, habitat critical to survival and key life cycle stage seasonality of the four species of marine turtles within the NWMR.

Table 6-2 Genetic stock, habitat critical to survival and key life cycle stage seasonality of the four species of marine turtles within the NWMR

Species	Woodside Activity Area			Habitat Critical to Survival			
	Browse	NWS/S	NWC	Nesting (* Major Rookery[1])	Internesting Buffer	Seasonality- Nesting	Preferred Habitat[2]
Green Turtle							
NWS Stock (G-NWS)	✓	✓	✓	Adele Island Maret Island Cassini Island Lacepede Islands* Barrow Island* Montebello Islands (all with sandy beaches)* Serrurier Island Dampier Archipelago Thevenard Island Northwest Cape* Ningaloo coast	20 km radius	Nov-Mar	Nearshore reef habitats in the photic zone.
Ashmore Reef Stock (G-AR)	✓	-	-	Ashmore Reef* Cartier Reef*		All year (peak: Dec-Jan)	
Scott Reef-Browse Island Stock (G-ScBr)	✓	-	-	Scott Reef (Sandy Islet)* Browse Island*		Nov-Mar	
Hawksbill Turtle							
Western Australia Stock (H-WA)	-	✓	-	Dampier Archipelago (including Rosemary Island and Delambre Island)* Montebello Islands (including Ah Chong Island, South East Island and Trimouille Island)* Lowendal Islands (including Varanus Island, Beacon Island and Bridled Island) Sholl Island	20 km radius	Oct-Feb	Nearshore and offshore reef habitats.

Species	Woodside Activity Area			Habitat Critical to Survival			
	Browse	NWS/S	NWC	Nesting (* Major Rookery[1])	Internesting Buffer	Seasonality- Nesting	Preferred Habitat[2]
Flatback Turtle							
Cape Domett Stock (F-CD)	✓	-	-	Cape Domett* Lacrosse Island	60 km radius	All year (peak: Jul-Sep)	Nearshore and offshore sub-tidal and soft bottomed habitats of offshore islands.
South-west Kimberley Stock (F-swKim)	-	✓	-	Eighty Mile Beach* Eco Beach* Lacepede Islands		Oct-Mar	
Pilbara Stock (F-Pil)	-	✓	-	Montebello Islands Mundabullangana Beach* Barrow Island* Cemetery Beach Dampier Archipelago (including Delambre Island* and Huay Island) Coastal islands from Cape Preston to Locker Island		Oct-Mar	
Unknown genetic stock Kimberley, Western Australia	✓	✓	-	Maret Islands Montilivet Islands Cassini Island Coronation Islands (includes Lamarck Island) Napier-Broome Bay Islands (West Governor Island, Sir Graham Moore Island – near Kalumbaru) Champagny, Darcy and Augustus Islands (Camden Sound)		May-July	

Species	Woodside Activity Area			Habitat Critical to Survival			
	Browse	NWS/S	NWC	Nesting (* Major Rookery[1])	Internesting Buffer	Seasonality-Nesting	Preferred Habitat[2]
Loggerhead Turtle							
Western Australia Stock (LH-WA)	-	-	✓	Dirk Hartog Island* Muiron Islands* Gnaraloo Bay* Ningaloo coast	20 km radius	Nov-May	Nearshore and island coral reefs, bays and estuaries in tropical and warm temperate latitudes.

[1] *Major rookeries as outlined in the Recovery Plan (Commonwealth of Australia, 2017)*

[2] *Preferred habitat as outlined in the Recovery Plan (Commonwealth of Australia, 2017)*

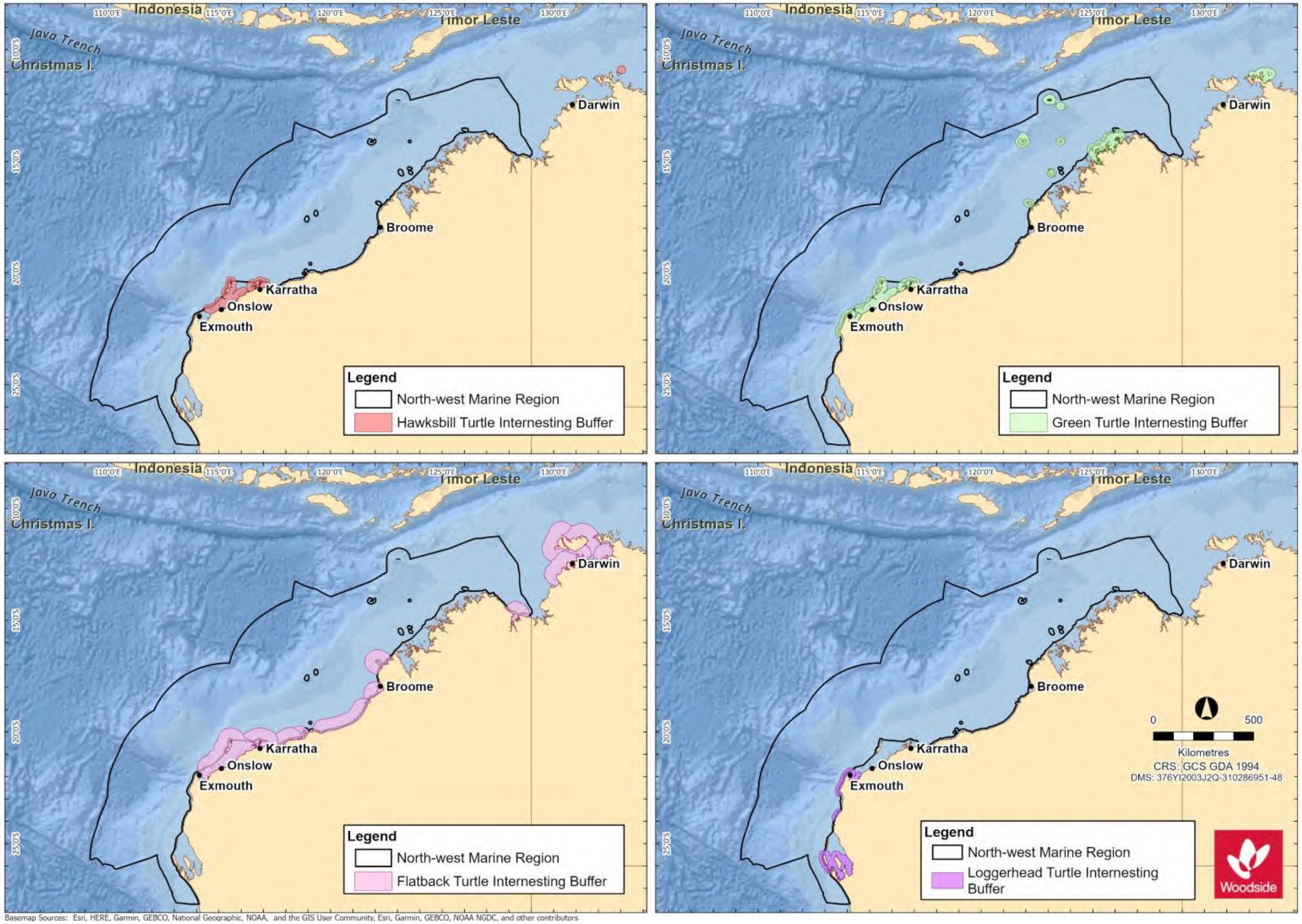

Figure 6-2 Marine turtle species habitat critical to survival (nesting beaches and internesting buffers) for the NWMR

6.3 Marine Turtle Biological Important Areas in the NWMR

A review of the National Conservation Values Atlas (DAWE, 2020[2]) identified BIAs for the four marine turtle species that occur within the NWMR. These are described in **Table 6-3**. Note that nesting and internesting BIAs are not listed in **Table 6-3** as they are defined as in the Recovery Plan as habitat critical to survival for marine turtles nesting beaches and internesting areas (refer **Table 6-2**).

[2] http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf

Table 6-3 Marine turtle BIAs within the NWMR

Species	Woodside Activity Area			BIAs		
	Browse	NWS/S	NWC	Mating	Foraging	Migration[3]
Green turtle	✓	✓	✓	No mating BIA identified within the NWMR.	Foraging inshore areas of Barrow Island Foraging at Montgomery Reef Foraging at Montebello Islands Foraging at Dixon Island Foraging around Ashmore Reef Foraging at Seringapatam Reef and Scott Reef Foraging in the De Grey River area to Bedout Island Foraging around the Islands between Cape Preston and Onslow and inshore of Barrow Island Foraging around Dampier Archipelago (islands to the west of the Burrup Peninsula) Foraging at Legendre Island and Huay Island Foraging around Delambre Island Foraging in the Joseph Bonaparte Gulf Foraging in waters adjacent to James Price Point	Green turtles can migrate more than 2600 km between their feeding and nesting grounds. Individual turtles foraging in the same area do not necessarily take the same migration route (Limpus *et al.*, 1992). Ferreira et al. (2021) broadly identified two migratory corridors, one used by the NWS stock-Pilbara and another used by the NWS stock-Kimberley and the Scott-Browse stock with some overlap at the northern and southern extents respectively. This study showed that the foraging distribution of green turtles from two stocks in WA expands throughout north-west and northern Australian coastal waters, including the NT and Queensland.
Hawksbill turtle	✓	✓	✓	No mating BIA identified within the NWMR.	Foraging around the Lowendal Island group Foraging at Delambre Island Foraging around Dixon Island Foraging in the De Grey River area to Bedout Island Foraging around the islands between Cape Preston and	Individuals may migrate up to 2400 km between their nesting and foraging grounds (DSEWPAC, 2012a).

[3] Migration BIA does not exist for Marine Turtles – general information provided.

Species	Woodside Activity Area			BIAs		
	Browse	NWS/S	NWC	Mating	Foraging	Migration[3]
					Onslow and inshore of Barrow Island Foraging around the islands of the Dampier Archipelago (to the west of the Burrup Peninsula) Foraging at Ashmore Reef	
Flatback turtle	✓	✓	-	Lacepede Islands Mating at Montebello Islands Mating at Dampier Archipelago (islands to the west of the Burrup Peninsula) Mating at Barrow Island A year-round internesting buffer biologically important area (BIA) of 80 km is located north and north-west of the Montebello Islands, extending 20 km further than the habitat critical to survival. However, use level for this BIA has been defined as very low (Commonwealth of Australia, 2017) and the habitat critical to survival internesting buffer is the legally recognised area of protection under the EPBC Act *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* Refer to the Marine Bioregional Plan for the North-west Marine Region (DSEWPAC, 2012a) for locations of seasonal 80 km internesting buffer BIAs for flatback turtles	Foraging at the islands between Cape Preston and Onslow and inshore of Barrow Island. Foraging at Montebello Islands Foraging at Dampier Archipelago (islands to the west of the Burrup Peninsula) Foraging at Legendre Island and Huay Island Foraging at Delambre Island Foraging in the Joseph Bonaparte Depression Foraging in waters adjacent to James Price Point	There is evidence that some flatback turtles undertake long-distance migrations between breeding and feeding grounds (Limpus *et al.*, 1983). However, flatback turtles generally do not have a pelagic phase to their lifecycle. Instead, hatchlings grow to maturity in shallow coastal waters thought to be close to their natal beaches (DSEWPAC, 2012a).

Species	Woodside Activity Area			BIAs		
	Browse	NWS/S	NWC	Mating	Foraging	Migration[3]
Loggerhead turtle	✓	✓	-	No mating BIA identified within the NWMR	Foraging in the De Grey River area to Bedout Island Foraging on the Western Joseph Bonaparte Depression Foraging in the waters adjacent to James Price Point	Adult loggerhead turtles dispersing from Dirk Hartog Island beaches (near Shark Bay) have remained within WA waters from southern WA to the Kimberley. Turtles dispersing from the North-west Cape–Muiron Islands nesting area have ranged north as far as the Java Sea and the north-western Gulf of Carpentaria, and to south-west WA (DSEWPAC, 2012).
Olive ridley turtle	✓	✓	-	No mating BIA identified within the NWMR	Foraging in the Western Joseph Bonaparte Depression and Gulf Foraging in the Dampier Archipelago (islands to the west of the Burrup Peninsula)	Migration routes and distances between nesting beaches and foraging areas are not known for Australian olive ridley turtles.

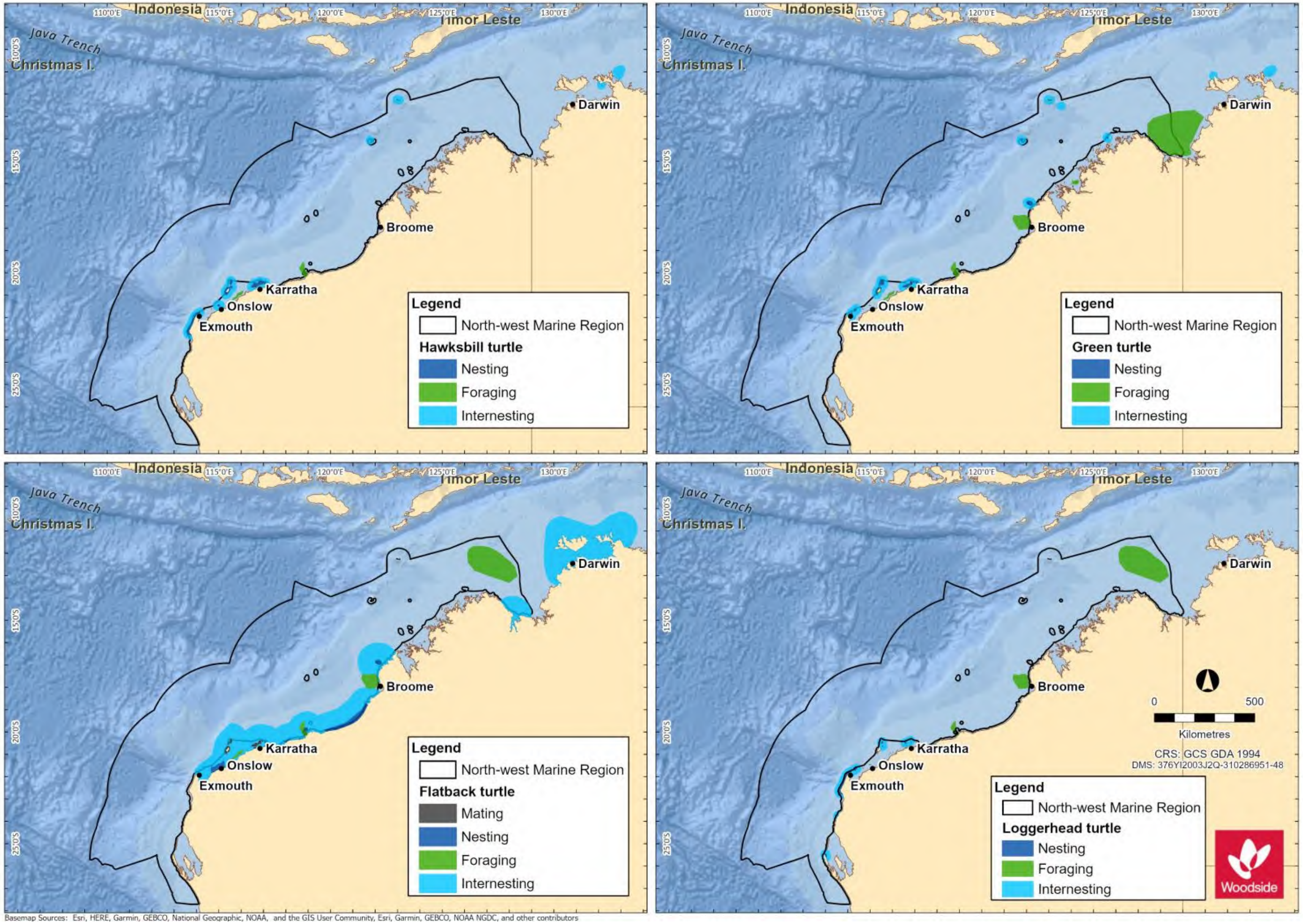

Figure 6-3 Marine turtle species BIAs within the NWMR

6.4 Marine Turtle Summary for NWMR

Six of the seven marine turtle species occur within the Woodside activity areas. Across all three areas, globally significant breeding populations of four marine turtle species; the green, hawksbill, flatback and loggerhead turtle, have been recorded.

However, offshore waters do not represent biologically important habitat for marine turtles in any of the three Woodside activity areas. Isolated records of transient individuals (on post-nesting migration) are expected, but there is no evidence of important habitat or behaviours for marine turtles in offshore, open water environment of the NWS, in general.

6.4.1 Browse

The proposed Browse activity area includes major nesting areas that support globally significant breeding populations of two marine turtle species:

- the green turtle, including two distinct genetic stocks (Ashmore Reef and Scott Reef-Browse Island); and
- the flatback turtle, Cape Domett genetic stock.

Locations of habitat critical for each of the two species are outlined in **Table 6-2** and **Figure 6-2**.

BIAs for the green and flatback turtle are outlined in **Table 6-3** and **Figure 6-3**.

Table 6-4 Marine turtle key information for Browse activity area

Species / Genetic Stock	Key Information
Green Turtle	
Ashmore Reef Stock (G-AR)	The G-AR stock nests in a localised area of the Indian Ocean in the Ashmore Reef and Cartier Island AMP areas. Population estimates are not available for Ashmore Reef, although annual breeding numbers are thought to be in the low hundreds (Whiting, 2000). Designated habitat critical for the G-AR stock are the nesting locations of Ashmore Reef and Cartier Reef, and an internesting buffer of 20 km radius around these rookeries, year-round with peak internesting activity occurring December to January (refer Table 6 of the Recovery Plan). Juvenile and adult turtles forage within the tidal/sub-tidal habitats of offshore islands and coastal waters with coral reef, mangrove, sand, rocky reefs, and mudflats where there are algal turfs or seagrass meadows present (Commonwealth of Australia, 2017).
Scott Reef-Browse Island Stock (G-ScBr)	The G-ScBr stock is a discrete unit known to nest at only two locations within the north-east Indian Ocean—Sandy Islet and Browse Island. There is currently very limited data available for the G-ScBr stock, therefore population numbers are not known. Designated habitat critical for the G-ScBr stock are the nesting locations of Sandy Islet and Browse Island, and an internesting buffer of 20 km radius around these rookeries, for the period November to March (refer Table 6 of the Recovery Plan). Surveys conducted at Scott Reef in 2006, 2008 and 2009 indicate that the summer months from late November to February are the preferred breeding season for green turtles at Sandy Islet (Guinea, 2009). Satellite tagging studies (Pendoley, 2005; Guinea, 2011) have provided an indication of the behaviour and migratory routes of adult green turtles leaving Scott Reef. Most animals appear to swim through South Reef lagoon and disperse toward the Western Australian mainland via two distinct post-nesting migration pathways; travelling east and north toward the Bonaparte Archipelago and then north along the coast to foraging areas in NT waters, or travelling south to Cape Leveque and then south along the coast to the Turtle Islands off the mouth of the De Grey River in the Pilbara region (Ferreira *et al*., 2021).

Species / Genetic Stock	Key Information
Flatback Turtle	
Cape Domett Stock (F-CD)	Cape Domett is an important high density nesting area. Combined with a smaller site at Lacrosse Island, the F-CD stock is one of the largest flatback turtle stocks in Australia. Average nesting abundance at Cape Domett is estimated at 3250 females per year (Whiting *et al.*, 2008). Designated habitat critical for the F-CD stock are the nesting locations of Cape Domett and Lacrosse Island, and an internesting buffer of 60 km radius around these rookeries, year-round with peak internesting activity occurring July to September. Extending further than the habitat critical internesting buffer, an internesting buffer BIA of 80 km is located at Cape Domett and Lacrosse Island.

6.4.2 North-west Shelf / Scarborough

The NWS / Scarborough activity area includes major nesting areas that support globally significant breeding populations of three marine turtle species, representing four discreet genetic stocks:

- the green turtle, NWS genetic stock;
- the hawksbill turtle, WA genetic stock; and
- the flatback turtle, South-west Kimberley stock and Pilbara genetic stocks.

Locations of habitat critical for each of the four species are outlined in **Table 6-2** and **Figure 6-2**.

BIAs for the green, hawksbill, and flatback are outlined in **Table 6-3** and **Figure 6-3**.

Table 6-5 Marine turtle key information for NWS / Scarborough activity area

Species / Genetic Stock	Key Information
Green Turtle	
NWS Stock (G-NWS)	The G-NWS stock is one of the largest green turtle stocks in the world and the largest in the Indian Ocean. The G-NWS stock is estimated at approximately 20,000 individuals (DSEWPAC, 2012a) and the trend for the stock is reported as stable (Commonwealth of Australia, 2017). Major rookeries of the G-NWS stock within the NWS / Scarborough activity area are located at Barrow Island and the Montebello Islands. These areas are designated habitat critical for the stock and include an internesting buffer of 20 km radius around these rookeries, November to March.
Hawksbill Turtle	
Western Australia Stock (H-WA)	The H-WA stock is the largest in the Indian Ocean. The majority of the nesting for this stock is located in the Pilbara. The Dampier Archipelago has the largest nesting aggregation recorded. In particular, Rosemary Island supports the most significant hawksbill turtle rookery in the WA region and one of the largest in the Indian Ocean; approximately 500-1000 females nest on the island annually, more than at any other WA rookery (Pendoley, 2005; Pendoley *et al*., 2016). Major rookeries of the H-WA stock within the NWS / Scarborough activity area are located at Rosemary Island, Delambre Island and the Montebello Islands. These areas are designated habitat critical for the stock and include an internesting buffer of 20 km radius around these rookeries, October to February.
Flatback Turtle	
South-west Kimberley Stock (F-swKim)	The genetic relationship between this nesting aggregation and the Cape Domett and Pilbara stocks is currently under review. Population numbers of the F-swKim stock are unknown. Major rookeries of the F-swKim stock are located at Eighty Mile Beach and Eco Beach. These areas are designated habitat critical for the stock and include an internesting buffer of 60 km radius around these rookeries, October to March.

Species / Genetic Stock	Key Information
Pilbara Stock (F-Pil)	The extent of genetic relatedness of flatback turtles along the WA coast is currently under review. Population numbers of the F-Pil stock are unknown. This stock nests on many islands in the Pilbara and southern Kimberley, with major rookeries at Mundabullangana Beach, Delambre Island and Barrow Island. These areas are designated habitat critical for the F-Pil stock and include an internesting buffer of 60 km radius around these rookeries, October to March. Extending further than the habitat critical internesting buffer, a year-round internesting buffer BIA of 80 km is located north and north-west of the Montebello Islands. However, use level for this BIA has been defined as very low (Commonwealth of Australia, 2017) and the habitat critical internesting buffer is the legally recognised area of protection under the EPBC Act *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance*. Post-nesting satellite tracking indicates foraging occurs along the WA coast in water shallower than 130 m and within 315 km of shore (Commonwealth of Australia, 2017).

6.4.3 North-west Cape

The North-west Cape activity area includes major nesting areas that support globally significant breeding populations of two marine turtle species, representing two discreet genetic stocks:

- the green turtle, NWS genetic stock; and
- the loggerhead turtle, Western Australia genetic stock.

Locations of habitat critical for each of the two species are outlined in **Table 6-2** and **Figure 6-2**.

BIAs for the green and loggerhead turtles are outlined in **Table 6-3** and **Figure 6-3**.

A 2018 survey, including on-beach monitoring of the Muiron Islands and Ningaloo Coast from North-west Cape to Bungelup (Rob *et al.*, 2019), supports the concept that North-west Cape and the Muiron Islands are major important nesting areas for green and loggerhead turtles, as identified in the Recovery Plan (Commonwealth of Australia, 2017).

Table 6-6 Marine turtle key information for North-west Cape activity area

Species / Genetic Stock	Key Information
Green Turtle	
NWS Stock (G-NWS)	The G-NWS stock is one of the largest green turtle stocks in the world and the largest in the Indian Ocean. The G-NWS stock is estimated at approximately 20,000 individuals (DSEWPAC, 2012a) and the trend for the stock is reported as stable (Commonwealth of Australia, 2017). There is one major rookery of the G-NWS stock located within the North-west Cape activity area. Located on the mainland coast of the North-west Cape, this area is designated habitat critical for the stock and includes an internesting buffer of 20 km radius around the rookery, November to March.
Loggerhead Turtle	
Western Australia Stock (LH-WA)	The LH-WA stock is one of the largest in the world (Limpus, 2009). The trend for the stock is reported as stable (Commonwealth of Australia, 2017). Major rookeries of the LH-WA stock are located at Dirk Hartog Island, Muiron Islands and Gnaraloo Bay. These areas are designated habitat critical for the stock and include an internesting buffer of 20 km radius around these rookeries, November to May. Dirk Hartog Island in the Shark Bay Marine Park, with an average of 122 nests per day over 2.1 km (Reinhold and Whiting, 2014), is recognised as the most important loggerhead turtle rookery in WA (Commonwealth of Australia, 2016; as cited in Rob *et al.*, 2019).

6.5 Sea Snakes

Sea snakes are commonly found in the NWMR and NMR, but less so in the SWMR, and occupy three broad habitat types: shallow water coral reef and seagrass habitats, deepwater soft bottom habitats away from reefs, and surface water pelagic habitats (Guinea, 2007a).

There are 25 listed species of sea snake reported within or adjacent to the NWMR (Guinea, 2007a; Udyawer *et al*., 2016), of which four are endemic to reef habitats in the remote parts of the region:

- dusky sea snake (*Aipysurus fuscus*);
- large headed sea snake (*Hydrophis pacificus*);
- short-nosed sea snake (*Aipysurus apraefrontalis*); and
- leaf-scaled sea snake (*Aipysurus foliosquama*).

The short-nosed sea snake and the leaf-scaled sea snake are listed threatened species (Critically Endangered) under the EPBC Act **(Table 6-7**).

There is currently limited knowledge about the ranges and distribution patterns of sea snake species in the NWMR, in addition to a lack of understanding of population status and threats. Recent findings of *A. apraefrontalis* and *A. foliosquama* in locations outside of their previously defined ranges have highlighted the lack of information on species distributions in the NWMR (Udyawer *et al.*, 2016). Udyawer *et al.* (2020) used a correlative modelling approach to understand habitat associations and identify suitable habitats for five sea snake species (*A. apraefrontalis, A. foliosquama, A. fuscus, A. l. pooleorum* and *A. tenuis*). Species-specific habitat suitability was modelled across 804,244 km^2 of coastal waters along the NWS, and the resulting habitat suitability maps enabled the identification of key locations of suitable habitat for these five species (refer **Table 6-6**).

No habitat critical to survival or BIAs for sea snake species have been identified in the NWMR. While the Ashmore Reef and Cartier Island AMPs have been recognised for their high diversity and density of sea snakes (DSEWPAC, 2012a), surveys have revealed a steep decline in sea snake numbers at Ashmore Reef (Guinea, 2007b; Lukoschek *et al.*, 2013). Leaf-scaled and short-nosed sea snakes have been absent from surveys at Ashmore Reef since 2001, despite an increase in survey intensity (Guinea, 2006, 2007b; Guinea and Whiting, 2005; Lukoschek *et al.*, 2013). The reason for the decline is unknown.

Table 6-7 Information on the two threatened sea snake species within the NWMR

Species	Preferred Habitat and Diet	Habitat Location
Short-nosed sea snake	Preferred habitat: Primarily on the reef flats or in shallow waters of the outer reef edges to depths of 10 m (Minton *et al*., 1975). Typically, movement is restricted to within 50 m of reef flat habitat (Guinea and Whiting, 2005). Diet: Primarily fishes and eels.	The short-nosed sea snake has been recorded from Exmouth Gulf to the reefs of the Sahul Shelf, although most records come from Ashmore and Hibernia reefs (Guinea and Whiting, 2005). Key locations of suitable habitat: Ashmore Reef, Exmouth Gulf, Muiron Islands, Montebello Islands (Udyawer *et al.*, 2020).
Leaf-scaled sea snake	Preferred habitat: The leaf-scaled sea snake occurs in shallow protected areas of reef flats, typically in water depth less than 10 m. Diet: Primarily shallow water coral-associated wrasse, gudgeons, clinids and eels (McCosker, 1975; Voris, 1972; Voris and Voris, 1983)	The leaf-scaled sea snake has only been recorded at Ashmore and Hibernia reefs (Guinea and Whiting, 2005), indicating it has a very limited distribution. Key locations of suitable habitat: Ashmore Reef, Shark Bay, Exmouth Gulf, Barrow Island and Montebello Islands (Udyawer *et al.*, 2020).

6.6 Crocodiles

The salt-water crocodile (*Crocodylus porosus*) is a listed migratory species under the EPBC Act known to occur within the NWMR. The species is found in most major river systems of the Kimberley, including the Ord, Patrick, Forrest, Durack, King, Pentecost, Prince Regent, Lawley, Mitchell, Hunter, Roe and Glenelg rivers. The largest populations occur in the rivers draining into the Cambridge Gulf and the Prince Regent River and Roe River systems. There have also been isolated records in rivers of the Pilbara region, around Derby near Broome and as far south as Carnarvon on the mid-west coast.

No BIAs for salt-water crocodile have been identified in the NWMR.

7. MARINE MAMMALS

7.1 Regional Context

The offshore waters of WA include important habitat for marine mammals, including areas that support key life stages such as breeding, foraging, and migration. Of the 45 species of cetacean occurring in Australian waters, 27 species occur regularly in the waters of the NWMR, nine species in the waters of the NMR and 33 species in the SWMR. The waters of the NWMR and the NMR also support significant populations of dugong (DSEWPAC, 2012a, c).

The NWMR is an important migratory pathway between feeding grounds in the Southern Ocean and breeding grounds in tropical waters of the NWMR for several cetacean species (DSEWPAC, 2012a). Numerous large mysticetes (baleen whale) species, in particular the humpback whale, are known to utilise the region for migration and calving, and the pygmy blue whale for foraging and as a migration pathway between southern feeding and northern breeding/feeding areas, north of the equator.

The SWMR is an important area for numerous marine mammal species including pinniped species, large, migratory whale species and resident coastal whale and dolphin species (DSEWPAC, 2012b).

The NMR and adjacent areas are important for several species of cetacean, particularly inshore dolphin species. These species, and other marine mammals, rely on the waters of the NMR and adjacent coastal areas for breeding and foraging. However, there is little knowledge of the seasonal movements, migrations and breeding seasonality for many of the marine mammal species in the NMR due to lack of extensive surveys (DSEWPAC, 2012c).

Table 7-1 outlines the threatened and migratory marine mammal species that may occur within the NWMR, with their conservation status and relevant recovery plans and/or conservation advice.

Table 7-1 Marine mammal species identified by the EPBC Act PMST as occurring within the NWMR

Species Name	Common Name	*Environment Protection and Biodiversity Conservation Act 1999*			WA *Biodiversity Conservation Act 2016*	EPBC Act Part 13 Statutory Instrument
		Threatened Status	Migratory Status	Listed	Conservation Status	
Cetaceans - Mysticeti						
Balaenoptera musculus	Blue whale	Endangered	Migratory	Cetacean	Endangered	Conservation Management Plan for the Blue Whale - A Recovery Plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2015-2025 (Commonwealth of Australia, 2015a)
Eubalaena australis	Southern right whale	Endangered	Migratory	Cetacean	Vulnerable	Conservation Management Plan for the Southern Right Whale: A Recovery Plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2011-2021 (DSEWPAC, 2012d)
Balaenoptera borealis	Sei whale	Vulnerable	Migratory	Cetacean	Endangered	Conservation Advice *Balaenoptera borealis* sei whale (Threatened Species Scientific Committee, 2015a)
Megaptera novaeangliae	Humpback whale	Vulnerable	Migratory	Cetacean	Conservation dependent	Conservation Advice *Megaptera novaeangliae* humpback whale (Threatened Species Scientific Committee, 2015b)
Balaenoptera physalus	Fin whale	Vulnerable	Migratory	Cetacean	Endangered	Conservation Advice *Balaenoptera physalus* fin whale (Threatened Species Scientific Committee, 2015c)
Balaenoptera edeni	Bryde's whale	N/A	Migratory	Cetacean	N/A	N/A
Balaenoptera bonaerensis	Antarctic minke whale	N/A	Migratory	Cetacean	N/A	N/A
Cetaceans - Odontoceti						
Physeter macrocephalus	Sperm whale	N/A	Migratory	Cetacean	Vulnerable	N/A
Orcinus orca	Killer whale	N/A	Migratory	Cetacean	N/A	N/A
Orcaella heinsohni	Australian snubfin dolphin	N/A	Migratory	Cetacean	Priority	N/A
Sousa chinensis	Indo-Pacific humpback dolphin	N/A	Migratory	Cetacean	Priority	N/A

Species Name	Common Name	*Environment Protection and Biodiversity Conservation Act 1999*			WA *Biodiversity Conservation Act 2016*	EPBC Act Part 13 Statutory Instrument
		Threatened Status	Migratory Status	Listed	Conservation Status	
Tursiops aduncus	Spotted bottlenose dolphin (Arafura/Timor Sea populations)	N/A	Migratory	Cetacean	N/A	N/A
Sirenians and Pinnipeds						
Dugong dugon	Dugong	N/A	Migratory	Marine	Other protected fauna	N/A
Neophoca cinerea	Australian sea lion	Endangered	N/A	Marine	Vulnerable	Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) 2013 (DSEWPAC, 2013a) Conservation Advice *Neophoca cinerea* Australian Sea Lion (Threatened Species Scientific Committee, 2020a) (in effect under the EPBC Act from 23-Dec-2020)

7.2 Cetaceans in the NWMR

Cetaceans are generally widely distributed and highly mobile. In general, distribution patterns reflect seasonal feeding areas, characterised by high productivity, and migration routes associated with reproductive patterns. The NWMR is thought to be an important migratory pathway between feeding grounds in the Southern Ocean and breeding grounds in tropical waters for several cetacean species (DSEWPAC, 2012a).

From the Protected Matters search, 34 EPBC Act listed species were recorded as potentially occurring or having habitat within the NWMR (**Appendix A**). Of those, 12 cetacean species are listed as threatened and/or migratory, including baleen whales, toothed whales and dolphins that occur within the NWMR (**Table 7-2**).

7.3 Dugongs in the NWMR

The dugong is listed as migratory under the EPBC Act. Dugongs inhabit seagrass meadows in coastal waters, estuarine creeks and streams, and reef systems (DSEWPAC, 2012a).

Some of the coastal waters adjacent to the NWMR support significant populations of dugongs, including Shark Bay, Exmouth Gulf, in and adjacent to Ningaloo Reef, in coastal waters along the Kimberley coast, and on the edge of the continental shelf at Ashmore Reef (DEWHA, 2008).

Although the patterns of dugong movement in WA are not well understood, it is thought that dugongs move in response to availability of seagrass (Marsh *et al.*, 1994; Preen *et al.*, 1997) and water temperature.

There are a number of BIAs for dugong within and adjacent to waters of the NWMR (refer **Section 7.5**).

7.4 Pinnipeds in the NWMR

The Australian sea lion is listed as a species that may occur, or may have habitat within the NWMR (Protected Matters search - **Appendix A**). It is included here as the Australian sea lion is the only pinniped endemic to Australia (Strahan, 1983) and has been recorded within the southern extent of the NWMR at Shark Bay, WA (Kirkwood *et al.*, 1992). The most northern known breeding colony is at the Houtman Abrolhos Islands in the SWMR. The Australian sea lion's breeding range extends from the Houtman Abrolhos Islands, WA to The Pages Island, east of Kangaroo Island, SA. The Australian sea lion was listed as endangered in 2020 (Threatened Species Scientific Committee, 2020a). An assessment of the status and trends in abundance of this endemic, coastal pinniped species (Goldsworthy *et al.* 2021) documented an overall reduction in pup abundance over three generations, providing strong evidence that the species meets IUCN endangered criteria.

There are no BIAs for the Australian sea lion in the NWMR.

Table 7-2 Information on the threatened/migratory marine mammal species within the NWMR

Species	Key Information
	Baleen whales (Mysticeti)
Humpback whale	In Australian waters two genetically distinct populations migrate annually along the west (Group IV) and east coasts (Group V) between May and November. In WA, the migration pathway for the Group IV population (also known as Breeding Stock D) extends from Albany to the Kimberley coastline, passing through the NWMR (Threatened Species Scientific Committee, 2015b). Since the 1982 moratorium on commercial whaling population numbers have recovered significantly; from approximately 2000 to 3000 individuals in 1991, to between 19,200–33,850 individuals in 2008 (Bannister and Hedley, 2001; Bejder *et al.*, 2019; Hedley *et al.*, 2011). Aerial surveys off the WA coast undertaken between 2000 and 2008 produced a population estimate for the Group IV population of 26,100 individuals (CI 20,152–33,272) in 2008 (Salgado Kent *et al.*, 2012). Current population growth for the Group IV population is estimated to be between 9.7 and 13% per annum (Threatened Species Scientific Committee, 2015b). Using the Salago-Kent *et al.* (2012) estimate of 26,100 individuals and an annual population growth rate of ~10%, current population size could be in excess of 75,000 individuals (Woodside, 2019). The Group IV population migrates northward from their Antarctic feeding grounds around May each year, reaching the NWMR around early June. The southward migration subsequently starts in mid-September, around the time of breeding and calving (typically August to September) (Threatened Species Scientific Committee, 2015b). Within the NWMR there are key calving areas between Broome and the northern end of Camden Sound, and resting areas in the southern Kimberley region, Exmouth Gulf and Shark Bay. In particular, high numbers of humpback whales are observed in Camden Sound and Pender Bay from June to September each year (Threatened Species Scientific Committee, 2015b). There are reports of neonates further south, suggesting that the calving areas may be poorly defined. Aerial photogrammetric surveys in 2013 and 2015 recorded large numbers of humpback whale calves along North-west Cape, with estimated minimum relative calf abundance of 463–603 in 2013 and 557–725 in 2015 (Irvine *et al.*, 2018). The majority of calves sighted in both years (85% in 2013; 94% in 2015) were neonates, and these observations indicate that a minimum of approximately 20% of the expected number of calves of this population are born near, or south of, North-west Cape. Thus, the calving grounds for the Group IV population extend south from Camden Sound to at least North-west Cape, 1000 km south-west of the currently recognized calving area (Irvine *et al.*, 2018). There are BIAs for migration and breeding and calving for the humpback whale along the WA coast and within the NWMR (refer **Table 7-3** and **Figure 7-1**).
Blue whale	There are two recognised sub-species of blue whale in the Southern Hemisphere, both of which are recorded in Australian waters. These are the southern (or ‘true’) blue whale (*Balaenoptera musculus*) and the ‘pygmy’ blue whale (*Balaenoptera musculus brevicauda*) (Commonwealth of Australia, 2015a). In general, southern blue whales occur in waters south of 60°S and pygmy blue whales occur in waters north of 55°S (i.e. not in the Antarctic). On this basis, nearly all blue whales sighted in the NWMR are likely to be pygmy blue whales. The East Indian Ocean (EIO) pygmy blue whale population is seasonally distributed from Indonesia (a potential breeding ground) to south-west of Australia and east across the Great Australian Bight and Bonney Upwelling to beyond the Bass Strait (Blue Planet Marine, 2020). Migration seems to be variable, with some individuals appearing as resident to areas of high productivity and others undertaking migrations across long distances (Commonwealth of Australia, 2015a). McCauley *et al.* (2018) describe three migratory stages around Australia for the EIO pygmy blue whale population: a ‘southbound migratory stage’ where whales travel southwards from Indonesian waters offshore from the WA coastline, mostly from October to December but possibly into January of the following year; a protracted ‘southern Australian stage’ (January to June) where animals spread across southern waters of the Indian Ocean and south of Australia; and a ‘northbound migratory stage’ (April to August) where animals travel north back to Indonesia again. There are currently insufficient data to accurately estimate population numbers of the pygmy blue whale in Australian waters (Blue Planet Marine, 2020; Commonwealth of Australia, 2015a). There are, however, two estimates of population size of the EIO pygmy blue whale for WA. McCauley and Jenner (2010) calculated the population to be between 662 and 1559 individuals in 2004 based on passive acoustics (whale vocalisations), and Jenner *et al.* (2008) (based on photographic mark and recapture) calculated between 712 and 1754 individuals, but both estimates did not account for animals

Species	Key Information
	travelling further west into the Indian Ocean (McCauley *et al.*, 2018). More recent passive acoustic data estimates a 4.3% growth rate that applies to the proportion of EIO pygmy blue whales seasonally present in offshore water of the south-eastern Australia and may not reflect the full population but does imply an increasing population (McCauley *et al.*, 2018). The pygmy blue whale is typically present in the Perth Canyon from November to June, with an observed peak between March and May (Commonwealth of Australia, 2015a; Blue Planet Marine, 2020). The pygmy blue whale feeds in the Perth Canyon at depths of 200 to 300 m, which overlaps the typical distribution of krill (200–500 m water depth (day) to surface (night) (McCauley *et al.*, 2004; Commonwealth of Australia, 2015a). Other possible feeding grounds off the WA coast include the wider area around the Perth Canyon, and possible foraging areas off the Ningaloo Coast and at Scott Reef (Commonwealth of Australia, 2015a). Refer **Table 7-3** and **Figure 7-2** for the location and type of BIAs for blue whales in the NWMR. There is a migratory BIA for the pygmy blue whale within WA waters, which extends for most of the length of the NWMR within offshore waters.
Bryde's whale	The Bryde's whale is the least migratory of its genus and is restricted geographically from the equator to approximately 40°N and S, or the 20° isotherm (Bannister *et al.*, 1996). The species is known to exhibit inshore and offshore forms in other international locations that vary in morphology and migratory behaviours (Bannister *et al.*, 1996). This appears to also be the case within Australian waters. Bryde's whales have been identified as occurring in both oceanic and inshore waters, with the only key localities recognised in WA being in the Houtman Abrolhos Islands and north of Shark Bay (Bannister *et al.*, 1996). Data suggests offshore whales migrate seasonally, heading towards warmer tropical waters during the winter; however, information about migration within the NWMR is not well known (McCauley and Duncan, 2011). McCauley (2011) detected Bryde's whales using acoustic loggers deployed in and around Scott Reef from 2006 to 2009. Other acoustic logger data of Bryde's whale vocalisations recorded between Ningaloo and north of Darwin showed no apparent trends or seasonality (McCauley, 2011). There are no identified BIAs for this species in the National Conservation Values Atlas.
Southern right whale	The southern right whale occurs primarily in waters between about 20°S and 60°S and moves from high latitude feeding grounds in summer to warmer, low latitude, coastal locations in winter (Bannister *et al.*, 1996). Southern right whales aggregate in calving areas along the south coast of WA outside of the NWMR. However, there have been sightings in waters of the NWMR as far north as Ningaloo (Bannister and Hedley, 2001), and a stranding record exists for the far north Kimberley coast (ALA, 2020). Southern right whale calving grounds are found at mid to lower latitudes and are occupied during the austral winter and early-mid spring. They are regularly present on the southern Australian coast from about mid-May to mid-November, and peak periods for mating are from mid-July through August. Mating occurs within these breeding grounds as evidenced by many observations of intromission and mating behaviours. Southern right whales in south-western Australia appear to be increasing at the maximum biological rate but there is limited evidence of increase in south-eastern Australian waters (DSEWPAC, 2012d). There are no identified BIAs for this species in the NWMR.
Antarctic minke whale	The Antarctic minke whale is distributed worldwide and has been recorded off all Australian states (but not in the NT), feeding in cold waters and migrating to warmer waters to breed. It is thought that the Antarctic minke whale migrates up the WA coast to about 20°S to feed and possibly breed (Bannister *et al.*, 1996); however, detailed information about timing and location of migrations and breeding grounds within the NWMR is not well known. In the high latitudinal winter breeding grounds in other regions, the species appears to be distributed off the continental shelf edge. No population estimates are available for Antarctic minke whales in Australian waters. There are no identified BIAs for this species in the National Conservation Values Atlas.
Sei whale	The sei whale is a baleen whale with a worldwide oceanic distribution and is expected to seasonally migrate between low latitude wintering areas and high latitude summer feeding grounds (Bannister *et al.*, 1996; Prieto *et al.*, 2012). There are no known mating or calving areas in Australian waters. The species has a preference for deep waters, typically occurs in oceanic basins and continental slopes (Prieto *et al.*, 2012), and exhibits a migration pathway influenced by seasonal feeding and breeding patterns. Sei whales have been infrequently recorded in Australian waters (Bannister *et al.*, 1996). Reliable estimates of the sei whale population size in Australian waters are currently not possible due to a lack of dedicated surveys and their elusive characteristics. Similarly, the extent of occurrence and area of occupancy of sei whales in Australian waters cannot be calculated due to the

Species	Key Information
	rarity of sighting records. They will typically travel in small pods of three to five individuals, with some segregation by age, sex and reproductive status. Calving grounds are presumed to exist in low latitudes with mating and calving potentially occurring during winter months (Threatened Species Scientific Committee, 2015a). There are no known mating or calving areas in Australian waters, and there are no identified BIAs for this species in the National Conservation Values Atlas.
Fin whale	The fin whale is a large baleen whale distributed worldwide. Fin whales migrate annually between high latitude summer feeding grounds and lower latitude over-wintering areas (Bannister *et al.*, 1996) and follow oceanic migration paths. The species is uncommonly encountered in coastal or continental shelf waters. Australian Antarctic waters are important feeding grounds for fin whales but there are no known mating or calving areas in Australian waters (Morrice *et al.*, 2004). The species has been observed in groups of six to 10 individuals, as well as in pairs and alone (Threatened Species Scientific Committee, 2015c). Accurate distribution patterns are not known within Australian waters and the majority of data are from stranding events. Fin whales have been recorded vocalising off the Perth Canyon, WA, between January and April 2000 (McCauley *et al.*, 2000). It is currently not possible to accurately estimate the population size of fin whales in Australian waters predominantly due to the species' behaviour and local ecology, as the proportion of time they spend at the surface varies greatly depending on these factors. In addition, natural fluctuations of fin whales in Australian waters are unknown; however, long-range movements do appear to be prey-related. A recent study by Aulich *et al.* (2019) used passive acoustic monitoring as a tool to identify the migratory movements of fin whales in Australian waters. On the west coast, the earliest arrival of these animals occurred at Cape Leeuwin in April, and between May and October they migrated along the WA coastline to the Perth Canyon, which likely acts as a way-station for feeding (Aulich *et al.*, 2019). Some whales were found to continue migrating as far north as Dampier (Aulich *et al.*, 2019). There are no identified BIAs for this species in the National Conservation Values Atlas.
Toothed whales (Odontoceti)	
Sperm whale	Sperm whales are the largest of the toothed whales and are distributed worldwide in deep waters (greater than 200 m) off continental shelves and sometimes near shelf edges (Bannister *et al.*, 1996). The species tends to inhabit offshore areas at depths of 600 m or more and is uncommon in waters less than 300 m deep (Ceccarelli *et al.*, 2011). There is limited information about sperm whale distribution in Australian waters, however, they are usually found in deep offshore waters, with more dense populations close to continental shelves and canyons. In the open ocean, there is a generalised movement of sperm whales southwards in summer, and corresponding movement northwards in winter, particularly for males. Detailed information about the distribution and migration patterns of sperm whales off the WA coast is not available. Females with young may reside within the NWMR all year round, males may migrate through the region and the species may be associated with canyon habitats (Ceccarelli *et al.*, 2011). Sperm whales have been recorded in deep waters off North-west Cape and appear to occasionally venture into shallower waters in other areas. Twenty-three (23) sightings of sperm whales (variable pod sizes, ranging from one to six animals) were recorded by marine mammal observers (MMOs) during the North West Cape MC3D marine seismic survey (December 2016 to April 2017) (Woodside, 2020). These animals were observed in deep, continental slope waters of the Montebello Saddle (maximum distance of approximately 90 km from North-west Cape), and the waters overlying the Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula KEF. The deep waters above the gully/saddle on the inner edge of the plateau (the Montebello Saddle) are thought to be important for sperm whales that may feed in the region (based on 19th Century whaling records; Townsend, 1935). There are no identified BIAs for this species in the NWMR.
Killer whale	The preferred habitat of killer whales includes oceanic, pelagic and neritic (relatively shallow waters over the continental shelf) regions, in both warm and cold waters. Killer whales appear to be more common in cold, deep waters; however, they have been observed along the continental slope and shelf, particularly near seal colonies, as well as in shallow coastal areas of WA (Bannister *et al.*, 1996; Thiele and Gill, 1999). The total number of killer whales in Australian waters is unknown, however, it may be that the total number of mature animals within waters around the continent is less than 10,000. Killer whales are known to make seasonal movements, and probably follow regular migratory routes, but no information is available for the

Species	Key Information
	species in Australian waters. Killer whales are top-level carnivores, and there are reports from around Australia of attacks on dolphins, juvenile humpback whales, blue whales, sperm whales, dugongs and Australian sea lions (Bannister *et al.*, 1996). Killer whales are known to target humpback whales, particularly calves, off Ningaloo Reef during the humpback southern migration season (Pitman *et al.*, 2015). Overall, observations suggest that humpback calves are a predictable, plentiful, and readily taken prey source for killer whales off Ningaloo Reef for at least five months of the year. Additionally, there are records of killer whales attacking dugongs in Shark Bay (Anderson and Prince, 1985). However, there are no recognised key localities or important habitats for killer whales within the NWMR (DSEWPAC, 2012a). There are no identified BIAs for this species in the NWMR.
Australian snubfin dolphin	Stranding and museum specimen records indicate that Australian snubfin dolphins occur only in waters off northern Australia, from approximately Broome on the west coast to the Brisbane River on the east coast (Parra *et al.*, 2002). Aerial and boat-based surveys indicate that Australian snubfin dolphins occur mostly in protected shallow waters close to the coast, and close to river and creek mouths (Parra, 2006; Parra *et al.*, 2006; Parra *et al.*, 2002). Within the NWMR, species has been found in the shallow coastal waters and estuaries along the Kimberley coast. Beagle and Pender bays on the Dampier Peninsula, and tidal creeks around Yampi Sound and between Kuri Bay and Cape Londonderry are important areas for Australian snubfin dolphins (DEWHA, 2008). Roebuck Bay has generally been considered the south-western limit of snubfin dolphin distribution across northern Australia, but the species has been recorded in Port Hedland harbour, the Dampier Archipelago, Montebello Islands, Exmouth Gulf and off North-west Cape (Allen *et al.*, 2012). A first comprehensive catalogue of snubfin dolphin sightings has been compiled for the Kimberley, north-west Western Australia (Bouchet *et al.* 2021) and documented that snubfin dolphins are consistently encountered in shallow water (<21 m depth) close to (<15 km) freshwater inputs with high detection rates in known hotspots such as Roebuck Bay and Cygnet Bay as well as suitable coastal habitat in the wider Kimberley region. Refer **Table 7-3** and **Figure 7-3** for the location and type of BIAs for Australian snubfin dolphins in the NWMR.
Indo-Pacific humpback dolphin (Australian humpback dolphin)	Previously included with *Sousa chinensis*, the Australian humpback dolphin (*S. sahulensis*) was elevated to a species in 2014. *S. chinensis* is now applied for humpback dolphins in the eastern Indian and western Pacific Oceans and *S. sahulensis* for humpback dolphins in the waters of the Sahul Shelf from northern Australia to southern New Guinea (Jefferson and Rosenbaum, 2014). The Australian humpback dolphin is listed as *S. chinensis* under EPBC Act. The Australian humpback dolphin (referred to as 'humpback dolphin' hereafter) inhabits the tropical/subtropical waters of the Sahul Shelf across northern Australia and southern Papua New Guinea (Jefferson and Rosenbaum, 2014). Based on historical stranding data, museum specimens and opportunistic sightings collected during aerial and boat-based surveys for other fauna it has been inferred that humpback dolphins occur from the WA/NT border south-west to Shark Bay (Hanf *et al.*, 2016). Allen *et al.* (2012) suggested that humpback dolphins use a range of inshore habitats, including both clear and turbid coastal waters across northern WA. The waters surrounding North-west Cape are an important area for the species. Boat-based surveys up to 5 km out from the coast (Brown *et al.*, 2012) recorded humpback dolphins from 0.3 to 4.5 km away from shore and in depths ranging from 1.2 to 20 m, with a mean of ~8 m. Other studies around North-west Cape, surveying waters up to 5 km from the coast, recorded humpback dolphins in water depths of up to 40 m (Hanf *et al.*, 2016). Based on density, site fidelity and residence patterns, North-west Cape is clearly an important habitat toward the south-western limit of this species' range (Hunt *et al.*, 2017). Aerial surveys targeting dugongs over the western Pilbara have recorded humpback dolphins more than 60 km from the mainland in shallow shelf waters (i.e. <30 m deep) near Barrow Island and the western Lowendal Islands (Hanf, 2015). The species has also been recorded in fringing coral reef and shallow, sheltered sandy lagoons at the Montebello Islands (Raudino *et al.*, 2018). Over the past ten years a number of studies have focused on populations of humpback dolphins along the Kimberley coast, including Roebuck Bay, the Dampier Peninsula, Cone Bay, Yampi Sound, Prince Regent River and the Cambridge Gulf (Brown *et al.*, 2016). Refer Table **Table 7-3** and **Figure 7-4** for the location and type of BIAs for Indo-Pacific humpback dolphins in the NWMR.
Indo-Pacific bottlenose dolphin (Spotted bottlenose dolphin)	There are four known sub-populations of spotted bottlenose dolphins, of which the Arafura/Timor Sea populations were identified as potentially occurring within the NWMR. The species is restricted to inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters including coastal areas around oceanic islands, from Shark Bay to the western edge of the Gulf of Carpentaria. The species

Species	Key Information
	forages in a range of habitats but is generally restricted to water depths of less than 200 m (DSEWPAC, 2012a). Important foraging/breeding areas include the shallow coastal waters and estuaries along the Kimberley coast and Roebuck Bay. Refer **Table 7-3** the location and type of BIAs for spotted bottlenose dolphins in the NWMR.
Sirenians	
Dugong	Dugongs are distributed along the WA coast throughout the Gascoyne, Pilbara and Kimberley. Specific areas supporting dugong populations include: Shark Bay; Ningaloo and Exmouth Gulf; the Pilbara coast (Exmouth Gulf to De Grey River [Marsh *et al.*, 2002]); and Eighty Mile Beach and the Kimberley coast, including Roebuck Bay (Brown *et al.*, 2014). Dugong distribution is correlated with the seagrass habitats upon which it feeds, although water temperature has also been correlated with dugong movements and distribution (Preen *et al.*, 1997; Preen, 2004). Dugongs are known to migrate between seagrass habitats (hundreds of kilometres) (Sheppard *et al.*, 2006), and in Shark Bay they exhibit seasonal movements as a behavioural thermoregulatory response to winter water temperatures (Holley *et al.*, 2006; Marsh *et al.*, 2011). Aerial surveys since the mid-1980s indicate that dugong populations are now stable at a regional scale in Shark Bay and in the Exmouth/Ningaloo Reef. Refer **Table 7-3** and **Figure 7-5** for the location and type of BIAs for dugong in the NWMR.
Pinnipeds	
Australian sea lion	The Australian sea lion is the only endemic pinniped (true seals, fur seals and sea lions) in Australian waters. It is a member of the Otariidae (eared seals) family. The birth interval in Australian sea lions is around 17–18 months. The Australian sea lion is unique among pinnipeds in being the only species that has a non-annual breeding cycle that is also temporally asynchronous across its range (DSEWPAC, 2013a; Threatened Species Scientific Committee, 2020a). This means the breeding period (copulation and birthing) in one colony will occur at different times to breeding in another colony. The Australian sea lion is considered to be a specialised benthic forager—that is, it feeds primarily on the sea floor. Studies have shown that the species will eat a range of prey, including fish, cephalopods (squid, cuttlefish and octopus), sharks, rays, rock lobsters and penguins (DSEWPAC, 2013a; Threatened Species Scientific Committee, 2020a). The Australian sea lion feeds on the continental shelf, most commonly in depths of 20–100 m, and they typically travel up to about 60 km from their colony on each foraging trip, with a maximum distance of around 190 km when over shelf waters. The current breeding distribution of the Australian sea lion extends from the Houtman Abrolhos Islands on the west coast of WA to the Pages Islands in SA. Sites for the 58 breeding colonies occurring in WA and SA are designated as habitat critical to the survival of the species under the Recovery Plan for the Australian sea lion (DSEWPAC, 2013a). Of these, four are located in the SWMR along the west coast of WA: Abrolhos Islands (Easter Group), Beagle Island, North Fisherman Island and Buller Island. There are also a number of foraging BIAs for both males and females along the west coast, extending from the Abrolhos Islands south to Rockingham. There is no designated habitat critical to survival or identified BIAs for this species in the NWMR. **Figure 7-6** shows the foraging BIAs for the Australian sea lion to the south of the NWMR.

7.5 Biological Important Areas in the NWMR

BIAs representing important life cycle stages and behaviours for six species of marine mammal in the NWMR: the humpback whale, the pygmy blue whale, Australian snubfin dolphin, Australian humpback dolphin, spotted bottlenose dolphin and dugong, are presented in **Table 7-3**.

Table 7-3 Marine mammal BIAs within the NWMR

Species	Woodside Activity Area			BIAs				
	Browse	NWS/S	NWC	Resting	Foraging	Breeding	Calving	Migration
Humpback whale[1]	✓	✓	✓	Shark Bay Exmouth Gulf (north migration – early June) (south migration – late Aug to Oct) Southern Kimberley region	No foraging BIA identified within the NWMR	Kimberley coast from the Lacepede Islands to north of Camden Sound (mid Aug – early Sept)	Core calving in waters off the Kimberley coast from the Lacepede Islands to north of Camden Sound (mid Aug – early Sept)	Southern border of the NWMR to north of the Kimberley (arrive June)
Blue whale and Pygmy blue whale [1 2]	✓	✓	✓	No resting BIA identified within the NWMR	Possible foraging areas off Ningaloo and Scott Reef	No breeding BIA identified within the NWMR	No calving BIA identified within the NWMR	Augusta to Derby. Along the shelf edge at depths of 500 m to 1000 m; appear close to Ningaloo coast Montebello Islands area on southern migration (north: April – Aug) (south: Oct – late Dec)
Australian snubfin dolphin [1]	✓	✓	-	No resting BIA identified within the NWMR	Roebuck Bay Cambridge Gulf Camden Sound area King Sound (south) King Sound (north) Yampi Sound Talbot Bay Maret Islands Bigge Island Admiralty Gulf Parry Harbour Bougainville Peninsula Vansittart Bay Anjo Peninsula Napier	Roebuck Bay Cambridge Gulf Camden Sound area King Sound (south) King Sound (north) Yampi Sound Talbot Bay Maret Islands Bigge Island Admiralty Gulf Parry Harbour Bougainville Peninsula Vansittart Bay, Anjo Peninsula Napier Broome Bay Deep Bay Prince Regent River King George River Cape Londonderry	Roebuck Bay Cambridge Gulf Camden Sound area King Sound (south) King Sound (north) Yampi Sound Talbot Bay Maret Islands Bigge Island Admiralty Gulf Parry Harbour Bougainville Peninsula Vansittart Bay Anjo Peninsula Napier Broome Bay Deep Bay Prince Regent River	No migration BIA identified within the NWMR

Species	Woodside Activity Area			BIAs				
	Browse	NWS/S	NWC	Resting	Foraging	Breeding	Calving	Migration
					Broome Bay Deep Bay Prince Regent River King George River Cape Londonderry Ord River	Ord River	King George River Cape Londonderry Ord River	
Indo-Pacific humpback dolphin	✓	✓	-	No resting BIA identified within the NWMR	Roebuck Bay Willie Creek Prince Regent River King Sound (north) Yampi Sound Talbot Bay Walcott Inlet Doubtful Bay Deception Bay Augustus Island Maret Islands Bigge Island King Sound, southern sector Vansittart Bay, Anjo Peninsula	Roebuck Bay Willie Creek Prince Regent River King Sound (north) Yampi Sound Talbot Bay Walcott Inlet Doubtful Bay Deception Bay Augustus Island	Roebuck Bay Willie Creek Prince Regent River	No migration BIA identified within the NWMR
Spotted bottlenose dolphin	✓	✓	✓	No resting BIA identified within the NWMR	Roebuck Bay Cambridge Gulf Camden Sound area King Sound (south) King Sound (north) Yampi Sound	Roebuck Bay Cambridge Gulf Camden Sound area King Sound (south) King Sound (north) Yampi Sound	No calving BIA identified within the NWMR	No migration BIA identified within the NWMR

Species	Woodside Activity Area			BIAs				
	Browse	NWS/S	NWC	Resting	Foraging	Breeding	Calving	Migration
Dugong[1]	✓	✓	✓	No resting BIA identified within the NWMR	Exmouth Gulf Ningaloo Reef Shark Bay Roebuck Bay Dampier Peninsula	No breeding BIA identified within the NWMR	Exmouth Gulf Ningaloo Reef Shark Bay	Not listed as a migratory species

[1.] *DSEWPAC (2012a)*

[2.] *Commonwealth of Australia (2015a)*

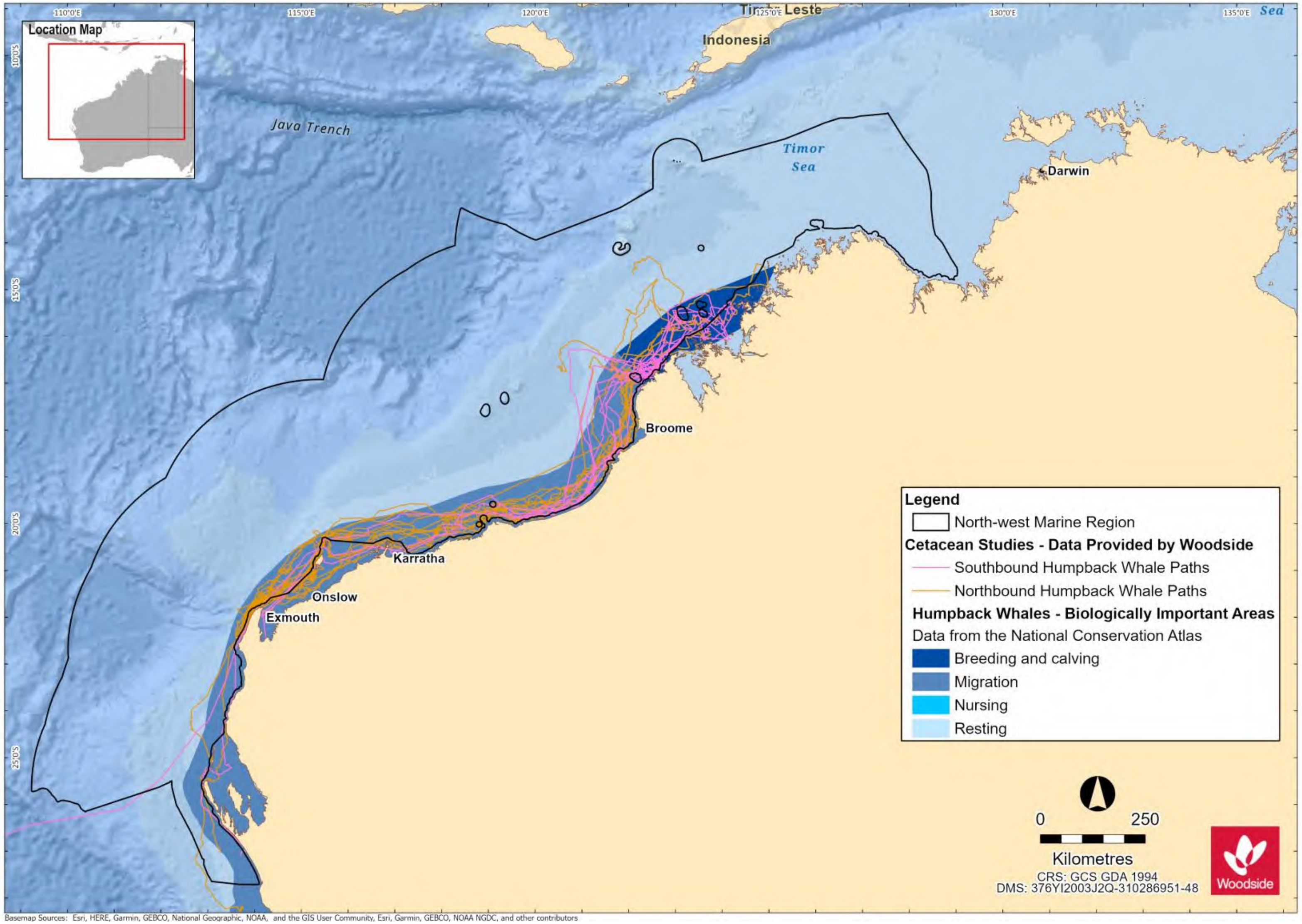

Figure 7-1 Humpback whale BIAs for the NWMR and tagged tracks for north and south bound migrations

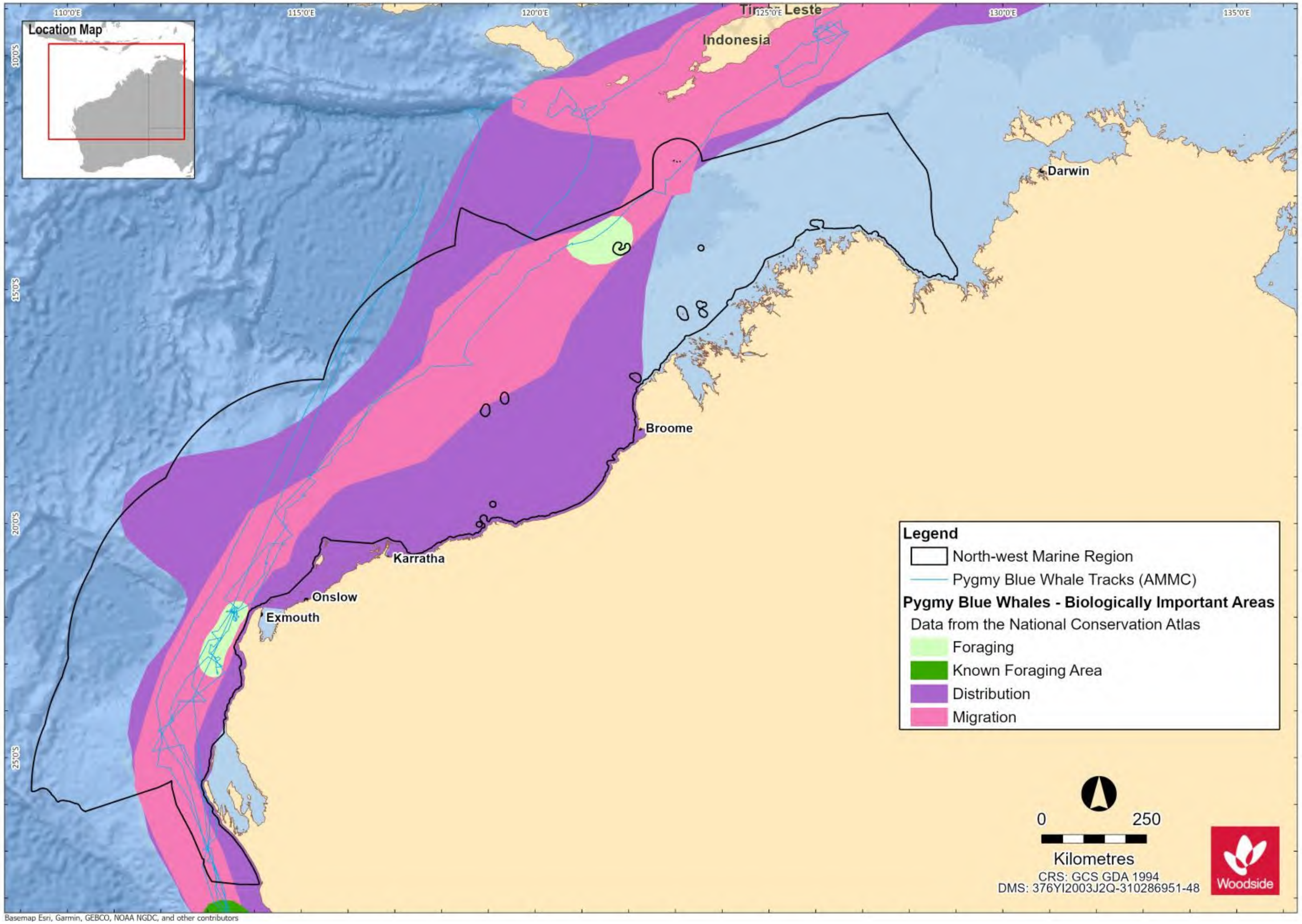

Figure 7-2 Pygmy blue whale BIAs for the NWMR and tagged whale tracks for northbound migration

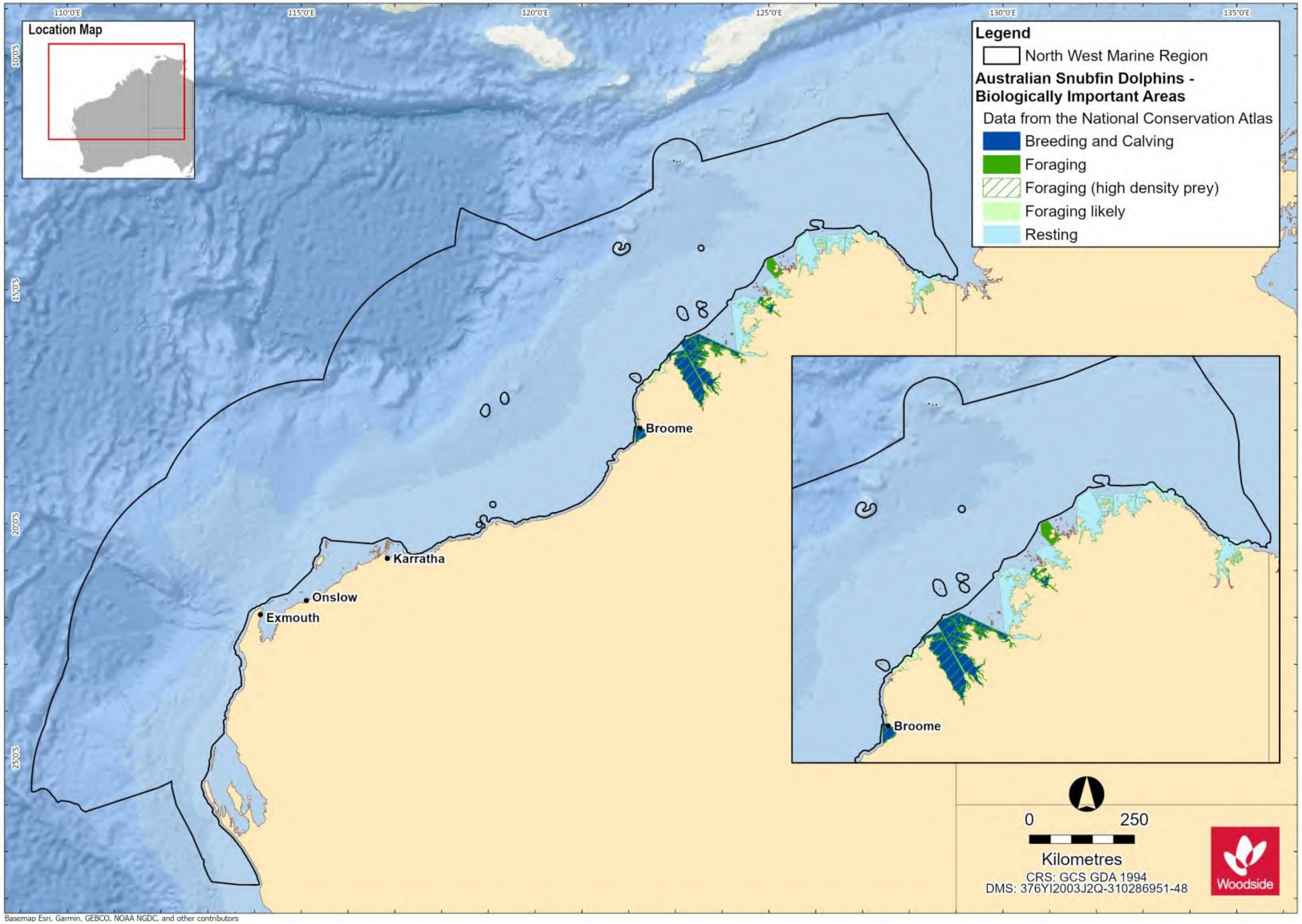

Figure 7-3 Australian snubfin dolphin BIAs for the NWMR

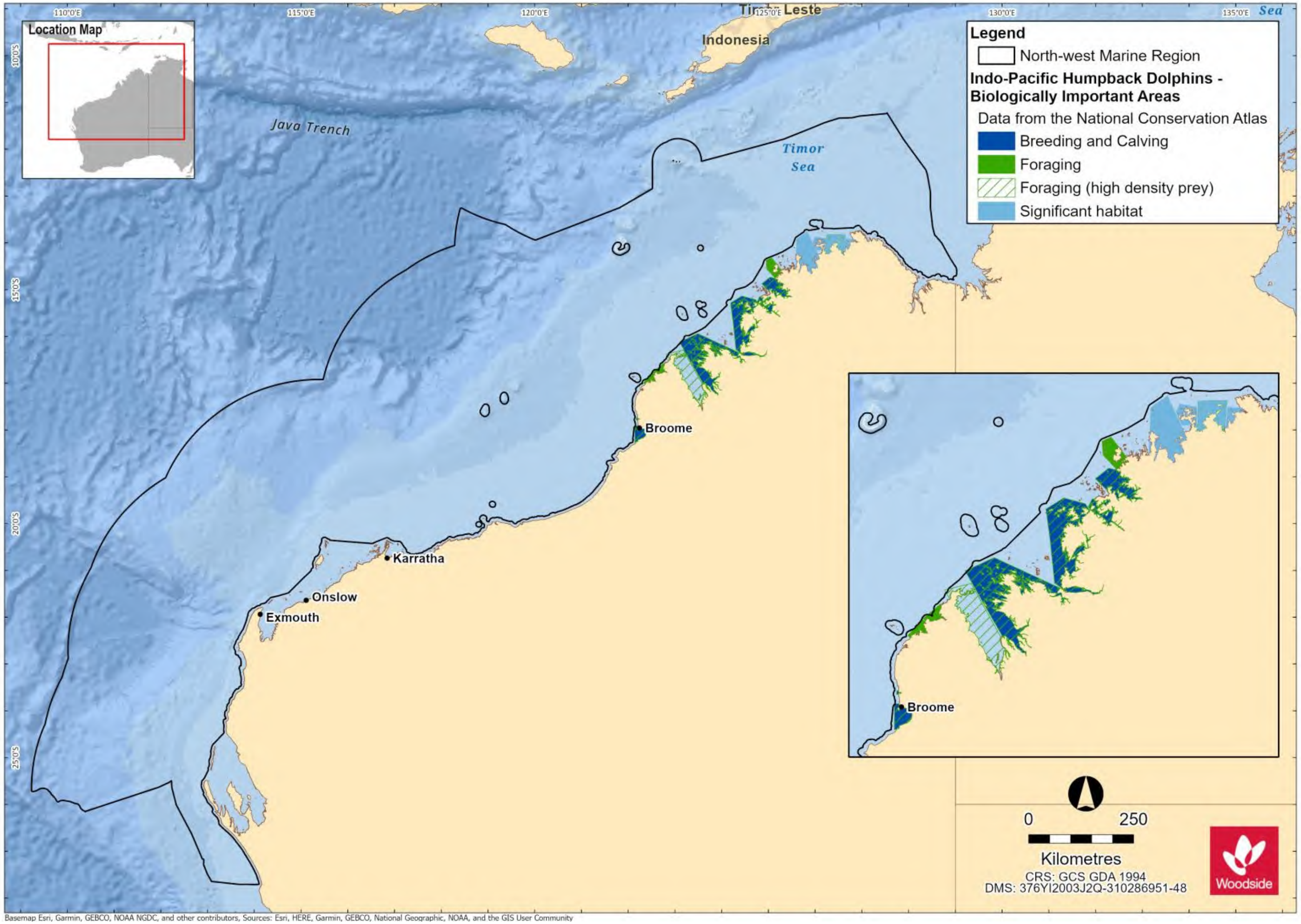

Figure 7-4 Indo-Pacific humpback dolphin BIAs for the NWMR

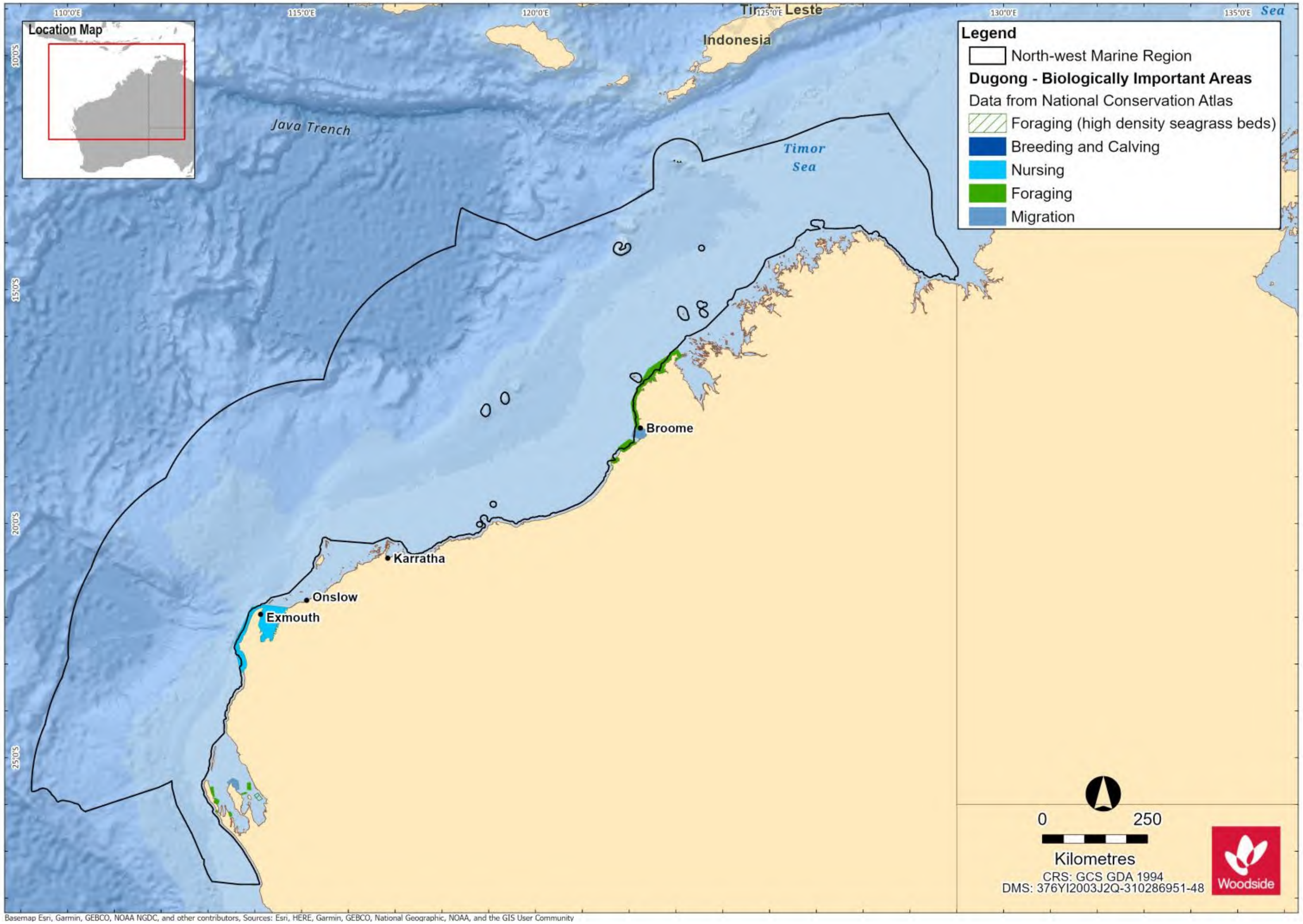

Figure 7-5 Dugong BIAs for the NWMR

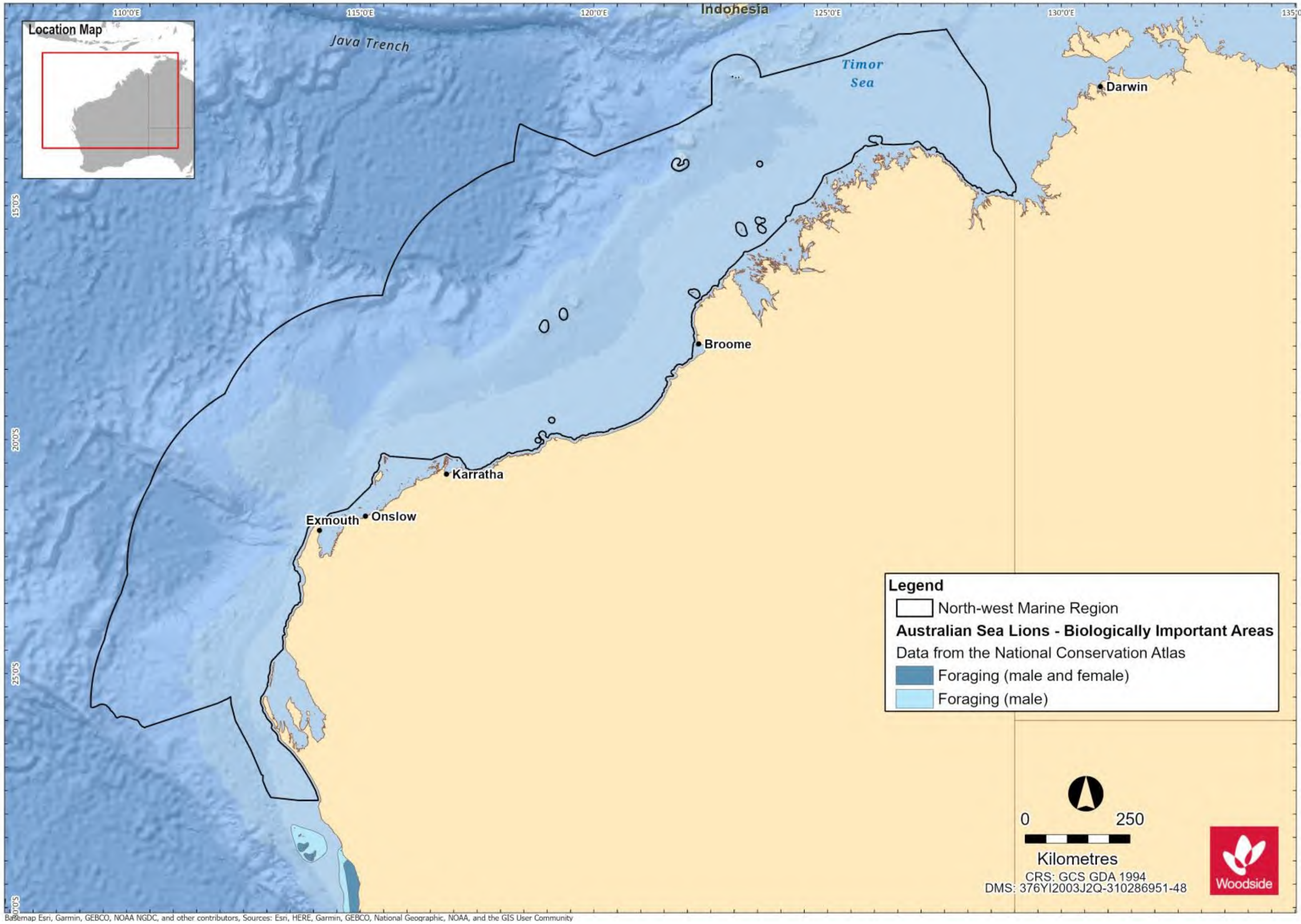

Figure 7-6 Australian sea lion BIAs in the northern extent of the SWMR closest to the NWMR

7.6 Marine Mammal Summary for the NWMR

7.6.1 Browse

The Browse activity area includes biologically important habitat for five threatened and/or migratory marine mammal species:

- blue whale and pygmy blue whale (foraging and migration areas);
- humpback whale (breeding, calving and migration areas);
- Indo-Pacific humpback dolphin (foraging, breeding and calving areas);
- Australian snubfin dolphin (foraging, breeding and calving areas); and
- dugong (foraging).

BIAs for the marine mammal species are outlined in **Table 7-3**.

7.6.2 North-west Shelf / Scarborough

The NWS / Scarborough activity area includes biologically important habitat for five threatened and/or migratory marine mammal species:

- blue whale and pygmy blue whale (foraging and migration areas);
- humpback whale (resting and migration areas);
- Indo-Pacific humpback dolphin (foraging, breeding and calving areas);
- Australian snubfin dolphin (foraging, breeding and calving areas); and
- dugong (foraging and calving areas).

BIAs for the marine mammal species are outlined in **Table 7-3**.

7.6.3 North-west Cape

The North-west Cape activity area includes biologically important habitat for three threatened and/or migratory marine mammal species:

- blue whale and pygmy blue whale (foraging and migration areas);
- humpback whale (resting and migration areas); and
- dugong (foraging and calving areas).

BIAs for the marine mammal species are outlined in **Table 7-3**.

8. SEABIRDS AND MIGRATORY SHOREBIRDS OF THE NWMR

8.1 Regional Context

The NWMR supports high numbers and species diversity of seabirds and migratory shorebirds including many that are EPBC Act listed, threatened and migratory. The NWMR marine bioregional plan reported 34 seabird species (listed as threatened, migratory and/or marine) that are known to occur, and 30 of 37 species of migratory shorebird species that regularly occur in Australia, are recorded at Ashmore Reef in the NWMR (DSEWPAC, 2012e). The NWMR marine bioregional plan also noted that Roebuck Bay and Eighty Mile Beach are internationally significant and recognised migratory shorebird locations.

Many migratory seabirds and shorebirds are protected through bilateral agreements between Australia and Japan (JAMBA), China (CAMBA) and the Republic of Korea (ROKAMBA), recognising the migratory route and important stopover and resting habitats of the East Asian-Australasian Flyway (EAAF). Important migratory bird habitats are also recognised as part of protected wetlands of the internationally significance under the Ramsar Convention. Important Bird Areas (IBAs) for the NWMR, which are also recognised as global Key Biodiversity Areas (KBAs) (BirdLife Australia[4]), include:

- Roebuck Bay KBA (and Ramsar site): Internationally significant migratory shorebird species.
- Mandora Marsh and Anna Plains KBA (adjacent to Eighty Mile Beach, Ramsar site): Internationally significant migratory shorebird species.
- Dampier Saltworks KBA: Internationally significant migratory shorebird species.
- Montebello Islands KBA: Shorebird and seabird species.
- Barrow Island KBA: Shorebird and seabird species.
- Exmouth Gulf Mangroves KBA: Internationally significant migratory shorebird species.

Table 8-1 presents a list of the threatened and migratory seabird and shorebird species that occur within the NWMR, with their conservation status and relevant recovery plans and/or conservation advice.

4 https://www.birdlife.org.au/projects/KBA#:~:text=The%20Key%20Biodiversity%20Areas%20(KBAs,of%20advocacy%20for%20protected%20areas. Accessed April, 2021.

Table 8-1. Bird species (threatened/migratory) identified by the EPBC Act PMST and other sources of information as potentially occurring within the NWMR

Species Name	Common Name	*Environment Protection and Biodiversity Conservation Act 1999*			WA *Biodiversity Conservation Act 2016*	EPBC Act Part 13 Statutory Instrument
		Threatened Status	Migratory Status	Listed	Conservation Status	
Seabirds						
Macronectes giganteus	Southern giant petrel	Endangered	Migratory	Marine	Migratory	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (DSEWPAC, 2011c)
Papasula abbotti	Abbott's booby	Endangered	N/A	Marine	N/A	Conservation Advice for the Abbott's booby - *Papasula abbotti* (Threatened Species Scientific Committee, 2020b)
Pterodroma mollis	Soft-plumaged petrel	Vulnerable	N/A	Marine	N/A	Conservation Advice *Pterodroma mollis* soft-plumaged petrel (Threatened Species Scientific Committee, 2015f)
Sternula nereis nereis	Australian fairy tern	Vulnerable	N/A	N/A	Vulnerable	Conservation Advice for *Sternula nereis nereis* (Fairy Tern) (DSEWPAC, 2011d)
Anous tenuirostris melanops	Australian lesser noddy	Vulnerable	N/A	Marine	Endangered	Conservation Advice *Anous tenuirostris melanops* Australian lesser noddy (Threatened Species Scientific Committee, 2015e)
Thalassarche carteri	Indian yellow-nosed albatross	Vulnerable	Migratory	Marine	Endangered	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (DSEWPAC, 2011c)
Anous stolidus	Common noddy	N/A	Migratory	Marine	Migratory	Draft Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2019)
Fregata ariel	Lesser frigatebird	N/A	Migratory	Marine	Migratory	
Fregata minor	Great frigatebird	N/A	Migratory	Marine	Migratory	
Sula leucogaster	Brown booby	N/A	Migratory	Marine	Migratory	
Sula sula	Red-footed booby	N/A	Migratory	Marine	Migratory	

Species Name	Common Name	*Environment Protection and Biodiversity Conservation Act 1999*			*WA Biodiversity Conservation Act 2016*	EPBC Act Part 13 Statutory Instrument
		Threatened Status	Migratory Status	Listed	Conservation Status	
Onychiprion anaethetus (listed as *Sterna anaethetus)*	Bridled tern	N/A	Migratory	Marine	Migratory	
Thalasseus bergii	Greater crested tern	N/A	Migratory	Marine	Migratory	
Sternula albifrons	Little tern	N/A	Migratory	Marine	Migratory	
Sterna dougallii	Roseate tern	N/A	Migratory	Marine	Migratory	
Onychoprion fuscata	Sooty tern	N/A	N/A	Marine	N/A	
Hydroprogne caspia	Caspian tern	N/A	Migratory	Marine	Migratory	
Ardenna pacifica	Wedge-tailed shearwater	N/A	Migratory	Marine	Migratory	
Puffinus assimillis	Little shearwater	N/A	N/A	Marine	N/A	
Ardenna carneipes	Flesh-footed shearwater	N/A	Migratory	Marine	Vulnerable	
Calonectris leucomelas	Streaked shearwater	N/A	Migratory	Marine	Migratory	
Phaethon lepturus	White-tailed tropicbird	N/A	Migratory	Marine	Migratory	
Chroicocephalus novaehollandiase	Silver gull	N/A	N/A	Marine	N/A	
Migratory shorebirds						
Numenius madagascariensis	Eastern curlew, Far Eastern curlew	Critically endangered	Migratory	Marine	Critically endangered	Conservation Advice *Numenius madagascariensis* eastern curlew (DOE, 2015a)
Calidris ferruginea	Curlew sandpiper	Critically endangered	Migratory	Marine	Critically endangered	Conservation Advice *Calidris ferruginea* curlew sandpiper (DOE, 2015b)
Calidris tenuirostris	Great knot	Critically endangered	Migratory	Marine	Critically endangered	Conservation Advice *Calidris tenuirostris* Great knot (Threatened Species Scientific Committee, 2016a)
Limosa lapponica menzbieri	Bar-tailed godwit (*menzbieri*)	Critically endangered	Migratory	Marine	Critically endangered	Conservation Advice *Limosa lapponica menzbieri* Bar-tailed godwit (northern Siberia). (Threatened Species Scientific Committee, 2016c)

Species Name	**Common Name**	***Environment Protection and Biodiversity Conservation Act 1999***			**WA *Biodiversity Conservation Act 2016***	**EPBC Act Part 13 Statutory Instrument**
		Threatened Status	**Migratory Status**	**Listed**	**Conservation Status**	
Calidris canutus	Red knot	Endangered	Migratory	Marine	Endangered	Conservation Advice *Calidris canutus* Red knot (Threatened Species Scientific Committee, 2016b)
Charadrius mongolus	Lesser sand plover	Endangered	Migratory	Marine	Endangered	Conservation Advice *Charadrius mongolus* Lesser sand plover (Threatened Species Scientific Committee, 2016e)
Charadrius leschenaultii	Greater sand plover	Vulnerable	Migratory	Marine	Vulnerable	Conservation Advice *Charadrius leschenaultia* Greater sand plover (Threatened Species Scientific Committee, 2016d)
All migratory shorebird species	Wildlife Conservation Plan for Migratory Shorebirds (Commonwealth of Australia, 2015c).					

8.2 Seabirds in the NWMR

Seabirds are birds that are adapted to life within the marine environment (oceanic and coastal) and are generally long-lived, have delayed breeding and have fewer young than other bird species (Commonwealth of Australia, 2019). At least 34 seabird species listed as threatened, migratory and/or marine under the EPBC Act are known to occur regularly in the NWMR and include a variety of species of terns, noddies, petrels, shearwaters, frigatebirds, and boobies. Many of these species spend most of their lives at sea (predominately pelagic species), ranging over large distances to forage. These pelagic species only come onshore to breed and raise chicks at natal or high-fidelity breeding colonies on remote, offshore island locations in and adjacent to the NWMR. Many species are ecologically significant to the NWMR, as they are endemic to the region, can be present in large numbers in breeding seasons and non-breeding seasons, and many exhibit extensive annual migrations that include marine areas outside the Australian EEZ (DSEWPAC, 2012e).

The presence of seabirds within the NWMR is influenced by seabird species that migrate and forage in the area during the non-breeding season and this includes many seabird species that breed on the Houtman Abrolhos in the SWMR. Pelagic seabirds have been documented foraging at current boundaries and seasonal upwellings within the NWMR (refer to Sutton *et al*., 2019). The Houtman Abrolhos Islands National Park located in the SWMR, is one of the most significant seabird breeding locations in the eastern Indian Ocean. Sixteen (16) species of seabirds breed there. Eighty percent of common (brown) noddies, 40% of sooty terns and all the lesser noddies found in Australia nest at the Houtman Abrolhos (Surman, 2019). Important seabird areas in the NWMR are as identified by the KBAs (refer to **Section 8.1**) and the information on a select number of seabird species documented for the NWMR (based on the screening criteria presented in **Section 3**), as presented in **Table 8-2**.

Table 8-2 Information on threatened/migratory seabird species of the NWMR

Species	Key Information
Seabirds	
Southern giant petrel	This species is included in the National recovery plan for threatened albatrosses and giant petrels. Habitat critical to survival is defined for breeding and foraging. There are six known breeding localities under Australian jurisdiction (for all species giant petrels) and all are located in the Southern Ocean including islands off Tasmania and within the Australian Antarctic Territory (DSEWPAC, 2011c). Habitat critical to survival identified for foraging is defined as waters south of 25 degrees latitude. The giant petrel species distribution is mainly within the Southern Ocean but this species does migrate into subtropical waters during the winter and its distribution includes the southern extent of the NWMR. No BIAs for this species are located in the NWMR.
Abbott's booby	The Abbott's booby is a large, long-lived seabird known to nest only at Christmas Island. The recovery of this species is strongly dependent on the protection of breeding habitat defined habitat critical to the survival of this species on Christmas Island (Threatened Species Scientific Committee, 2020b). This species spends much of its time at sea and known to forage over large distances offshore when nesting and its range includes off the coast of Java, near the Chagos and in the Banda Sea, and may possibly extend into the north-western extent of the NWMR. No BIAs for this species are located in the NWMR.
Soft-plumaged petrel	This petrel species breeds only at two locations in Australian waters within the Southern Ocean (one off Tasmania and Macquarie Island) (Threatened Species Scientific Committee, 2015f). As a mainly sub-Antarctic species they are usually distributed in cooler seas but distribution extents into subtropical waters and its known distribution includes the southern extent of the NWMR. No BIAs for this species are located in the NWMR.
Australian fairy tern	The Australian fairy tern is listed as Vulnerable for the sub-species only recorded for WA. It has a coastal distribution from Sydney, south to Tasmania and around southern WA up to the Dampier Archipelago and out on the offshore island groups of Barrow, Montebello and the Lowendals (DSEWPAC, 2011d). The Australian fairy tern feeds on small baitfish and roosts and nests on sandy beaches below vegetation. These behaviours, generally, occur in inshore waters of island archipelagos and on the Australian mainland shores and adjacent wetlands. Fairy terns breed from August to February. The Australian fairy tern is unlikely to be present

Species	Key Information
	within the offshore environment of the NWMR. The largest breeding colony in Western Australia for this species is in the Houtman Abrolhos Islands, SWMR (Surman, 2019). For the description and location of BIAs in the NWMR, refer to **Table 8-3** and **Figure 8-2.**
Australian lesser noddy	The Houtman Abrolhos, WA is an important breeding habitat for the Australian lesser noddy in the eastern Indian Ocean. This species exhibits nesting habitat specialisation (white mangrove stands) and has a limited foraging range during the breeding season. Furthermore, the lesser noddy forages over shelf waters and appears not to disperse over their non-breeding period as they remain largely in the general vicinity or slightly to the south of the colony in the non-breeding season (February to September; Surman *et al*., 2018). No BIAs for this species are located in the NWMR.
Indian yellow-nosed albatross	This species is included in the National recovery plan for threatened albatrosses and giant petrels. Habitat critical to survival is defined for breeding and foraging. There are six known breeding localities under Australian jurisdiction (for all species of albatrosses) and all are located in the Southern Ocean including islands off Tasmania and within the Australian Antarctic Territory (DSEWPAC, 2011c). Habitat critical to survival identified for foraging is defined as waters south of 25 degrees latitude. All albatross species distribution (including the Indian yellow-nose albatross) is mainly within the Southern Ocean but this species does migrate into subtropical waters during the winter and its distribution includes the southern extent of the NWMR. No BIAs for this species are located in the NWMR.
Common noddy	This species is listed as migratory and marine. The common (or brown) noddy is the largest species of noddy found in Australian waters. The species is widespread in tropical and subtropical areas beyond Australia. This seabird species is gregarious and normally occurs in flocks, up to hundreds of individuals, when feeding or roosting. The Houtman Abrolhos, WA is the primary breeding habitat for the common noddy in the Eastern Indian Ocean. This species spends their non-breeding season (March to August) in the NWS area, around 950 km north from the breeding colony (Surman *et al*. 2018). The species occurs within NWMR waters, particularly around offshore islands such as the Montebello Island group. This species is recorded on unmanned oil and gas platforms within the NWS. No BIAs for this species are located in the NWMR.
Lesser frigatebird **Great frigatebird**	Both species of frigatebird are listed as migratory and marine. Within the NWMR, the lesser frigatebird is known to breed on Adele, Bedout and West Lacepede islands, Ashmore Reef and Cartier Island (Commonwealth of Australia, 2019). The lesser frigatebird feeds mostly on fish and sometimes cephalopods, and all food is taken while the bird is in flight. Lesser frigatebirds generally forage close to breeding colonies. Breeding/foraging BIAs for the lesser frigatebird are located in the NWMR; refer to **Table 8-3**.
Brown booby	The brown booby is the most common booby, occurring throughout all tropical oceans bounded by latitudes 30º N and 30º S. There are large colonies on offshore islands within the NWMR such as the Lacepede Islands (one of the largest colonies in the world), Ashmore Reef, and other offshore Kimberley islands. This seabird species is a specialised plunge diver, mostly eating fish and some cephalopods (Commonwealth of Australia, 2019). Breeding/foraging BIAs for the brown booby are located in the NWMR; refer to **Table 8-3** and **Figure 8-3**.
Red-footed booby	Within the NWMR, its known breeding sites for this species include Ashmore Reef and Cartier Island. It is a pelagic species and generally occurs away from land. It mainly eats flying fish and squid. Prey abundance is reliant on the high productivity in slope areas off remote islands where the birds breed (Commonwealth of Australia, 2019). Breeding/foraging BIAs for the red-footed booby are located in the NWMR; refer to **Table 8-3** and **Figure 8-3**.
Greater crested tern	The greater crested tern has a widespread distribution recorded on islands and coastlines of tropical and subtropical areas, ranging from the Atlantic coast of South Africa, Indian Ocean and through south-east Asia and Australia. Outside the breeding season it can be found at sea throughout its range, with the exception of the central Indian Ocean (Commonwealth of Australia, 2019). The largest breeding colony in WA for this species is the Houtman Abrolhos Islands, SWMR (Surman, 2019). No BIAs for this species are located in the NWMR.
Little tern	There are three sub-populations of this species in Australia and two of these occur in the NWMR: northern Australian breeding sub-population occurring around Broome and extending across in to the NMR, and an east Asian breeding sub-population, with the terns present from Shark Bay to south-eastern Queensland during the austral summer. Little terns

Species	Key Information
	usually forage close to breeding colonies in the shallow water of estuaries (Commonwealth of Australia, 2019). For the description and location of BIAs in the NWMR, refer to **Table 8-3** and **Figure 8-2**.
Roseate tern	This species is generally tropical in distribution and there are many breeding populations in the NWMR, including Ashmore Reef, Napier Broome Bay, Bonaparte Archipelago, Lacepede Islands, Dampier Archipelago and the Lowendal Islands. A large number of non-breeding roseate terns have been observed at several remote locations in the Kimberley and there are high numbers also recorded for Eighty Mile Beach Ramsar site. The Kimberley colonies are likely to be another sub-species that breeds in east Asia. Roseate terns predominately eat small pelagic fish (Commonwealth of Australia, 2019). The largest breeding colony in Western Australia for this species is in the Houtman Abrolhos Islands, SWMR (Surman, 2019). For the description and location of BIAs in the NWMR, refer to **Table 8-3** and **Figure 8-2**.
Wedge-tailed shearwater	The wedge-tailed shearwater is a pelagic, marine seabird known from tropical and subtropical waters. Its distribution is widespread across the Indian and Pacific oceans. It is known to breed on the east and west coasts (and offshore islands) of Australia. This species is known to consume fish, cephalopods, and other biota primarily via contact-dipping. Wedge-tailed shearwaters are now understood to undertake extensive foraging trips (over thousands of kilometres over periods of days when chicking and provisioning young) and much longer and extensive pelagic travels over the north-west Indian Ocean during the non-breeding season, targeting current boundaries and upwellings. The species breeds throughout its range, mainly on vegetated islands, atolls and cays and excavates burrows in the ground where chicks are raised (Commonwealth of Australia, 2019). Large breeding colonies of the wedge-tailed shearwater are located on the Houtman Abrolhos islands (SWMR) (Surman *et al*., 2018) and several locations in the NWMR including: Muiron Islands (North-west Cape), Varanus Island and the Dampier Archipelago in the Pilbara where burrow numbers were estimated to several hundred thousand to half a million such as on the Muiron Islands, though it is not known if all burrows are utilised on an annual basis (Birdlife Australia, 2018; Surman *et al.*, 2018). Cannell *et al* (2019) satellite tracked adult wedge-tailed shearwaters during egg incubation and chick rearing on the Muiron Islands in January 2018. For the incubation trips, there was a strong consistency for the birds to travel towards seamounts, typically located north-west of the Muiron Islands, between Australia and Indonesia. One bird however remained south-west of the islands, in the Cape Range Canyon. A similar pattern to utilise areas associated with sea mounts was also observed for the long foraging trips during chick rearing, though some of the foraging was concentrated in deeper waters. A bimodal foraging strategy during chick-rearing was observed, with adults undertaking long foraging trips after a series of shorter foraging trips within the NWMR. Surman *et al*. (2018) reported most wedge-tailed shearwaters from the breeding colonies on the Houtman Abrolhos undertook extensive non-breeding migrations. This seabird species occupied waters adjacent or to the north of their nesting sites or migrated 4200 km north-west into the equatorial central Indian Ocean near the Ninety East Ridge during the non-breeding season (later April to mid-November). For the description and location of BIAs in the NWMR, refer to **Table 8-3** and **Figure 8-1**.
Flesh-footed shearwater	The species mainly occurs in the subtropics, over continental shelves and slopes and occasionally inshore waters, with individual birds pass through the tropics and over deeper waters during migration to the North Pacific and Indian oceans (Commonwealth of Australia, 2019). They are a common visitor to the waters off southern Australia, from south-western WA to south-eastern Queensland. The fleshy-footed shearwater is a trans-equatorial migrant, breeding from late September to May off south-western Australia, and migrating north by early May, across the southern Indian and possibly Indonesia to the northern Pacific Ocean. No BIAs for the flesh-footed shearwater are located in the NWMR.
Streaked shearwater	The streaked shearwater has a broad distribution in the western Pacific Ocean, breeding on the coast and offshore islands of Japan, Russia, China and the Korean Peninsula. During winter months (non-breeding season), the species undertakes trans-equatorial migration to the coasts of Vietnam, New Guinea, the Philippines, Australia, southern India and Sri Lanka. The streaked shearwater feeds mainly on fish and squid that it catches by surface-seizing and shallow plunges (Commonwealth of Australia, 2019). No BIAs for the streaked shearwater are located in the NWMR.
White-tailed tropicbird	Tropicbirds are predominately pelagic species and the white-tailed tropicbird forages in warm waters and over long distances (pan-tropical). The species is most common off north-west Australia. In the NWMR, this species is considered a sub-species and are limited in number and distribution. Nesting sites are known for Clerke Reef (Rowley Shoals) and Ashmore

Species	Key Information
	Reef. Christmas Island is also a known nesting site and the species can disperse several thousand kilometres during foraging trips. This species feeds mainly on fish and cephalopods, captured by deep plunge diving (Commonwealth of Australia, 2019). There are breeding BIAs at the Rowley Shoals and Ashmore Reef within the NWMR for the white-tailed tropicbird; refer to **Table 8-3**.
Silver gull	The silver gull is typically described as an inshore and coastal foraging seabird and has an Australian-wide distribution including locations within the NWMR. It is noted as it has been recorded on unmanned oil and gas platforms located within the NWS.

8.2.1 Biologically Important Areas in the NWMR

BIAs representing important life cycle stages and behaviours for eight species of seabird in the NWMR are presented in **Table 8-3**.

Table 8-3 Seabird BIAs within the NWMR

Seabird Species	Woodside Activity Area			BIAs			
	Browse	NWS/S	NWC	Breeding/foraging	Foraging	Breeding	Resting
Australia fairy tern	-	✓	✓	-	No foraging BIAs in the NWMR Foraging in high numbers: the BIA is located in the SWMR including the Houtman Abrolhos Islands	Dampier Archipelago, Montebello, Lowendal and Barrow Island Groups, south Ningaloo and barrier island of Shark Bay	-
Wedge-tailed shearwater	✓	✓	✓	Widespread area of the NWMR offshore and inshore waters	Foraging in high numbers: the BIA is located in the SWMR including the Houtman Abrolhos Islands	-	-
Great frigatebird	✓	-	-	Ashmore Reef, Adele Island	-	-	-
Lesser frigatebird	✓	✓	-	Off Eighty Mile Beach, Lacepedes, Adele Island, North Kimberley and Ashmore Reef	-	-	-
Brown booby	✓	✓	-	Off Eighty Mile Beach, Lacepedes, Adele Island, North Kimberley and Ashmore Reef	-	-	-
Red-footed booby	✓	-	-	Adele Island, Ashmore Reef	-	-	-
Little tern	✓	✓	-	Rowley Shoals, Adele Island	-	-	-
Roseate tern	✓	✓	✓	-	No foraging BIAs in the NWMR Foraging (provisioning young) and foraging BIAs located in the SWMR – Houtman Abrolhos Islands the	Dampier Archipelago, Montebello, Lowendal and Barrow Island Groups, south Ningaloo and barrier island of Shark Bay	Eighty Mile Beach

Seabird Species	Woodside Activity Area			BIAs			
	Browse	NWS/S	NWC	Breeding/foraging	Foraging	Breeding	Resting
					nearest BIA to the NWMR		
White-tailed tropicbird	✓	-	-			Rowley Shoals Ashmore Reef	

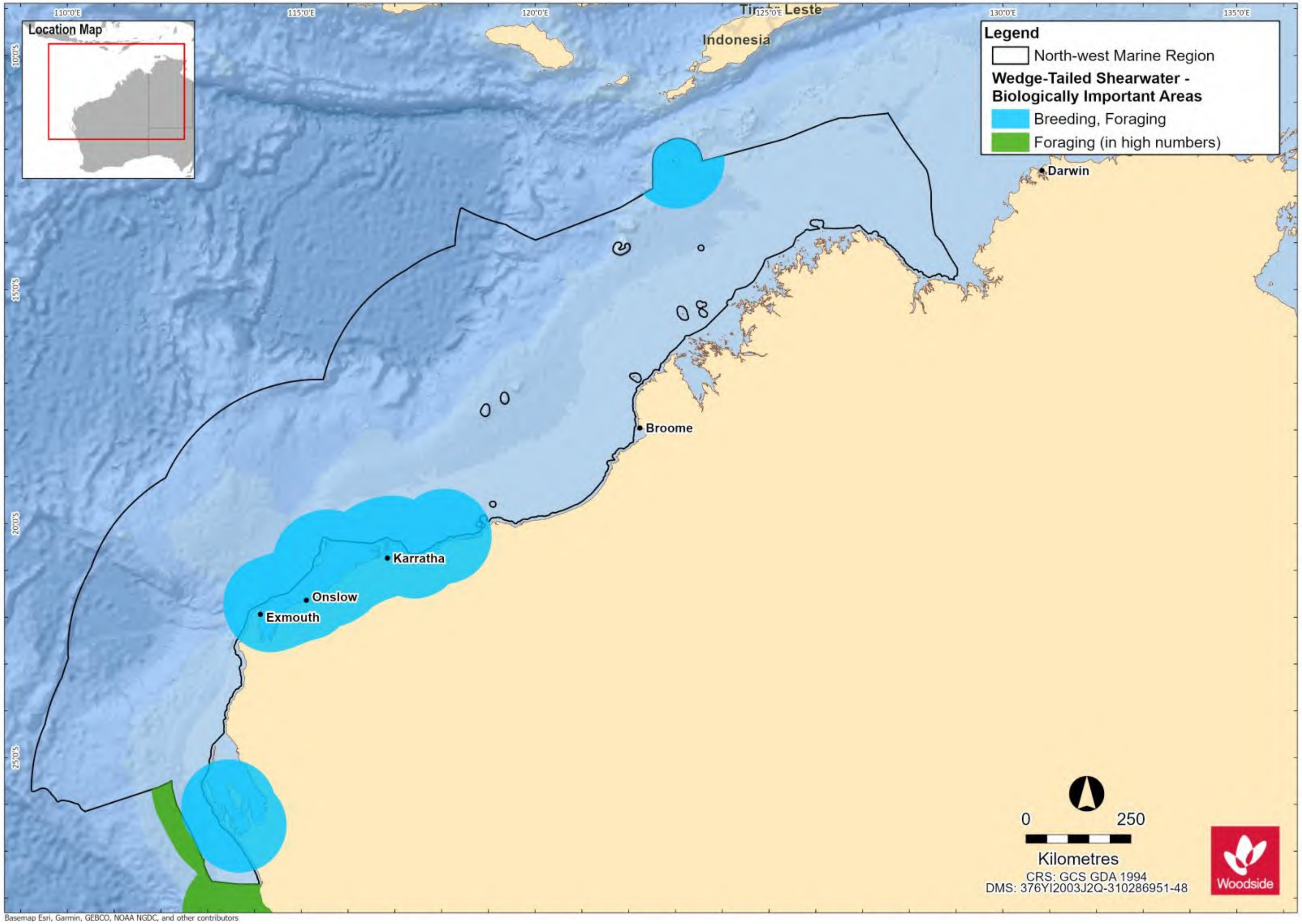

Figure 8-1 Wedge-tailed shearwater BIAs for the NWMR

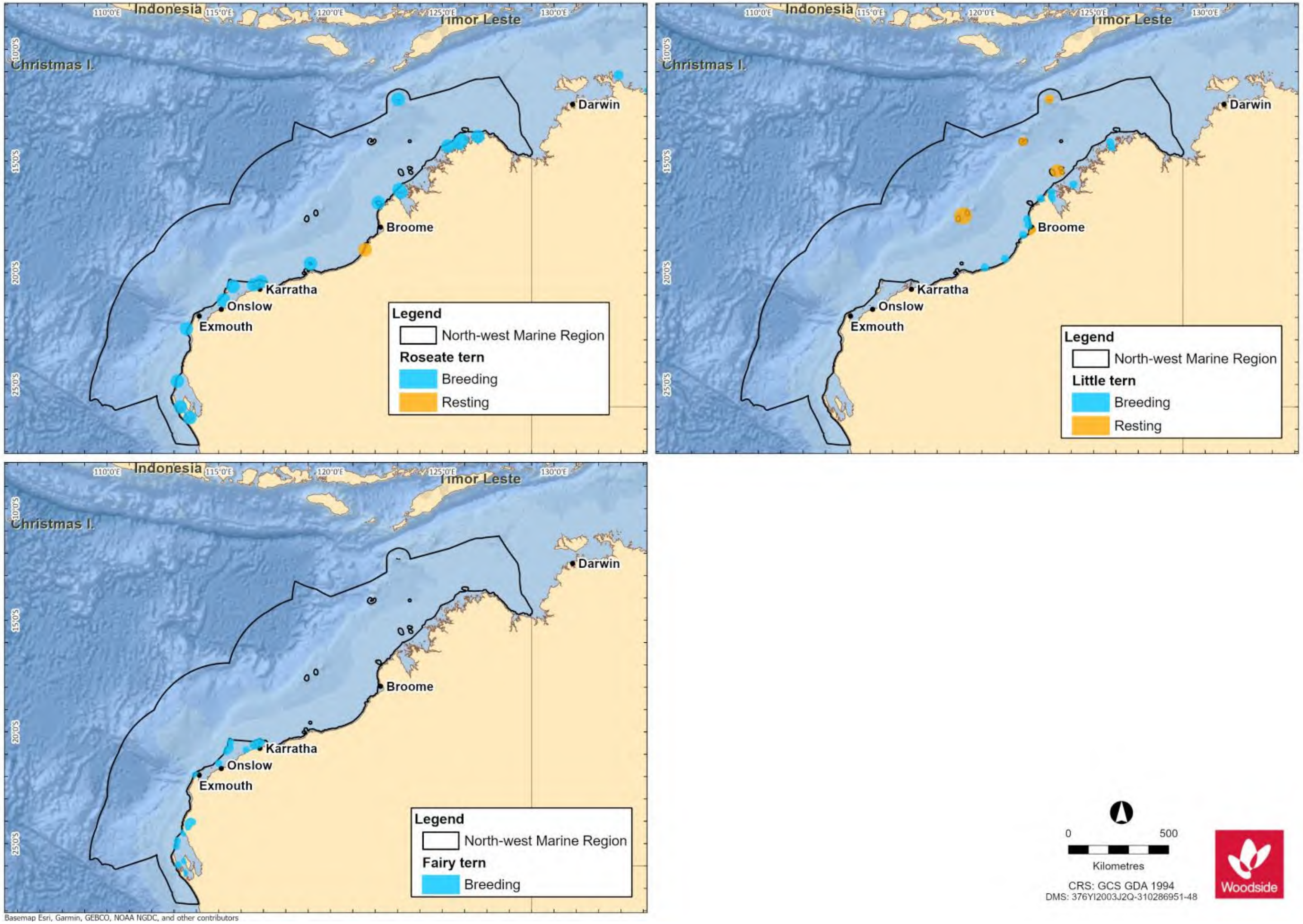

Figure 8-2 Tern species BIAs for the NWMR

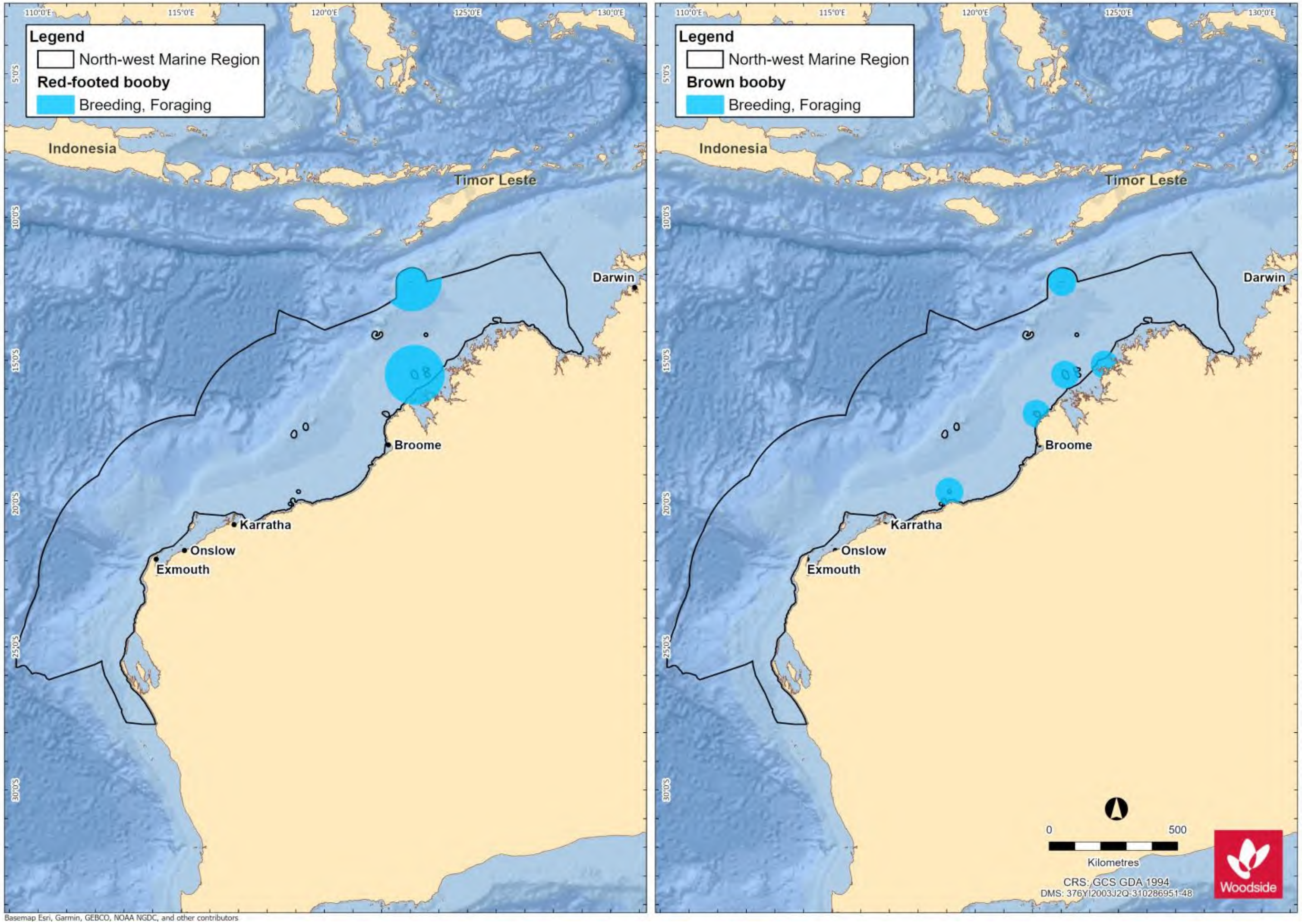

Figure 8-3 Red-footed and brown booby BIAs for the NWMR

8.2.2 Seabird Summary for NWMR

8.2.2.1 Browse

The Browse activity area includes biologically important habitat for seven threatened and/or migratory seabird species:

- wedge-tailed shearwater (breeding/foraging);
- great and lesser frigatebirds (breeding/foraging);
- brown booby (breeding/foraging);
- red-footed booby (breeding/foraging);
- little tern (breeding/foraging);
- roseate tern (breeding and resting); and,
- white-tailed tropicbird (breeding).

BIAs for the seabird species are outlined in **Table 8-3**.

8.2.2.2 NWS / Scarborough

The NWS / Scarborough activity area includes biologically important habitat for five threatened and/or migratory seabird species:

- wedge-tailed shearwater (breeding/foraging);
- lesser frigatebird (breeding/foraging);
- brown booby (breeding/foraging);
- little tern (breeding/foraging); and
- roseate tern (breeding and resting).

BIAs for the seabird species are outlined in **Table 8-3**.

8.2.2.3 North-west Cape

The North-west Cape activity area includes biologically important habitat for five threatened and/or migratory seabird species:

- Australian fairy tern (breeding);
- wedge-tailed shearwater (breeding/foraging); and
- roseate tern (breeding and resting).

BIAs for the seabird species are outlined in **Table 8-3**.

8.3 Shorebirds

Shorebirds (migratory and resident species) are generally associated with wetland or coastal environments, and the NWMR hosts a large number of many shorebird species, particularly in the Austral summer (refer to **Appendix A** for the EPBC Act PMST reports on listed species of shorebirds). Shorebirds may use coastal environments for feeding, nesting or migratory stopovers. In coastal environments, shorebirds generally feed during low tide on exposed intertidal mud and sand flats, and roost in suitable habitat above the high water mark. Many shorebird species undergo annual migrations, typically breeding at high latitudes of the Northern Hemisphere and migrating south for the non-breeding season and Australia is part of the East Asian-Australasian Flyway (EAAF). The EAAF extends from breeding grounds in the Russian tundra, Mongolia and Alaska southwards through east and south-east Asia, to non-breeding areas of Indonesia, Papua New Guinea, Australia and New Zealand (Weller and Lee, 2017). The EAAF is of most relevance to the NWMR. There are 37 species of shorebird which annually migrate to Australia via the EAAF and 36 of these species spend the austral summer (non-breeding season) foraging and roosting in coastal and wetland habitats (Commonwealth of Australia, 2015c; Weller and Lee, 2017).

Ashmore Reef is documented as a BIA for migratory shorebirds in the NWMR (DSEWPAC, 2012a).

Table 8-4. Information on threatened/migratory shorebird species of the NWMR

Species	Key Information
Shorebirds	
Eastern curlew, Far eastern curlew	This species is the largest, migratory shorebird in the world, with a long neck, long legs and a very long downcurved bill and is a long-haul flyer. The eastern curlew is a coastal species with a continuous distribution north from Barrow Island to the Kimberley region. The species is endemic to the EAAF and is a non-breeding visitor to Australia from August to March, primarily foraging on crabs and molluscs in intertidal mudflats. During the non-breeding season in Australia, this species is most associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (DOE, 2015a).
Curlew sandpiper	The curlew sandpiper breeds in northern Siberia but has a non-breeding range that extends from western Africa to Australia, with small numbers reaching New Zealand (Bamford *et al*., 2008). In Australia, curlew sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers. Records occur in all states and the NT during the non-breeding period, and also during the breeding season when many non-breeding one-year old birds remain in Australia rather than migrating north along the EAAF. The species preferred habitat for foraging is mudflats and nearby shallow waters in sheltered coastal areas such as estuaries, bay, inlets and lagoons (DOE, 2015b).
Great knot	The great knot breeds in the Northern Hemisphere and undertakes biannual migrations along the EAAF to non-breeding habitat in Australia. The great knot winters in Australia and has been recorded around the entirety of the Australian coast the greatest numbers are found in northern Western Australia (Pilbara (Dampier Archipelago) and Kimberley and the Northern Territory. In Australia, this species prefers sheltered, coastal habitat with large intertidal mudflats or sandflats (inkling inlets, bays, harbours, estuaries and lagoons). High numbers (exceeding several thousand birds are regularly recorded from Roebuck Bay. The great knot feeds on a variety of invertebrates by pecking at or just below the surface of moist mud or sand (Threatened Species Scientific Committee, 2016a).
Bar-tailed godwit (*menzbieri*)	The bar-tailed godwit is a large, migratory shorebird and there are two sub-species in the EAAF (*Limosa lapponica baueri* and *L. l. menzbieri*). The sub-species *L. l. menzbieri* breeds in northern Siberia and spends its non-breeding period mostly in the north of WA but also in South-east Asia. The bar-tailed godwit (*menzbieri*) usually forages near the water in shallow water, mainly in tidal estuaries and harbours with a preference for exposed sandy or soft mud substrates on intertidal flats, banks and beaches (Threatened Species Scientific Committee, 2016c).
Red knot (*piersmai*)	This species is a small to medium migratory shorebird. There are two sub-species that cannot be distinguished from each other in nonbreeding plumage, however, *Calidris canutus piersmai* tend to overwinter almost exclusively in north-west Australia. The red knot migrates long distances from breeding grounds in high northern latitudes, where it breeds during the boreal summer, to the Southern Hemisphere during the austral summer with migration along the EAAF. Very large numbers are recorded for the north-west Australia and is common in all suitable habitats around the coast, including inland clay pans near Roebuck Bay (where the species roosts). The red knot usually forages in soft substrate along the waters edge on intertidal mudflats, sandflats and sandy beaches of sheltered coasts (Threatened Species Scientific Committee, 2016b).
Lesser sand plover	The lesser sand plover is a small to medium shorebird and one of 36 migratory shorebirds that breed in the Northern Hemisphere during the boreal summer and are known to annually migrate to the non-breeding grounds of Australia along the EAAF for the austral summer. There are five different sub-species and it is most likely the non-breeding ranges of the sub-species *Charadrius m. mongolus* overlaps with the NWMR. This species is widespread in coastal regions, preferring sandy beaches, mudflats of coastal bays and estuaries (Threatened Species Scientific Committee, 2016e).
Greater sand plover	The greater sand plover is a small to medium shorebird and in its non-breeding plumage is difficult to distinguish from the lesser sand plover. This species breeds in the Northern

Species	Key Information
	Hemisphere and undertakes annual migrations to and from Southern Hemisphere feeding grounds in the austral summer along the EAAF. The species distribution in Australia during the non-breeding season is widespread, in WA the greater sand plover is widespread between Northwest Cape and Roebuck Bay (Threatened Species Scientific Committee, 2016d).

9. KEY ECOLOGICAL FEATURES

Key ecological features (KEFs) are elements of the Commonwealth marine environment that are considered to be important for a marine region's biodiversity or ecosystem function and integrity. KEFs have been identified by the Australian Government based on advice from scientists about the ecological processes and characteristics of the area.

KEFs meet one or more of the following criteria:

- a species, group of species, or a community with a regionally important ecological role (e.g. a predator, prey that affects a large biomass or number of other marine species),
- a species, group of species or a community that is nationally or regionally important for biodiversity,
- an area or habitat that is nationally or regionally important for:
  - enhanced or high productivity (such as predictable upwellings – an upwelling occurs when cold nutrient-rich waters from the bottom of the ocean rise to the surface),
  - aggregations of marine life (such as feeding, resting, breeding or nursery areas), or
  - biodiversity and endemism (species which only occur in a specific area),
- a unique seafloor feature, with known or presumed ecological properties of regional significance.

Thirteen KEFs are designated within the NWMR, twelve KEFs within the SWMR and eight KEFs within the NMR. These KEFs have been identified in the Protected Matters search (**Appendix A**) and outlined in **Table 9-1, Table 9-2** and **Table 9-3,** and **Figure 9-1, Figure 9-2** and **Figure 9-3**.

Table 9-1 Key Ecological Features (KEF) within the NWMR

KEF Name	Woodside Activity Area			Values[1]	Description
	Browse	NWS/S	NW Cape		
Carbonate bank and terrace system of the Sahul Shelf	✓	-	-	Unique seafloor feature with ecological properties of regional significance Regionally important because of their role in enhancing biodiversity and local productivity relative to their surrounds. The carbonate banks and terraces provide areas of hard substrate in an otherwise soft sediment environment which are important for sessile species	The Carbonate banks and terrace system of the Sahul Shelf are located in the western Joseph Bonaparte Gulf and to the north of Cape Bougainville and Cape Londonderry. The carbonate banks and terraces are part of a larger complex of banks and terraces that occurs on the Van Diemen Rise in the adjacent NMR. The bank and terrace system of the Van Diemen Rise covers approximately 31,278 km^2 and forms part of the larger system associated with the Sahul Banks to the north and Londonderry Rise to the east. The feature is characterised by terrace, banks, channels and valleys (DSEWPAC, 2012c). The banks, ridges and terraces of the Van Diemen Rise are raised geomorphic features with relatively high proportions of hard substrate that support sponge and octocoral gardens. These, in turn, provide habitat to other epifauna, by providing structure in an otherwise flat environment (Przeslawski *et al.*, 2011). Plains and valleys are characterised by scattered epifauna and infauna that include polychaetes and ascidians. These epibenthic communities support higher order species such as olive ridley turtles, sea snakes and sharks (DSEWPAC, 2012c)
Pinnacles of the Bonaparte Basin	✓	-	-	Unique seafloor feature with ecological properties of regional significance Provide areas of hard substrate in an otherwise soft sediment environment and so are important for sessile species Recognised as a biodiversity hotspot for sponges The Pinnacles of the Bonaparte Basin KEF is located within both the NWMR and NMR (refer **Table 9-3**)	The Pinnacles of the Bonaparte Basin provide areas of hard substrate in an otherwise relatively featureless environment, the pinnacles are likely to support a high number of species, although a better understanding of the species richness and diversity associated with these structures is required (DSEWPAC, 2012a, 2012c). Covering >520 km^2 within the Bonaparte Basin, this feature contains the largest concentration of pinnacles along the Australian margin. The Pinnacles of the Bonaparte Basin are thought to be the eroded remnants of underlying strata; it is likely that the vertical walls generate local upwelling of nutrient-rich water, leading to phytoplankton productivity that attracts aggregations of planktivorous and predatory fish, seabirds, and foraging turtles (DSEWPAC, 2012a, 2012c).
Ashmore Reef and Cartier Island and surrounding Commonwealth waters	✓	-	-	High productivity, biodiversity and aggregation of marine life that apply to both the benthic and pelagic habitats within the feature	Ashmore Reef is the largest of only three emergent oceanic reefs present in the north-eastern Indian Ocean and is the only oceanic reef in the region with vegetated islands. Ashmore contains a large reef shelf, two large lagoons, several channelled carbonate sand flats, shifting sand cays, an extensive reef flat, three vegetated islands—East, Middle and West islands—and

KEF Name	Woodside Activity Area			Values[1]	Description
	Browse	NWS/S	NW Cape		
					surrounding waters. Rising from a depth of more than 100 m, the reef platform is at the edge of the NWS and covers an area of 239 km². Ashmore Reef and Cartier Island and the surrounding Commonwealth waters are regionally important for feeding and breeding aggregations of birds and other marine life; they are areas of enhanced primary productivity in an otherwise low-nutrient environment (DSEWPAC, 2012a). Ashmore Reef supports the highest number of coral species of any reef off the WA coast.
Seringapatam Reef and the Commonwealth waters in the Scott Reef complex	✓	-	-	Support diverse aggregations of marine life, have high primary productivity relative to other parts of the region, are relatively pristine and have high species richness, which apply to both the benthic and pelagic habitats within the feature	Seringapatam Reef and the Commonwealth waters in the Scott Reef complex are regionally important in supporting the diverse aggregations of marine life, high primary productivity, and high species richness associated with the reefs themselves. As two of the few offshore reefs in the north-west, they provide an important biophysical environment in the region (DSEWPAC, 2012a).
Continental slope demersal fish communities	✓	✓	✓	High biodiversity of demersal fish assemblages, including high levels of endemism	The diversity of demersal fish assemblages on the continental slope in the Timor Province, the Northwest Transition and the North-west Province is high compared to elsewhere along the Australian continental slope (DSEWPAC, 2012a). The continental slope between North-west Cape and the Montebello Trough has more than 500 fish species, 76 of which are endemic, which makes it the most diverse slope bioregion in Australia (Last *et al.*, 2005). The slope of the Timor Province and the Northwest Transition also contains more than 500 species of demersal fishes of which 64 are considered endemic (Last *et al.*, 2005), making it the second richest area for demersal fishes throughout the whole continental slope. Demersal fish species occupy two distinct demersal biomes associated with the upper slope (225–500 m water depths) and the mid-slope (750–1000 m). Although poorly known, it is suggested that the demersal slope communities rely on bacteria and detritus-based systems comprised of infauna and epifauna, which in turn become prey for a range of teleost fishes, molluscs and crustaceans (Brewer *et al.*, 2007). Higher-order consumers may include carnivorous fishes, deepwater sharks, large squid, and toothed whales (Brewer *et al.*, 2007). Pelagic production is phytoplankton-based, with hot spots around oceanic reefs and islands (Brewer *et al.*, 2007).

KEF Name	Woodside Activity Area			Values[1]	Description
	Browse	NWS/S	NW Cape		
Ancient coastline at 125 m depth contour	✓	✓	✓	Unique seafloor feature with ecological properties of regional significance Provides areas of hard substrate and therefore may provide sites for higher diversity and enhanced species richness relative to surrounding areas of predominantly soft sediment	Several steps and terraces as a result of Holocene sea level changes occur in the region, with the most prominent of these features occurring as an escarpment along the NWMR and Sahul Shelf at a water depth of 125 m. The Ancient Coastline is not continuous throughout the NWMR and coincides with a well-documented eustatic stillstand at about 130 m worldwide (Falkner *et al.*, 2009). Where the Ancient Coastline provides areas of hard substrate, it may contribute to higher diversity and enhanced species richness relative to soft sediment habitat (Falkner *et al.*, 2009). Parts of the Ancient Coastline, represented as rocky escarpment, are considered to provide biologically important habitat in an area predominantly made up of soft sediment. The escarpment type features may also potentially facilitate mixing within the water column due to upwelling, providing a nutrient-rich environment. Although the Ancient Coastline adds additional habitat types to a representative system, the habitat types are not unique to the coastline as they are widespread on the upper shelf (Falkner *et al.*, 2009)
Canyons linking the Argo Abyssal Plain and Scott Plateau	-	✓	-	Facilitates nutrient upwelling, creating enhanced productivity and encouraging diverse aggregations of marine life	Interactions with the Leeuwin Current and strong internal tides are thought to result in upwelling at the canyon heads, thus creating conditions for enhanced productivity in the region (Brewer *et al.*, 2007). As a result, aggregations of whale sharks, manta rays, humpback whales, sea snakes, sharks, predatory fishes and seabirds are known to occur in the area due to its enhanced productivity (Sleeman *et al.*, 2007).
Glomar Shoal	-	✓	-	An area of high productivity and aggregations of marine life including commercial and recreational fish species	Glomar Shoal is a submerged littoral feature located about 150 km north of Dampier on the Rowley shelf at depths of 33–77 m (Falkner *et al.*, 2009). Studies by Abdul Wahab *et al.* (2018) found a number of hard coral and sponge species in water depths less than 40 m. One hundred and seventy (170) different species of fishes were detected with greatest species richness and abundance in shallow habitats (Abdul Wahab *et al.*, 2018). Fish species present include a number of commercial and recreational species such as Rankin cod, brown striped snapper, red emperor, crimson snapper, bream and yellow-spotted triggerfish (Falkner *et al.*, 2009; Fletcher and Santoro, 2009). These species have recorded high catch rates associated with Glomar Shoal, indicating that the shoal is likely to be an area of high productivity.

KEF Name	Woodside Activity Area			Values[1]	Description
	Browse	NWS/S	NW Cape		
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	-	✓	-	Regionally important in supporting high species richness, higher productivity and aggregations of marine life	The Mermaid Reef and Commonwealth waters surrounding the Rowley Shoals KEF and is adjacent to the three nautical mile State waters limit surrounding Clerke and Imperieuse reefs, and include the Mermaid Reef Marine Park as described in **Section 10**. The reefs provide a distinctive biophysical environment in the region. They have steep and distinct reef slopes and associated fish communities. In evolutionary terms, the reefs may play a role in supplying coral and fish larvae to reefs further south via the southward flowing Indonesian Throughflow. Both coral communities and fish assemblages differ from similar habitats in eastern Australia (Done *et al.*, 1994).
Exmouth Plateau	-	✓	✓	Unique seafloor feature with ecological properties of regional significance, which apply to both benthic and pelagic habitats Likely to be an important area of biodiversity as it provides an extended area offshore for communities adapted to depths of approximately 1000 m	The Exmouth Plateau is a large, mid-slope, continental margin plateau that lies off the northwest coast of Australia. It ranges in depth from about 500 to more than 5000 m and is a major structural element of the Carnarvon Basin (Miyazaki and Stagg, 2013). The large size of the Exmouth Plateau and its expansive surface may modify deep water flow and be associated with the generation of internal tides; both of which may subsequently contribute to the upwelling of deeper, nutrient-rich waters closer to the surface (Brewer *et al.*, 2007). Satellite observations suggest that productivity is enhanced along the northern and southern boundaries of the plateau (Brewer *et al.*, 2007). Sediments on the plateau suggest that biological communities include scavengers, benthic filter feeders and epifauna (DSEWPAC, 2012a). Fauna in the pelagic waters above the plateau are likely to include small pelagic species and nekton attracted to seasonal upwellings, as well as larger predators such as billfishes, sharks and dolphins (Brewer *et al.*, 2007). Protected and migratory species are also known to pass through the region, including whale sharks and cetaceans.
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	-	-	✓	Unique seafloor feature with ecological properties of regional significance The feature is an area of moderately enhanced productivity, attracting aggregations of fish and higher-order consumers such as large predatory	The canyons are associated with upwelling as they channel deep water from the Cuvier Abyssal Plain up onto the slope. This nutrient-rich water interacts with the Leeuwin Current at the canyon heads (DSEWPAC, 2012a). Aggregations of whale sharks, manta rays, sea snakes, sharks, large predatory fish, and seabirds are known to occur in this area.

KEF Name	Woodside Activity Area			Values[1]	Description
	Browse	NWS/S	NW Cape		
				fish, sharks, toothed whales and dolphins Likely to be important due to their historical association with sperm whale aggregations	
Commonwealth waters adjacent to Ningaloo Reef	-	-	✓	High productivity and diverse aggregations of marine life The Commonwealth waters adjacent to Ningaloo Reef and associated canyons and plateau are interconnected and support the high productivity and species richness of Ningaloo Reef, globally significant as the only extensive coral reef in the world that fringes the west coast of a continent	The Leeuwin and Ningaloo currents interact, leading to areas of enhanced productivity in the Commonwealth waters adjacent to Ningaloo Reef. Aggregations of whale sharks, manta rays, humpback whales, sea snakes, sharks, large predatory fish, and seabirds are known to occur in this area (DSEWPAC, 2012a). The spatial boundary of this KEF, as defined in the NCVA, is defined as the waters contained in the existing Ningaloo AMP provided in **Section 10**.
Wallaby Saddle	-	-	✓	High productivity and aggregations of marine life: Representing almost the entire area of this type of geomorphic feature in the NWMR. It is a unique habitat that neither occurs anywhere else nearby (within hundreds of kilometres) nor with as large an area (Falkner *et al.* 2009)	The Wallaby Saddle may be an area of enhanced productivity. Historical whaling records provide evidence of sperm whale aggregations in the area of the Wallaby Saddle, possibly due to the enhanced productivity of the area and aggregations of baitfish (DSEWPAC, 2012a).

[1.] Values description sourced from Marine bioregional plan for the North-west Marine Region (DSEWPAC, 2012a) and the Department of Agriculture, Water and the Environment (DAWE) SPRAT database.

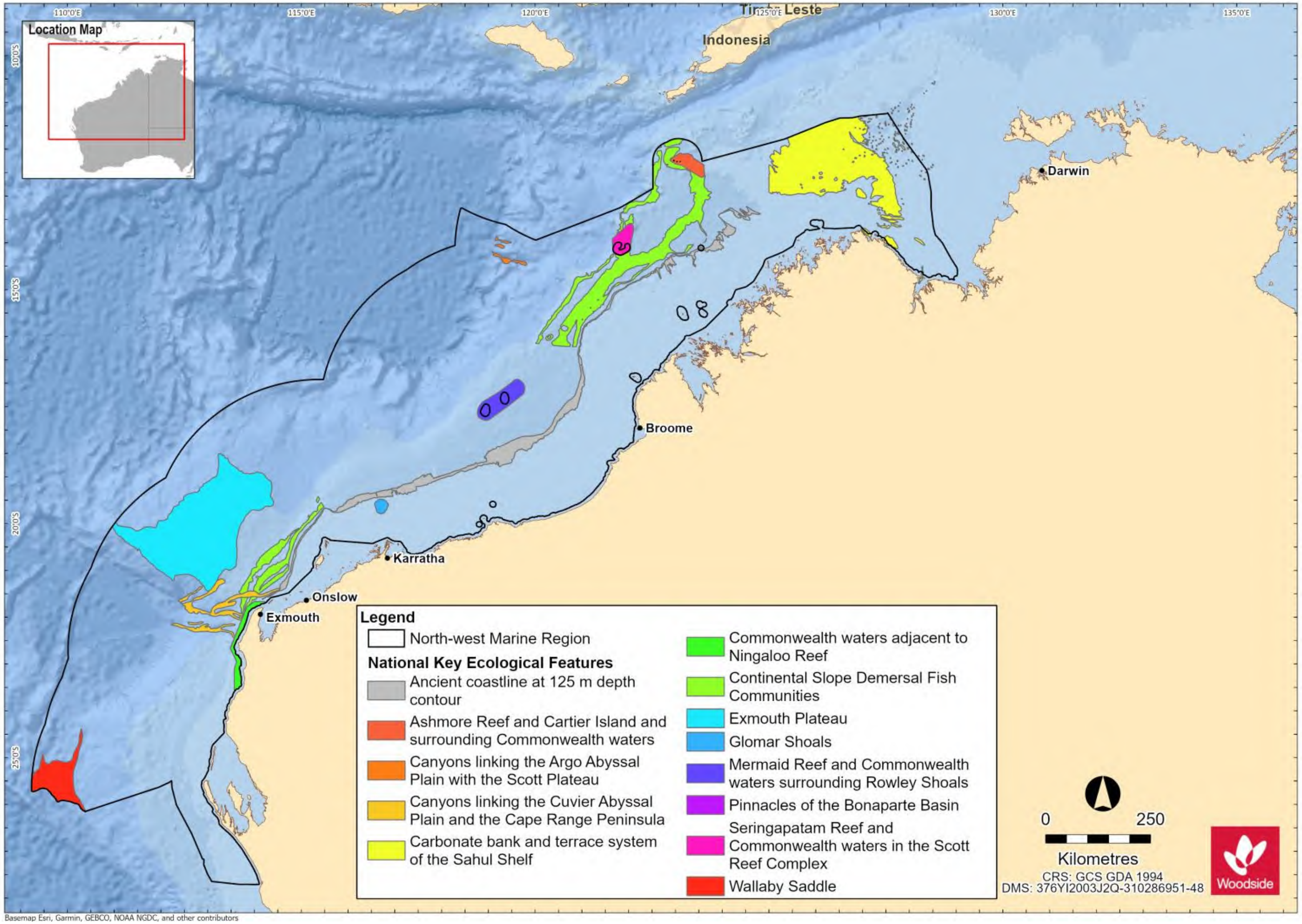

Figure 9-1 Key Ecological Features (KEFs) within the NWMR.

Table 9-2 Key Ecological Features (KEF) within the SWMR

KEF Name	Values[1]	Description
Albany Canyons group and adjacent shelf break	High productivity and aggregations of marine life, and unique seafloor feature with ecological properties of regional significance Both benthic and demersal habitats within the feature are of conservation value	The Albany Canyons group is thought to be associated with small, periodic subsurface upwelling events, which may drive localised regions of high productivity. The canyons are known to be a feeding area for sperm whale and sites of orange roughy aggregations. Anecdotal evidence also indicates that this area supports fish aggregations that attract large predatory fish and sharks.
Ancient coastline at 90-120 m depth	Relatively high productivity and aggregations of marine life, and high levels of biodiversity and endemism The feature creates topographic complexity, that may facilitate benthic biodiversity and enhanced biological productivity	Benthic biodiversity and productivity occur where the ancient coastline forms a prominent escarpment, such as in the western Great Australian Bight, where the sea floor is dominated by sponge communities of significant biodiversity and structural complexity.
Cape Mentelle upwelling	Facilitates nutrient upwelling, supporting high productivity and diverse aggregations of marine life	The Cape Mentelle upwelling draws relatively nutrient-rich water from the base of the Leeuwin Current, up the continental slope and onto the inner continental shelf, where it results in phytoplankton blooms at the surface. The phytoplankton blooms provide the basis for an extended food chain characterised by feeding aggregations of small pelagic fish, larger predatory fish, seabirds, dolphins and sharks.
Commonwealth marine environment surrounding the Houtman Abrolhos Islands (and adjacent shelf break)	High levels of biodiversity and endemism within benthic and pelagic habitats	The Houtman Abrolhos Islands and surrounding reefs support a unique mix of temperate and tropical species, resulting from the southward transport of species by the Leeuwin Current over thousands of years. The Houtman Abrolhos Islands are the largest seabird breeding station in the eastern Indian Ocean. They support more than one million pairs of breeding seabirds.

KEF Name	Values[1]	Description
Commonwealth marine environment surrounding the Recherche Archipelago	Aggregations of marine life and high levels of biodiversity and endemism within benthic and demersal communities	The Recherche Archipelago is the most extensive area of reef in the SWMR. Its reef and seagrass habitat supports a high species diversity of warm temperate species, including 263 known species of fish, 347 known species of molluscs, 300 known species of sponges, and 242 known species of macroalgae. The islands also provide haul-out (resting areas) and breeding sites for Australian sea lions and New Zealand fur seals.
Commonwealth marine environment within and adjacent to the west-coast inshore lagoons	High productivity and aggregations of marine life within benthic and pelagic habitats Important for benthic productivity and recruitment for a range of marine species	These lagoons are important for benthic productivity, including macroalgae and seagrass communities, and breeding and nursery aggregations for many temperate and tropical marine species. They are important areas for the recruitment of commercially and recreationally important fish species. Extensive schools of migratory fish visit the area annually, including herring, garfish, tailor and Australian salmon.
Commonwealth marine environment within and adjacent to Geographe Bay	High productivity and aggregations of marine life, and high levels of biodiversity, recruitment within benthic and pelagic communities	Geographe Bay is known for its extensive beds of tropical and temperate seagrass that support a diversity of species, many of them not found anywhere else. The bay provides important nursery habitat for many species. Juvenile dusky whaler sharks use the shallow seagrass habitat as nursery grounds for several years, before ranging out to adult feeding grounds along the shelf break. The seagrass also provides valuable habitat for fish and invertebrates (Carruthers *et al.*, 2007). It is also an important resting area for migratory humpback whales.
Diamantina Fracture Zone	Unique seafloor feature with ecological properties of regional significance which apply to its benthic and demersal habitats	The Diamantina Fracture Zone is a rugged, deep- water environment of seamounts and numerous closely spaced troughs and ridges. Very little is known about the ecology of this remote, deep- water feature, but marine experts suggest that its size and physical complexity mean that it is likely to support deep-water communities characterised by high species diversity, with many species found nowhere else.
Naturaliste Plateau	Unique seafloor feature with ecological properties of regional significance including high species diversity and endemism which apply to its benthic and demersal habitats	The Naturaliste Plateau is Australia's deepest temperate marginal plateau. The combination of its structural complexity, mixed water dynamics and relative isolation indicate that it supports deep- water communities with high species diversity and endemism.
Perth Canyon and adjacent shelf break, and other west-coast canyons	An area of higher productivity that attracts feeding aggregations of deep-diving mammals and large predatory fish. It is also recognised as a unique seafloor feature with ecological properties of regional significance	The Perth Canyon is the largest known undersea canyon in Australian waters. Deep ocean currents rise to the surface, creating a nutrient-rich cold- water habitat attracting feeding aggregations of deep-diving mammals, such as pygmy blue whales and large predatory fish that feed on aggregations of small fish, krill and squid.

KEF Name	Values[1]	Description
Western demersal slope and associated fish communities of the Central Western Province	Provides important habitat for demersal fish communities and supports species groups that are nationally or regionally important to biodiversity	The western demersal slope provides important habitat for demersal fish communities, with a high level of diversity and endemism. A diverse assemblage of demersal fish species below a depth of 400 m is dominated by relatively small benthic species such as grenadiers, dogfish and cucumber fish. Unlike other slope fish communities in Australia, many of these species display unique physical adaptations to feed on the sea floor (such as a mouth position adapted to bottom feeding), and many do not appear to migrate vertically in their daily feeding habits.
Western rock lobster	A species that plays a regionally important ecological role	This species is the dominant large benthic invertebrate in the region. The lobster plays an important trophic role in many of the inshore ecosystems of the SWMR. Western rock lobsters are an important part of the food web on the inner shelf, particularly as juveniles.

1. Values description sourced from Marine bioregional plan for the South-west Marine Region (DSEWPAC, 2012b) and the Department of Agriculture, Water and the Environment (DAWE) SPRAT database

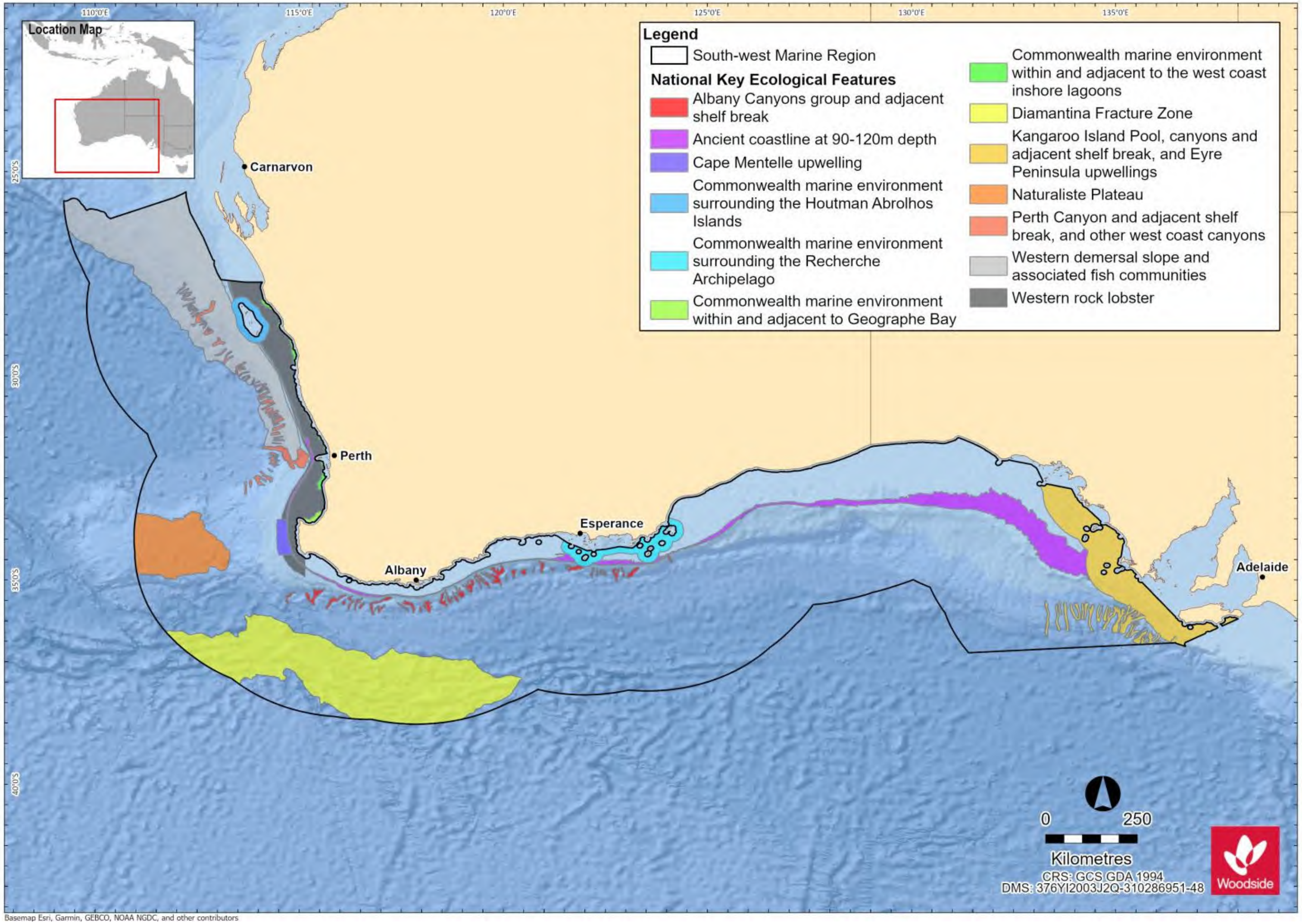

Figure 9-2. Key Ecological Features (KEFs) within the SWMR

Table 9-3 Key Ecological Features (KEF) within the NMR

KEF Name	Values[1]	Description
Carbonate bank and terrace system of the Van Diemen Rise	Important for its role in enhancing biodiversity and local productivity relative to its surrounds and for supporting relatively high species diversity The feature has been identified as a sponge biodiversity hotspot (Przeslawski *et al.* 2014)	The bank and terrace system of the Van Diemen Rise is part of the larger system associated with the Sahul Banks to the north and Londonderry Rise to the east; it is characterised by terrace, banks, channels and valleys. The variability in water depth and substrate composition may contribute to the presence of unique ecosystems in the channels. Species present include sponges, soft corals and other sessile filter feeders associated with hard substrate sediments of the deep channels; epifauna and infauna include polychaetes and ascidians. Olive ridley turtles, sea snakes and sharks are also found associated with this feature.
Gulf of Carpentaria basin	Regional importance for biodiversity, endemism and aggregations of marine life relevant to benthic and pelagic habitats	The Gulf of Carpentaria basin is one of the few remaining near-pristine marine environments in the world. Primary productivity in the Gulf of Carpentaria basin is mainly driven by cyanobacteria that fix nitrogen but is also strongly influenced by seasonal processes. The soft sediments of the basin are characterised by moderately abundant and diverse communities of infauna and mobile epifauna dominated by polychaetes, crustaceans, molluscs, and echinoderms. The basin also supports assemblages of pelagic fish species including planktivorous and schooling fish, with top predators such as shark, snapper, tuna, and mackerel.
Gulf of Carpentaria coastal zone	High productivity, aggregations of marine life (including several endemic species) and high biodiversity compared to broader region	Nutrient inflow from rivers adjacent to the NMR generates higher productivity and more diverse and abundant biota within the Gulf of Carpentaria coastal zone than elsewhere in the region. The coastal zone is near pristine and supports many protected species such as marine turtles, dugongs, and sawfishes. Ecosystem processes and connectivity remain intact; river flows are mostly uninterrupted by artificial barriers and healthy, diverse estuarine and coastal ecosystems support many species that move between freshwater and saltwater environments.
Pinnacles of the Bonaparte Basin	Unique seafloor feature with ecological properties of regional significance Provide areas of hard substrate in an otherwise soft sediment environment and so are important for sessile species Recognised as a biodiversity hotspot for sponges The Pinnacles of the Bonaparte Basin KEF is located within both the NWMR and NMR (refer **Table 9-1**)	Covering more than 520 km^2 within the Bonaparte Basin, this feature contains the largest concentration of pinnacles along the Australian margin. The Pinnacles of the Bonaparte Basin are thought to be the eroded remnants of underlying strata; it is likely that the vertical walls generate local upwelling of nutrient-rich water, leading to phytoplankton productivity that attracts aggregations of planktivorous and predatory fish, seabirds and foraging turtles.

KEF Name	Values[1]	Description
Plateaux and saddle north-west of the Wellesley Islands	High species abundance, diversity and endemism of marine life	Abundance and species density are high in the plateaux and saddle as a result of increased biological productivity associated with habitats rather than currents. Submerged reefs support corals that are typical of northern Australia, including corals that have bleach-resistant zooxanthellae; and particular reef fish species that are different to those found elsewhere in the Gulf of Carpentaria. Species present include marine turtles and reef fish such as coral trout, cod, mackerel, and shark. Seabirds frequent the plateaux and saddle, most likely due to the presence of predictable food resources for feeding offspring.
Shelf break and slope of the Arafura Shelf	The Shelf break and slope of the Arafura Shelf is defined as a key ecological feature for its ecological significance associated with productivity emanating from the slope It also forms part of a unique biogeographic province (Last *et al.*, 2005)	The shelf break and slope of the Arafura Shelf is characterised by continental slope and patch reefs and hard substrate pinnacles. The ecosystem processes of the feature are largely unknown in the region; however, the Indonesian Throughflow and surface wind-driven circulation are likely to influence nutrients, pelagic dispersal and species and biological productivity in the region. Biota associated with the feature is largely of Timor–Indonesian Malay affinity.
Submerged coral reefs of the Gulf of Carpentaria	High aggregations of marine life, biodiversity and endemism Twenty per cent of the reefs found in the NMR are situated within this KEF (Harris *et al.*, 2007)	The submerged coral reefs of the Gulf of Carpentaria are characterised by submerged patch, platform and barrier reefs that form a broken margin around the perimeter of the Gulf of Carpentaria basin, rising from the sea floor at depths of 30–50 m. These reefs provide breeding and aggregation areas for many fish species including mackerel and snapper and offer refuges for sea snakes and apex predators such as sharks. Coral trout species that inhabit the submerged reefs are smaller than those found in the Great Barrier Reef and may prove to be an endemic sub-species.
Tributary Canyons of the Arafura Depression	High productivity and high levels of species diversity and endemism of marine life within the benthic and pelagic habitats of the feature	The tributary canyons are approximately 80–100 m deep and 20 km wide. The largest of the canyons extend some 400 km from Cape Wessel into the Arafura Depression, and are the remnants of a drowned river system that existed during the Pleistocene era. Sediments in this feature are mainly calcium-carbonate rich, although sediment type varies from sandy substrate to soft muddy sediments and hard, rocky substrate. Marine turtles, deep sea sponges, barnacles and stalked crinoids have all been identified in the area.

[1]. Values description sourced from Marine bioregional plan for the North Marine Region (DSEWPAC, 2012c) and Department of Agriculture, Water and the Environment (DAWE) SPRAT database.

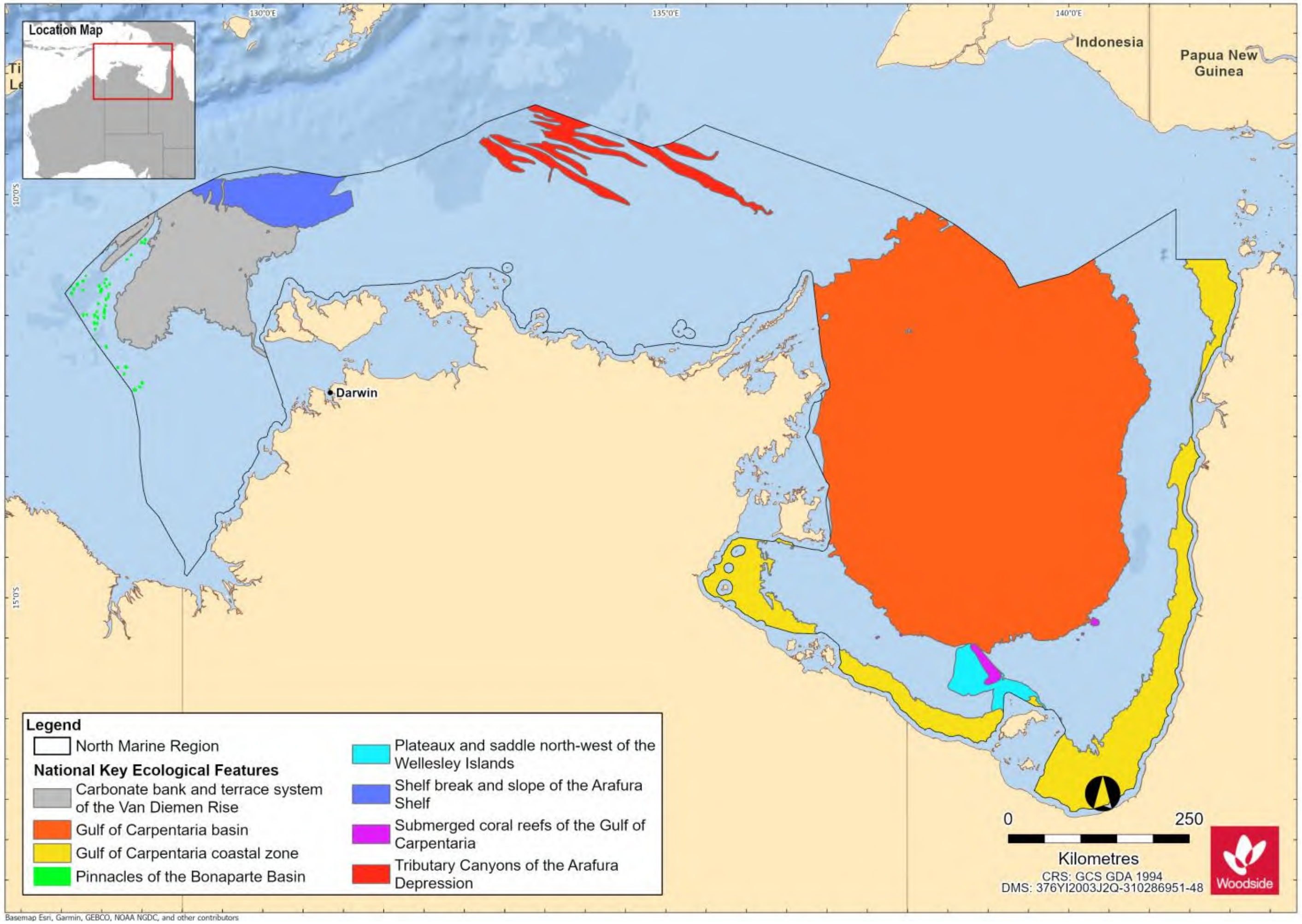

Figure 9-3. Key Ecological Features (KEFs) within the NMR

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10. PROTECTED AREAS

10.1 Regional Context

Protected areas included World Heritage Properties, National Heritage Places, Wetlands of International Importance, Australian Marine Parks, State Marine Parks and Reserves, Threatened Ecological Communities and the Australian Whale Sanctuary. The PMST Reports (**Appendix A**) shows that there are twenty-nine protected areas found in the NWMR, eighteen in the SWMR and nine in the NMR.

Table 10-1, Table 10-2 and **Table 10-3** outline the protected areas of each of the marine regions NWMR, SWMR and NMR, respectively.

10.2 World Heritage Properties

Properties nominated for World Heritage listing are inscribed on the list only after they have been carefully assessed as representing the best examples of the world's cultural and natural heritage. Only World Heritage listings classed as natural are discussed in this section. World Heritage sites classed as cultural are discussed in **Section 11**.

The list of Australia's World Heritage Properties and the PMST Reports (**Appendix A**) show two World Heritage Properties within the NWMR (**Table 10-1**), no World Heritage Properties within the SWMR (**Table 10-2),** and though not reported in the NMR PMST Report, Kakadu National Park and World Heritage Area is included in **Table 10-3**.

10.3 National and Commonwealth Heritage Places - Natural

The National Heritage List is Australia's list of natural, historic, and Indigenous places of outstanding significance to the nation. The National Heritage List Spatial Database describes the place name, class (Indigenous, natural, historic), and status. Commonwealth Heritage Places are a collection of sites recognised for their Indigenous, historical and/or natural values which are owned or controlled by the Australian Government.

Only National and Commonwealth Heritage Places classed as natural are discussed in this section. Heritage Places classed as indigenous or historic are discussed in **Section 11**.

A search of the National Heritage List Spatial Database and the PMST Reports (**Appendix A**) identified three natural National Heritage Places in the NWMR (**Table 10-1**), three in the SWMR (**Table 10-2**) and for the NMR, Kakadu National Park (not included in the PMST report) is included in **Table 10-3**.

A search of the Commonwealth Heritage List identified four natural commonwealth heritage places within the NWMR (**Table 10-1**).

10.4 Wetlands of International Importance (listed under the Ramsar Convention)

Australia has 65 Ramsar wetlands that cover >8.3 million ha. Ramsar wetlands are those that are representative, rare, or unique wetlands, or that are important for conserving biological diversity.

The List of Wetlands of International Importance held under the Ramsar Convention and the PMST Reports (**Appendix A**) identified four Ramsar Sites with coastal features within the NWMR (**Table 10-1**), four in the SWMR (**Table 10-2**) and two for the New Territory, included for the NMR (**Table 10-3**).

10.5 Australian Marine Parks

Australian Marine Parks (AMPs), proclaimed under the EPBC Act in 2007 and 2013, are located in Commonwealth waters that start at the outer edge of State and Territory waters, generally three nautical miles (~5.5 km) from the shore, and extend to the outer boundary of Australia's EEZ, 200 nm (~370 km) from the shore.

PMST Reports (**Appendix A**) show sixteen AMPs within the NWMR (**Table 10-1**), ten within the SWMR (**Table 10-2**) and eight within the NMR (**Table 10-3**).

10.6 Threatened Ecological Communities

No Threatened Ecological Communities (TECs) as listed under the EPBC Act are known to occur within the marine waters of the NWMR, SWMR or NMR as indicated by the PMST Reports (**Appendix A**).

10.7 Australian Whale Sanctuary

The Australian Whale Sanctuary has been established to protect all whales and dolphins found in Australian waters. Under the EPBC Act all cetaceans (whales, dolphins and porpoises) are protected in Australian waters.

The Australian Whale Sanctuary includes all Commonwealth waters from the three nautical mile State/Territory waters limit out to the boundary of the EEZ (i.e. out to 200 nm and further in some places). Within the Sanctuary it is an offence to kill, injure or interfere with a cetacean. Severe penalties apply to anyone convicted of such offences.

10.8 State Marine Parks and Reserves

State Marine Parks and Reserves, proclaimed under the *Conservation and Land Management Act 1984* (CALM Act), are located in State waters and vested in the WA Conservation and Parks Commission. State Marine Parks and Reserves of Western Australia have been considered, with 14 occurring in the NWMR (**Table 10-1**) and six occurring in the SWMR (**Table 10-2**).

10.9 Summary of Protected Areas within the NWMR

Table 10-1 Protected Areas within the NWMR

Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
World Heritage Properties						
Shark Bay World Heritage Property	-	-	✓		The Shark Bay World Heritage Property is adjacent to the Shark Bay AMP and was included on the World Heritage List in 1991.	Universal values of the Shark Bay World Heritage Property include large and diverse seagrass beds, stromatolites and populations of dugong and threatened species. Inscribed under Natural Criteria vii, viii, ix and x.
The Ningaloo Coast World Heritage Property	-	-	✓		The Ningaloo Coast World Heritage Property lies within the Ningaloo AMP and was included on the World Heritage List in 2011.	Universal values of the Ningaloo Coast World Heritage Property include high marine species diversity and abundance; in particular, Ningaloo Reef supports both tropical and temperate marine reptiles and mammals. Inscribed under Natural Criteria vii and x.
National Heritage Places - Natural						
Shark Bay	-	-	✓		The Shark Bay National Heritage Place consists of the same area included in the Shark Bay World Heritage Property (refer above) and was established on the National Heritage List in 2007.	The national heritage place has a number of exceptional natural features, including one of the largest and most diverse seagrass beds in the world, colonies of stromatolites and rich marine life including a large population of dugongs, and also provides a refuge for a number of other globally threatened species. Shark Bay meets the national heritage listing criteria a, b, c, d, e, f, g, h and i.
The Ningaloo Coast	-	-	✓		The Ningaloo Coast National Heritage Place consists of the same area included in the Ningaloo	The Ningaloo Coast contains one of the best developed near-shore reefs in the world, being home to rugged limestone peninsulas, spectacular coral and sponge gardens and the whale shark.

Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					Coast World Heritage Property (refer above) and was established on the National Heritage List in 2010.	The Ningaloo Coast meets the national heritage listing criteria a, b, c, d, and f.
The West Kimberley	✓	✓	-		The West Kimberley National Heritage Place covers an area of around 192,000 km^2 located in the north-west of Australia from Broome to Wyndham, and was established on the National Heritage List in 2011.	The Kimberley plateau, north-western coastline and northern rivers of the West Kimberley provide a vital refuge for many native plants and animals that are found nowhere else or which have disappeared from much of the rest of Australia. In addition, Roebuck Bay is internationally recognised as one of Australia's most significant sites for migratory wading birds. The national heritage place also contains a remarkable history of Aboriginal occupation, with many places of indigenous sacred value. The West Kimberley meets the national heritage listing criteria a, b, c, d, e, f, g, h and i.
Commonwealth Heritage Places - Natural						
Mermaid Reef – Rowley Shoals	-	✓	-	N/A	The Mermaid Reef – Rowley Shoals Commonwealth Heritage Place is located within the boundary of the Mermaid Reef Marine National Nature Reserve. The site was listed as a Commonwealth Heritage Place in 2004.	The Mermaid Reef-Rowley Shoals Commonwealth Heritage Place is regionally important for the diversity of its fauna and together with Clerke and Imperieuse reefs, has biogeographical significance due to the presence of species which are at, or close to, the limits of their geographic ranges, including fishes known previously only from Indonesian waters. Rowley Shoals is important for benchmark studies as one of the few places off the north-west coast of Western Australia which have been the site of major biological collection trips by the WA Museum.

Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
Ashmore Reef National Nature Reserve	✓	-	-		The Ashmore Reef Commonwealth Heritage Place is located within the boundary of the Ashmore Reef Marine Park (refer AMPs below). The site was listed as a Commonwealth Heritage Place in 2004.	Ashmore Reef has major significance as a staging point for wading birds migrating between Australia and the Northern Hemisphere and supports high concentrations of breeding seabirds, many of which are nomadic and typically breed on small isolated islands. Ashmore Reef is an important scientific reference area for migratory seabirds, sea snakes and marine invertebrates. The Ashmore Reef Commonwealth Heritage Place is significant for its history of human occupation and use. The island is believed to have been visited by Indonesian fisherman since the early eighteenth century. The islands were used both for fishing and as a staging point for voyages to the southern reefs off Australia's coast.
Scott Reef and Surrounds – Commonwealth Area	✓	-	-		Scott Reef and Surrounds Commonwealth Heritage Place is located within the Western Australian Coastal Waters surrounding North and South Scott Reef. The site was listed as a Commonwealth Heritage Place in 2004.	The Scott Reef and Surrounds Commonwealth Heritage Place is regionally important for the diversity of its fauna and has biogeographical significance due to the presence of species which are at, or close to, the limits of their geographic ranges, including fish known previously only from Indonesian waters. Scott Reef is recognised as important for scientific research and benchmark studies due to its age, the extensive documentation of its geophysical and physical environmental characteristics and its use as a site of major biological collection trips and surveys by the WA Museum and the Australian Institute of Marine Science.

Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
Ningaloo Marine Area – Commonwealth Waters	-	-	✓		The Ningaloo Marine Area Commonwealth Heritage Place is located within the Commonwealth waters of the Ningaloo Marine Park (refer AMPs below). The site was listed as a Commonwealth Heritage Place in 2004.	The Ningaloo Marine Area Commonwealth Heritage Place provides a migratory pathway for humpback whales and foraging habitat for whale sharks. The place is an important breeding area for billfish and manta ray. The Ningaloo Marine Area provides opportunities for scientific research relating to aspects of the area's unique features including tourism (marine ecology, whales, turtles, whale sharks, fish and oceanography.
Wetlands of International Importance (Ramsar)						
Ashmore Reef National Nature Reserve	✓	-	-	Ramsar	The Ashmore Reef Ramsar site is located within the boundary of the Ashmore Reef Marine Park (refer AMPs below). The site was listed under the Ramsar Convention in 2002.	Ashmore Reef Ramsar site supports internationally significant populations of seabirds and shorebirds, is important for turtles (green, hawksbill and loggerhead) and dugong, and has the highest diversity of hermatypic (reef-building) corals on the WA coast. It is known for its abundance and diversity of sea snakes. However, since 1998 populations of sea snakes at Ashmore Reef have been in decline.
Eighty Mile Beach	-	✓	-	Ramsar	The Eighty Mile Beach Ramsar site covers an area of 1250 km^2, located along a long section of the Western Australian coastline adjacent to the Eighty Mile Beach AMP (refer below).	The Eighty Mile Beach Ramsar site includes saltmarsh and a raised peat bog more than 7000 years old. The site contains the most important wetland for waders in north-western Australia, supporting up to 336,000 birds, and is especially important as a land fall for waders migrating south for the austral summer.
Roebuck Bay	-	✓	-	Ramsar	The Roebuck Bay Ramsar site covers an area of 550	The Roebuck Bay Ramsar site is recognised as one of the most important areas for migratory shorebirds in Australia.

Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					km², located south of Broome and adjacent to the Roebuck AMP (refer below).	The site regularly supports over 100,000 waterbirds, with numbers being highest in the austral spring when migrant species breeding in the Palearctic stop to feed during migration.
Ord River Floodplain	✓			Ramsar	The Ord River Floodplain Ramsar Site is in the East Kimberley region and encompasses an extensive system of river, seasonal creek, tidal mudflat, and floodplain wetlands. The Ramsar Site is a nursery, feeding and/or breeding ground for migratory birds, waterbirds, fish, crabs, prawns, and crocodiles.	The site represents the best example of wetlands associated with the floodplain and estuary of a tropical river system in the Tanami-Timor Sea Coast Bioregion in the Kimberley. In addition, the False Mouths of the Ord are the most extensive mudflat and tidal waterway complex in Western Australia.
Wetlands of National Importance (DAWE, 2019)						
Ashmore Reef	✓	-	-		Ashmore Reef is a shelf-edge platform reef located among the Sahul Banks of north-western Australia. It covers an area of 583 km² and consists of three islets surrounded by intertidal reef and sand flats.	These islets are major seabird nesting sites with 20 breeding species recorded to date. The total bird population has been estimated to exceed 100,000 during the peak breeding season. The marine reserve also has the highest diversity of marine fauna of the reefs on the NWS and differs from other reefs and coastal areas in the region. The area meets criteria 1, 3, 4 and 5 for inclusion on the Directory of Important Wetlands in Australia.
Mermaid Reef	-	✓	-		Mermaid Reef Marine Park covers an area of around 540 km², located ~280 km west north-west of Broome, and is the most north-easterly atoll of the Rowley Shoals.	The reefs of the Mermaid Reef Marine Park have biogeographic value due to the presence of species that are at or close to the limit of their distribution. The coral communities are one of the special values of Mermaid Reef. The area meets criteria 1, 2 and 3 for inclusion on the Directory of Important Wetlands in Australia.

Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
Exmouth Gulf East	-	-	✓		Exmouth Gulf East covers an area of 800 km^2 and includes wetlands in the eastern part of Exmouth Gulf, from Giralia Bay; to Urala Creek, Locker Point.	The Exmouth Gulf East is an outstanding example of tidal wetland systems of low coast of north-west Australia, with well- developed tidal creeks, extensive mangrove swamps and broad saline coastal flats. The site is one of the major population centres for dugong in WA and its seagrass beds and extensive mangroves provide nursery and feeding areas for marine fishes and crustaceans in the Gulf. The area meets criteria 1, 2 and 3 for inclusion on the Directory of Important Wetlands in Australia.
Hamelin Pool	-	-	✓		Hamelin Pool covers an area of 900 km^2 in the far south-east part of Shark Bay.	Hamelin Pool is an outstanding example of a hypersaline marine embayment and supports extensive microbialite (subtidal stromatolite) formations, which are the most abundant and diverse examples of growing marine microbialites in the world. The area meets criteria 1 and 6 for inclusion on the Directory of Important Wetlands in Australia.
Shark Bay East	-	-	✓		Shark Bay East covers a 250 km area of coastline comprising tidal wetlands, and marine waters less than 6 m deep at low tide, in the east arm of Shark Bay.	The site is an outstanding example of a very large, shallow marine embayment, with particularly extensive occurrence of seagrass beds and substantial areas of intertidal mud/sandflats and mangrove swamp. The site supports what is probably the world's largest discrete population of dugong; it is also a major nursery and/or feeding area for turtles, rays, sharks, other fishes, prawns and other marine fauna; and is a major migration stop-over area for shorebirds. The area meets criteria 1, 2, 3, 4, 5 and 6 for inclusion on the Directory of Important Wetlands in Australia.
Australian Marine Parks (DNP, 2018a)						
Abrolhos Marine Park	-	-	✓	II, IV, VI	Abrolhos Marine Park is located adjacent to the WA Houtman Abrolhos Islands, covering a large offshore	Abrolhos Marine Park is significant because it contains habitats, species and ecological communities associated with four bioregions:

Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					area of 88,060 km^2 extending from the WA State waters boundary to the edge of Australia's EEZ. The Abrolhos Marine Park is located within both the NWMR and SWMR.	• Central Western Province • Central Western Shelf Province • Central Western Transition • South-west Shelf Transition It includes seven KEFs: Commonwealth marine environment surrounding the Houtman Abrolhos Islands; Demersal slope and associated fish communities of the Central Western Province; Mesoscale eddies; Perth Canyon and adjacent shelf break, and other west-coast canyons; Western rock lobster; Ancient coastline at 90-120 m depth; and Wallaby Saddle. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging and breeding habitat for seabirds, foraging habitat for Australian sea lions and white sharks, and a migratory pathway for humpback and pygmy blue whales. The AMP is adjacent to the northernmost Australian sea lion breeding colony in Australia on the Houtman Abrolhos Islands.
Carnarvon Canyon Marine Park	-	-	✓	IV	Carnarvon Canyon Marine Park covers an area of 6177 km^2, located ~300 km north-west of Carnarvon.	Carnarvon Canyon Marine Park is significant because it contains habitats, species and ecological communities associated with the Central Western Transition bioregion. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. There is limited information about species' use of this AMP.
Shark Bay Marine Park	-	-	✓	VI	Shark Bay Marine Park covers an area of 7443 km^2 located ~60 km offshore of Carnarvon, adjacent to the Shark Bay World Heritage Property and National Heritage Place.	Shark Bay Marine Park is significant because it contains habitats, species and ecological communities associated with two bioregions: • Central Western Shelf Province • Central Western Transition. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under

<table>
<tr><th rowspan="2">Protected Area</th><th colspan="3">Woodside Activity Area</th><th rowspan="2">IUCN Protected Area Category* or Relevant Park Zone</th><th rowspan="2">Description</th><th rowspan="2">Conservation Values</th></tr>
<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>the EPBC Act. BIAs within the AMP include breeding habitat for seabirds, internesting habitat for marine turtles, and a migratory pathway for humpback whales.</td></tr>
<tr><td>Gascoyne Marine Park</td><td>-</td><td>-</td><td>✓</td><td>II, IV, VI</td><td>Gascoyne Marine Park covers an area of 81,766 km², located ~20 km off the west coast of the Cape Range Peninsula, adjacent to the Ningaloo Marine Park.</td><td>Gascoyne Marine Park is significant because it contains habitats, species and ecological communities associated with three bioregions:
• Central Western Shelf Transition
• Central Western Transition
• Northwest Province.
It includes four KEFs: Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula; Commonwealth waters adjacent to Ningaloo Reef; Continental slope demersal fish communities; and Exmouth Plateau.
The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding habitat for seabirds, internesting habitat for marine turtles, a migratory pathway for humpback whales, and foraging habitat and migratory pathway for pygmy blue whales.</td></tr>
<tr><td>Ningaloo Marine Park</td><td>-</td><td>-</td><td>✓</td><td>II, IV</td><td>Ningaloo Marine Park covers an area of 2435 km², stretching ~300 km along the west coast of the Cape Range Peninsula, and is adjacent to the WA Ningaloo Marine Park and Gascoyne Marine Park.</td><td>Ningaloo Marine Park is significant because it contains habitats, species and ecological communities associated with four bioregions:
• Central Western Shelf Transition
• Central Western Transition
• Northwest Province
• Northwest Shelf Province.
It includes three KEFs: Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula; Commonwealth waters adjacent to Ningaloo Reef; and Continental slope demersal fish communities.
The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding and</td></tr>
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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
						or foraging habitat for seabirds, internesting habitat for marine turtles, a migratory pathway for humpback whales, foraging habitat and migratory pathway for pygmy blue whales, breeding, calving, foraging and nursing habitat for dugong and foraging habitat for whale sharks.
Montebello Marine Park	-	✓	-	VI	Montebello Marine Park covers an area of 3413 km^2, located offshore of Barrow Island and 80 km west of Dampier extending from the WA State waters boundary, and is adjacent to the WA Barrow Island and Montebello Islands Marine Parks.	Montebello Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Province bioregion. It includes one KEF: Ancient coastline at 125 m depth contour. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding habitat for seabirds, internesting, foraging, mating, and nesting habitat for marine turtles, a migratory pathway for humpback whales and foraging habitat for whale sharks.
Dampier Marine Park	-	✓	-	II, IV, VI	Dampier Marine Park covers an area of 1252 km^2, located ~10 km north-east of Cape Lambert and 40 km from Dampier extending from the WA State waters boundary.	Dampier Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Province bioregion. The AMP provides protection for offshore shelf habitats adjacent to the Dampier Archipelago, and the area between Dampier and Port Hedland, and is a hotspot for sponge biodiversity. The AMP supports a range of species including those listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding and foraging habitat for seabirds, internesting habitat for marine turtles and a migratory pathway for humpback whales.
Eighty Mile Beach Marine Park	-	✓	-	VI	Eighty Mile Beach Marine Park covers an area of 10,785 km^2, located ~74 km north-east of Port Hedland, adjacent to the	Eighty Mile Beach Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Province and consists of shallow shelf habitats, including terrace, banks and shoals.

Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					WA Eighty Mile Beach Marine Park.	The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding, foraging and resting habitat for seabirds, internesting and nesting habitat for marine turtles, foraging, nursing and pupping habitat for sawfishes and a migratory pathway for humpback whales.
Argo – Rowley Terrace Marine Park	✓	✓	-	II, VI, VI (Trawl)	Argo-Rowley Terrace Marine Park covers an area of 146,003 km^2, located ~270 km north-west of Broome, and extends to the limit of Australia's EEZ. The AMP is adjacent to the Mermaid Reef Marine Park and the WA Rowley Shoals Marine Park.	Argo–Rowley Marine Park is significant because it contains habitats, species and ecological communities associated with two bioregions: • Northwest Transition • Timor Province. It includes two KEFs: Canyons linking the Argo Abyssal Plain with the Scott Plateau; and Mermaid Reef and Commonwealth waters surrounding Rowley Shoals. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include resting and breeding habitat for seabirds and a migratory pathway for the pygmy blue whale.
Mermaid Reef Marine Park	-	✓	-	II	Mermaid Reef Marine Park covers an area of 540 km^2, located ~280 km north-west of Broome, adjacent to the Argo–Rowley Terrace Marine Park and ~13 km from the WA Rowley Shoals Marine Park. Mermaid Reef is one of three reefs forming the Rowley Shoals. The other two are Clerke Reef and Imperieuse Reef, to the	Mermaid Reef Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Transition. It includes one KEF: Mermaid Reef and Commonwealth waters surrounding Rowley Shoals. The Rowley Shoals have been described as the best geological examples of shelf atolls in Australian waters. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding habitat for seabirds and a migratory pathway for the pygmy blue whale.

Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					south-west of the AMP, which are included in the WA Rowley Shoals Marine Park.	
Roebuck Marine Park	-	✓	-	VI	Roebuck Marine Park covers an area of 304 km^2, located ~12 km offshore of Broome, and is adjacent to the WA Yawuru Nagulagun/Roebuck Bay Marine Park.	Roebuck Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Province and consists entirely of shallow continental shelf habitat. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding and resting habitat for seabirds, foraging and internesting habitat for marine turtles, a migratory pathway for humpback whales and foraging habitat for dugong.
Kimberley Marine Park	✓	✓	-	II, IV, VI	Kimberley Marine Park covers an area of 74,469 km^2, located ~100 km north of Broome, extending from the WA State waters boundary north from the Lacepede Islands to the Holothuria Banks offshore from Cape Bougainville.	Kimberley Marine Park is significant because it includes habitats, species and ecological communities associated with three bioregions: • Northwest Shelf Province • Northwest Shelf Transition • Timor Province. It includes two KEFs: Ancient coastline at 125 m depth contour; and Continental slope demersal fish communities. The AMP supports a range of species, including protected species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding and foraging habitat for seabirds, internesting and nesting habitat for marine turtles, breeding, calving and foraging habitat for inshore dolphins, calving, migratory pathway and nursing habitat for humpback whales, migratory pathway for pygmy blue whales, foraging habitat for dugong and foraging habitat for whale sharks.
Ashmore Reef Marine Park	✓	-	-	Ia, IV	Ashmore Reef Marine Park covers an area of 583 km^2, located ~630 km north of	Ashmore Reef Marine Park is significant because it includes habitats, species and ecological communities associated with the Timor Province. It includes two KEFs:

Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					Broome and 110 km south of the Indonesian island of Roti. The AMP is located in Australia's External Territory of Ashmore and Cartier Islands and is within an area subject to a Memorandum of Understanding (MoU) between Indonesia and Australia, known as the MoU Box.	Ashmore Reef and Cartier Island and surrounding Commonwealth waters; and Continental slope demersal fish communities. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding, foraging and resting habitat for seabirds, resting and foraging habitat for migratory shorebirds, foraging, mating, nesting and internesting habitat for marine turtles, foraging habitat for dugong, and a migratory pathway for pygmy blue whales.
Cartier Island Marine Park	✓	-	-	Ia	Cartier Island Marine Park covers an area of 172 km^2, located ~45 km south-east of Ashmore Reef Marine Park and 610 km north of Broome. It is also located in Australia's External Territory of Ashmore and Cartier Islands and within an area subject to an MoU between Indonesia and Australia, known as the MoU Box.	Cartier Island Marine Park is significant because it includes habitats, species and ecological communities associated with the Timor Province. It includes two key ecological features: Ashmore Reef and Cartier Island and surrounding Commonwealth waters and continental slope demersal fish communities. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding and foraging habitat for seabirds, internesting, nesting and foraging habitat for marine turtles and foraging habitat for whale sharks. The AMP is also internationally significant for its abundance and diversity of sea snakes, some of which are listed species under the EPBC Act.
Joseph Bonaparte Gulf Marine Park	✓	-	-	VI	Joseph Bonaparte Gulf Marine Park covers an area of 8597 km^2 and is located ~15 km west of Wadeye, NT, and ~90 km north of Wyndham, WA, in the Joseph Bonaparte Gulf.	Joseph Bonaparte Gulf Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Transition bioregion. It includes one KEF: Carbonate bank and terrace system of the Sahul Shelf. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under

Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					It is adjacent to the WA North Kimberley Marine Park. The Joseph Bonaparte Gulf Marine Park is located within both the NWMR and NMR.	the EPBC Act. BIAs within the AMP include foraging habitat for marine turtles and the Australian snubfin dolphin.
Oceanic Shoals Marine Park	✓	-	-	II, IV, VI	Oceanic Shoals Marine Park covers an area of 71,743 km^2 and is located west of the Tiwi Islands, ~155 km north-west of Darwin, NT and 305 km north of Wyndham, WA. The Oceanic Shoals Marine Park is located within both the NWMR and NMR.	Oceanic Shoals Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Transition bioregion. It contains four KEFs: Carbonate bank and terrace systems of the Van Diemen Rise; Carbonate bank and terrace systems of the Sahul Shelf; Pinnacles of the Bonaparte Basin; and Shelf break and slope of the Arafura Shelf. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging and internesting habitat for marine turtles.
State Marine Parks and Reserves						
North Kimberley Marine Park	✓	-	-	Sanctuary, Special Purpose and General Use Zones	The North Kimberley Marine Park covers approx. 18,450 km^2 with its south-western boundary located ~270 km north-east of Derby.	The coral reefs of the north Kimberley have the greatest diversity in Western Australia and are some of the most pristine and remarkable reefs in the world. The park surrounds more than 1000 islands and is home to listed species such as dugongs, marine turtles, and sawfishes (DPAW, 2016a).
Lalang-garram / Horizontal Falls Marine Park and North Lalang-garram Marine Park (jointly managed)	✓	-	-	Sanctuary, Special Purpose and General Use Zones	The Lalang-garram / Horizontal Falls Marine Park covers ~3530 km^2 from Talbot Bay in the west and Glenelg River in the east. The North Lalang-garram Marine Park covers ~1100	The Lalang-garram / Horizontal Falls Marine Park's most celebrated attraction is created by massive tides of up to 10 m and narrow gaps in two parallel tongues of land meaning the tide falls faster than the water can escape, producing 'horizontal falls'. There are also islands with fringing coral reefs and mangrove-lined creeks and bays. The North Lalang-garram Marine Park has a number of islands fringed with coral reef and has been identified as an

Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					km^2 between Camden Sound and North Kimberley Marine Parks.	ecological hotspot and supports more than 1% of the world's population of brown boobies, with up to 2000 breeding pairs. About 500 pairs of crested terns also nest on the island (DPAW, 2016b).
Lalang-garram / Camden Sound Marine Park	✓	-	-	Sanctuary, Special Purpose and General Use Zones	Lalang-garram / Camden Sound Marine Park covers 7050 km^2 located about 150 km north of Derby.	The Lalang-garram / Camden Sound Marine Park is the most important humpback whale nursery in the Southern Hemisphere. It also features the spectacular coastal Montgomery Reef. The marine park is home to six species of threatened marine turtle. Australian snubfin and Indo-Pacific humpback dolphins, dugongs, saltwater crocodiles, and several species of sawfish (DPAW, 2013).
Rowley Shoals Marine Park	-	✓	-	Sanctuary, Recreation and General Use Zones	The Rowley Shoals comprise of three reef systems, Mermaid Reef, Clerke Reef and Imperieuse Reef, all 30-40 km apart. These reef systems are located ~300 km west north-west of Broome.	The three coral atolls of the Rowley Shoals Marine Park comprise of shallow lagoons inhabited by diverse corals and abundant marine life, each covering around 80 km^2 at the edge of Australia's continental shelf. Further offshore, the seafloor slopes away to the abyssal plain, some 6000 m below. Undersea canyons slice the slope; these features are commonly associated with diverse communities of deep-water corals and sponges and create localised upwellings that aggregate pelagic species like tunas and billfish (DEC, 2007a).
Yawuru Nagulagun / Roebuck Bay Marine Park	-	✓	-	Special Purpose Zone	Yawuru Nagulagun / Roebuck Bay Marine Park is a series of intertidal flats lying on the coast to the south-east of Broome.	Roebuck Bay is an internationally significant wetland and one of the most important feeding grounds for migratory shorebirds in Australia. Australian snubfin and Australian humpback dolphins frequent the waters and humpback whales pass through on their annual migration. Flatback turtles nest on the shores and are found in the bay's waters with other sea turtle species. Seagrass and macroalgae communities provide food for protected species such as the dugong and flatback turtle (DPAW, 2016c).
Eighty Mile Beach Marine Park	-	✓	-	Sanctuary, Recreation, Special	Eighty Mile Beach Marine Park covers ~2000 km^2 stretching across 220km of	Eighty Mile Beach Marine Park is one of the world's most important feeding grounds for small wading birds that migrate to the area each summer, travelling from countries

Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
				Purpose and General Use Zones	coastline between Port Hedland and Broome.	thousands of kilometres away. The marine park is a major nesting area for flatback turtles which are found only in northern Australia. Sawfishes, dugongs, dolphins and millions of invertebrates inhabit the sand and mud flats, seagrass meadows, coral reefs and mangroves (DPAW, 2014).
Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area (jointly managed)	-	✓	-	Sanctuary, Recreation, General Use and Special Purpose Zones	The Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area are located off the north-west coast of WA, ~1600 km north of Perth, and cover areas of ~583 km^2, 42 km^2 and 1,147 km^2, respectively.	The Montebello/Barrow islands marine conservation reserves have very complex seabed and island topography, resulting in a myriad of different habitats subtidal coral reefs, macroalgal and seagrass communities, subtidal soft-bottom communities, rocky shores and intertidal reef platforms, which support a rich diversity of invertebrates and finfish. The reserves are important breeding areas for several species of marine turtles and seabirds, which use the undisturbed sandy beaches for nesting. Humpback whales migrate through the reserves and dugongs occur in the shallow warm waters (DEC, 2007b).
Ningaloo Marine Park and Muiron Islands Marine Management Area (jointly managed)	-	-	✓	Sanctuary, Recreation, General Use and Special Purpose Zones	The Ningaloo Marine Park and Muiron Islands Marine Management Area are located off the North-west Cape of WA, ~1200 km north of Perth, and cover areas of ~2633 km^2 and 286 km^2, respectively.	Ningaloo Reef is the largest fringing coral reef in Australia. Temperate and tropical currents converge in the Ningaloo region resulting in highly diverse marine life including spectacular coral reefs, abundant fishes and species with special conservation significance such as turtles, whale sharks, dugongs, whales and dolphins. The region has diverse marine communities including mangroves, algae and filter-feeding communities and has high water quality. These values contribute to the Ningaloo Marine Park being regarded as the State's premier marine conservation icon. The Muiron Islands Marine Management Area is also important, containing a very diverse marine environment, with coral reefs, filter-feeding communities and macroalgal beds. In addition, the Islands are important seabird and green turtle nesting areas. (CALM, 2005a).

Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
Shark Bay Marine Park and Hamelin Pool Marine Nature Reserve (jointly managed)	-	-	✓	Sanctuary, Recreation, General Use and Special Purpose Zones	The Shark Bay Marine Park and Hamelin Pool Marine Nature Reserves are located 400 km north of Geraldton, covering areas of ~7487 km^2 and 1270 km^2, respectively.	Seagrass covers over 4000 km^2 of the Shark Bay Marine Park, with 12 different species making it one of the most diverse seagrass assemblages in the world. Dugongs regularly use this habitat, with the bay containing one of the largest dugong populations in the world. Humpback whales also use the bay as a staging post in their migration along the coast. Green and loggerhead turtles occur in the bay with Dirk Hartog Island providing the most important nesting site for loggerheads in Western Australia. Hamelin Pool contains the most diverse and abundant examples of stromatolites found in the world. These are living representatives of stromatolites that existed some 3500 million years ago (CALM, 1996).

**Conservation objectives for IUCN categories include:*

Ia: Strict Nature Reserve

Ib: Wilderness Area

II: national Park

III: Natural Monument or Feature

IV: Habitat/Species Management Area

V: Protected Landscape

VI: Protected area with sustainable use of natural resources – allow human use but prohibits large scale development.

IUCN categories for the marine park are provided and, in brackets, the IUCN categories for specific zones within each Marine Park as assigned under the North-west Marine Parks Network Management Plan 2018 (DNP, 2018a)

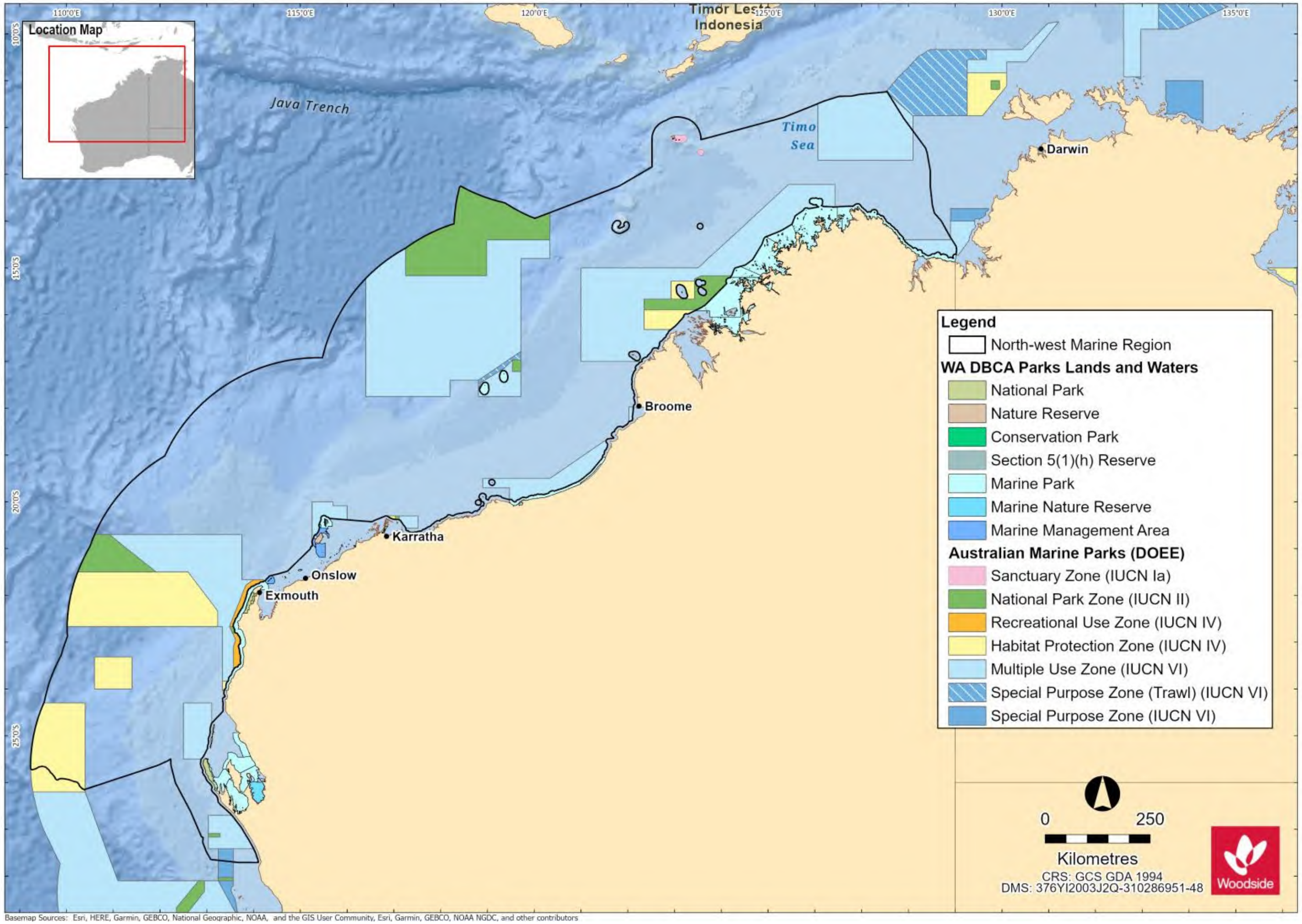

Figure 10-1 Commonwealth and State Marine Protected Areas for the NWMR

10.10 Summary of Protected Areas within the SWMR

Table 10-2 Protected Areas within the SWMR

Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
World Heritage Properties			
N/A			
National Heritage Places - Natural			
N/A			
Commonwealth Heritage Places - Natural			
N/A			
Wetlands of International Importance (Ramsar)			
Beecher Point Wetlands	Ramsar	Beecher Point Wetlands is a system of about sixty small wetlands located near Rockingham in south-west WA, covering an area of around 7 km^2. The site was listed under the Ramsar Convention in 2001.	The wetlands support sedgelands, herblands, grasslands, open-shrublands and low open-forests. The sedgelands that occur within the linear wetland depressions of the Ramsar site are a nationally listed TEC. At least four species of amphibians and twenty-one (21) species of reptiles have been recorded on the site. The site also supports the southern brown bandicoot. The site meets criteria 1 and 2 of the Ramsar Convention.
Forrestdale and Thomsons Lakes	Ramsar	Forrestdale Lake is located in the City of Armadale and Thomsons Lake is located in the City of Cockburn both of which lie within the southern Perth metropolitan area, in Western Australia. The site was listed under the Ramsar Convention in 1990.	The lakes are surrounded by medium density urban development and some agricultural land. The sediments of Thomsons Lake are between 30,000 and 40,000 years old, which are the oldest lake sediments discovered in WA to date. These lakes are the best remaining examples of brackish, seasonal lakes with extensive fringing sedgeland, typical of the Swan Coastal Plain. The site meets criteria 1, 3, 5 and 6 of the Ramsar Convention.
Peel-Yalgorup System	Ramsar	Peel-Yalgorup System, located adjacent to the City of Mandurah in	Peel-Yalgorup System Ramsar site is the most important area for waterbirds in south-western Australia. It supports a large number of waterbirds, and a

Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
		WA, is a large and diverse system of shallow estuaries, coastal saline lakes and freshwater marshes. The site was listed under the Ramsar Convention in 1990.	wide variety of waterbird species. It also supports a wide variety of invertebrates, and estuarine and marine fish. The site meets criteria 1, 3, 5 and 6 of the Ramsar Convention.
Vasse-wonnerup system	Ramsar	Vasse-Wonnerup System Ramsar wetland is situated in the Perth Basin, south-western WA. The site was listed under the Ramsar Convention in 1990.	Vasse-Wonnerup System is an extensive, shallow, nutrient-enriched wetland system of highly varied salinities. Large areas of the wetland dry out in late summer. Vasse-Wonnerup System supports tens of thousands of resident and migrant waterbirds of a wide variety of species. More than 80 species of waterbird have been recorded in the System such as red-necked avocets and black-winged stilts, wood sandpiper, sharp-tailed sandpiper, long-toed stint, curlew sandpiper and common greenshank. Thirteen waterbird species are also known to breed at the Ramsar site, including the largest regular breeding colony of black swans in south-western Australia. The site meets criteria 5 and 6 of the Ramsar Convention.
Wetlands of National Importance (DAWE, 2019)			
Rottnest Island Lakes		The Rottnest Island Lakes site is the cluster of 18 lakes and swamps on the north-east part of Rottnest Island.	An outstanding example of a series of lakes/swamps of varied depth and salinity located on an offshore island; the only island among 200 plus in WA exceeding 10 ha in area, that has a salt-lake complex; the only known example of seasonally meromictic lakes in Australia. The area meets criteria 1, 2, 3 and 6 for inclusion on the Directory of Important Wetlands in Australia.
Australian Marine Parks (DNP, 2018b)			
Abrolhos Marine Park	II, IV, VI	The Abrolhos Marine Park is located within both the NWMR and SWMR. Refer **Table 10-1** for description and conservation values.	
Bremer Marine Park	II, VI	Bremer Marine Park covers an area of 4472 km^2 and is located approximately half-way between Albany and Esperance, offshore from the Fitzgerald River National Park, extending from the WA State waters boundary.	Bremer Marine Park is significant because it contains habitats, species and ecological communities associated with two bioregions: • Southern Province • South-west Shelf Province. It includes two KEFs: Albany Canyon group and adjacent shelf break; and Ancient coastline at 90-120 m depth.

Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
			The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, Australian sea lions, and white sharks, a migratory pathway for humpback whales, and a significant calving area for southern right whales. The AMP includes canyons—important aggregation areas for killer whales.
Eastern Recherche Marine Park	II, VI	Eastern Recherche Marine Park covers an area of 20,575 km^2 and is located ~135 km east of Esperance, adjacent to the Recherche Archipelago, close to the WA Cape Arid National Park.	Eastern Recherche Marine Park is significant because it contains habitats, species and ecological communities associated with three bioregions: • South-west Shelf Province • Southern Province • Great Australian Bight Shelf Transition. It includes three KEFs: Mesoscale eddies; Ancient coastline at 90-120 m depth; and Commonwealth marine environment surrounding the Recherche Archipelago. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, Australian sea lions and white sharks, and a calving buffer area for southern right whales.
Geographe Marine Park	II, IV, VI	Geographe Marine Park covers an area of 977 km^2 and is located in Geographe Bay, ~8 km west of Bunbury and 8 km north of Busselton, adjacent to the WA Ngari Capes Marine Park.	Geographe Marine Park is significant because it contains habitats, species and ecological communities associated with the South-west Shelf Province bioregion. It includes two KEFs: Commonwealth marine environment within and adjacent to Geographe Bay; and Western rock lobster. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, a migratory pathway for humpback and pygmy blue whales, and a calving buffer area for southern right whales.
Great Australian Bight Marine Park	II, VI	Great Australian Bight Marine Park covers an area of 45,822 km^2 and is located ~12 km south-east of Eucla and 174 km west of Ceduna, adjacent to the SA Far West Coast and Nuyts Archipelago Marine Parks.	Great Australian Bight Marine Park is significant because it contains habitats, species and ecological communities associated with two bioregions: • Great Australian Bight Shelf Transition • Southern Province. It includes three KEFs: Ancient coastline at 90-120 m depth; Benthic invertebrate communities of the eastern Great Australian Bight; and Small pelagic fish of the South-west Marine Region. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, Australian sea lions, white sharks and

Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
			pygmy blue and sperm whales, and a calving area, migratory pathway and large aggregation area for southern right whales.
Jurien Marine Park	II, VI	Jurien Marine Park covers an area of 1851 km^2 and is located ~148 km north of Perth and 155 km south of Geraldton, adjacent to the WA Jurien Bay Marine Park.	Jurien Marine Park is significant because it includes habitats, species and ecological communities associated with two bioregions: • South-west Shelf Transition • Central Western Province. It includes three KEFs: Ancient coastline at 90-120 m depth; Demersal slope and associated fish communities of the Central Western Province; and Western rock lobster The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, Australian sea lions and white sharks, and a migratory pathway for humpback and pygmy blue whales.
Perth Canyon Marine Park	II, IV, VI	Perth Canyon Marine Park covers an area of 7409 km^2 and is located ~52 km west of Perth and ~19 km west of Rottnest Island.	Perth Canyon Marine Park is significant because it includes habitats, species and ecological communities associated with four bioregions: • Central Western Province • South-west Shelf Province • Southwest Transition • South-west Shelf Transition. It includes four KEFs: Perth Canyon and adjacent shelf break, and other west-coast canyons; Demersal slope and associated fish communities of the Central Western Province; Western rock lobster; and Mesoscale eddies. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, Antarctic blue, pygmy blue and sperm whales, a migratory pathway for humpback, Antarctic blue and pygmy blue whales, and a calving buffer area for southern right whales.
South-west Corner Marine Park	II, IV, VI	South-west Corner Marine Park covers an area of 271,833 km^2 and is located adjacent to the WA Ngari Capes Marine Park. It covers an extensive offshore area that is closest to WA State waters ~48 km west of Esperance, 73 km west of Albany and 68 km west of Bunbury.	South-west Corner Marine Park is significant because it contains habitats, species and ecological communities associated with three bioregions: • Southern Province • South-west Transition • South-west Shelf Province. It includes six KEFs: Albany Canyon group and adjacent shelf break; Cape Mentelle upwelling; Diamantina Fracture Zone; Naturaliste Plateau; Western rock lobster; and Ancient coastline at 90 m-120 m depth.

Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
			The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, Australian sea lions, white sharks and sperm whales, a migratory pathway for Antarctic blue, pygmy blue and humpback whales, and a calving buffer area for southern right whales.
Twilight Marine Park	II, VI	Twilight Marine Park covers an area of 4641 km^2 and is located ~245 km south-west of Eucla and 373 km north-east of Esperance, adjacent to the WA State waters boundary.	Twilight Marine Park is significant because it contains habitats, species and ecological communities associated with the Great Australian Bight Shelf Transition bioregion. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, Australian sea lions and white sharks, and a calving buffer area for southern right whales.
Two Rocks Marine Park	II, VI	Two Rocks Marine Park covers an area of 882 km^2 and is located ~25 km north-west of Perth, to the north-west of the WA Marmion Marine Park.	Two Rocks Marine Park is significant because it includes habitats, species and ecological communities associated with the South-west Shelf Transition bioregion. It includes three KEFs: Commonwealth marine environment within and adjacent to the west-coast inshore lagoons; Western rock lobster; and Ancient coastline at 90-120 m depth. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds and Australian sea lions, a migratory pathway for humpback and pygmy blue whales, and a calving buffer area for southern right whales.
State Marine Parks and Reserves			
Jurien Bay Marine Park	Sanctuary, Special Purpose and General Use Zones.	The Jurien Bay Marine Park is located on the central west coast of WA ~200 km north of Perth and covers an area of 824 km^2.	An extensive limestone reef system parallel to the shore has created a huge shallow lagoon that provides perfect habitat for Australian sea lions, dolphins and a myriad of juvenile fish. Extensive seagrass meadows inside the reef shelter many marine animals such as western rock lobsters, octopus and cuttlefish that make up the diet of young sea lions. The marine park also surrounds dozens of ecologically important islands that contain rare and endangered animals found nowhere else in the world (CALM, 2005b).
Marmion Marine Park	Sanctuary, Recreation and Special Use Zones.	The Marmion Marine Park lies within State waters between Trigg Island and Burns Beach and encompasses a coastal area of ~95 km^2. Marmion	The marine park has a number of sanctuary zones including Little Island, The Lumps and the Boyinaboat Reef protecting a variety of habitats from limestone reefs, seagrass beds and clear shallow lagoons that support a diversity of marine life. In addition, to a general use zone and the Waterman Recreation Area. The marine park contains important habitat for the endemic Australian

Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
		Marine Park was the State's first marine park, declared in 1987.	sea lion, an array of seabird species migratory whales are regular visitors (CALM, 1992; DPAW, 2016d).
Swan Estuary Marine Park	Special Purpose and Nature Reserve Zones.	Three biologically important areas of Perth's Swan River make up the Swan Estuary Marine Park, including Alfred Cove, Pelican Point and Crawley. These three sites cover a total area of 3.4 km^2.	The sand flats, mud flats and beaches at the three locations of the Swan Estuary Marine Park provide the only remaining significant feeding and resting areas in the Swan Estuary, for trans-equatorial migratory wading and waterbirds. The Park and adjacent reserves also provide habitat for a diverse assemblage of aquatic and terrestrial flora and fauna (CALM, 1999).
Shoalwater Islands Marine Park	Sanctuary, Special Purpose and General Use Zones.	The Shoalwater Islands Maine Park is located adjacent to Rockingham on the south-west coast of WA, ~50 km south of Perth and covers an area of ~66 km^2.	The Shoalwater Islands Marine Park consists of a complex seabed and coastal topography consisting of islands, limestone ridges and reef platforms, protected inshore areas and deeper basins, sandbars and beaches, and is home to five species of cetacean and 14 species of sea and shore bird. The waters of the marine park are also used to access feeding grounds for the little penguin (*Eudyptula minor*) colony on Penguin Island, which is close to the northernmost limit of the species' range and is the largest known breeding colony in Western Australia (DEC, 2007c).
Ngari Capes Marine Park	Sanctuary, Special Purpose and Recreation Zones.	The Ngari Capes Marine Park is located off the south-west coast of WA, ~250 km south of Perth, covering ~1238 km^2.	The Ngari Capes Marine Park consists of a complex arrangement of sandy bays, high energy limestone and granite reefs bordered by headlands and cliffs and two weathered capes. Coral communities consist of both tropical and temperate species. Cetaceans and pinnipeds are resident in and/or transient through the marine park as well as a diverse range of seabirds and shorebirds (DEC, 2013).
Walpole and Nornalup Inlets Marine Park	Recreation Zone.	The Walpole and Nornalup Inlets Marine Park is located adjacent to the towns of Walpole and Nornalup on the south coast of WA, ~120 km west of Albany, and covers ~14 km^2.	The Walpole and Nornalup Inlets Marine Park consists of a geologically complex lagoonal estuarine system comprising three significant rivers and two connected inlets that are permanently open to the ocean. Approximately 40 marine and estuarine finfish species commonly inhabit the inlet system, as well as a variety of shark and ray species and numerous seabirds and shorebirds. The sandy beaches and shoreline vegetation of the inlet system are of high ecological and social importance to the marine park (DEC, 2009).

**Conservation objectives for IUCN categories include:*

Ia: Strict Nature Reserve

Ib: Wilderness Area

II: national Park

III: Natural Monument or Feature

IV: Habitat/Species Management Area

V: Protected Landscape

VI: Protected area with sustainable use of natural resources – allow human use but prohibits large scale development.

IUCN categories for the marine park are provided and, in brackets, the IUCN categories for specific zones within each Marine Park as assigned under the South-west Marine Parks Network Management Plan 2018 (DNP, 2018b)

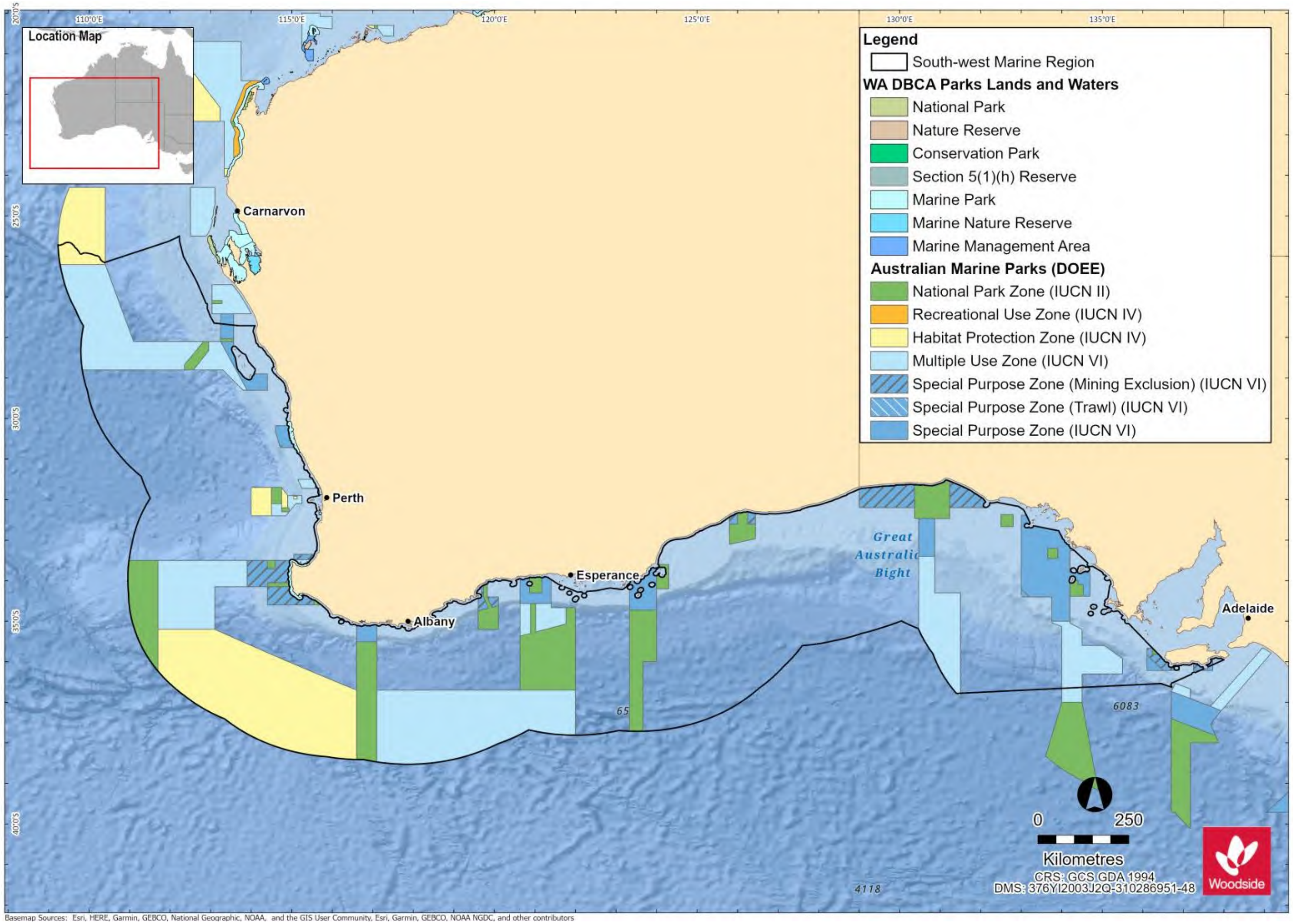

Figure 10-2. Commonwealth and State Marine Protected Areas for the SWMR

10.11 Summary of Protected Areas within the NMR

Table 10-3 Protected Areas within the NMR

Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
World Heritage Properties			
Kakadu National Park		Kakadu National Park is a living landscape with exceptional natural and cultural values. It is the largest National Park in Australia and preserves the greatest variety of ecosystems on the Australian continent including extensive areas of floodplains, mangroves, tidal mudflats, coastal areas and monsoon forests. The park was inscribed the World Heritage list in three stages over 11 years. It is located in tropical north Australia covering a total area of 19,804 square kilometres.	The conservation values reflect the WHA Criterion: (i), (vi), (vii) and (ix): Natural features relate to Criterion (vii) – the remarkable contrast between the internationally recognised Ramsar-listed wetlands and the spectacular rocky escarpment and its outliers and Criterion (ix) – four major river systems of tropical Australia and floodplains that are dynamic environments, shaped by changing sea levels and big floods every wet season. These floodplains illustrate the ecological and geomorphological effects that have accompanied Holocene climate change and sea level rise. Kakadu National Park contains important and significant habitats supporting a diverse range of flora and fauna.
National Heritage Places - Natural			
Kakadu National Park		Refer to World Heritage property description above.	Refer to World Heritage property conservation values above
Commonwealth Heritage Places - Natural			
N/A			
Wetlands of International Importance (Ramsar)			
Kakadu National Park		Australian Ramsar site number 2. The stage 1 and 2 Ramsar sites, established in 1980, 1985 and 1989, respectfully were combined into a single Ramsar site in 2010.	The Kakadu National Park Ramsar site straddles the western edge of the Arnhem Land Plateau encompassing a range of landforms and extensive floodplains. It is a mosaic of contiguous wetlands comprising the catchments of two large river systems, the East and South Alligator rivers and encompasses extensive tidal mudflat areas. It is an internationally important site for migratory shorebirds as part of the EAAF.

Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
Cobourg Peninsula		Australian Ramsar site number 1 established in 1974. This Ramsar site includes freshwater and extensive intertidal areas but excludes subtidal areas. It is in a remote location and there has been minimal human impact on the site.	The wetlands encompassed in the Ramsar site are some of the better protected and near-natural wetlands in the bioregion and there is a diverse array of wetland in a confined area. The site supports important turtle nesting habitat and habitat for coastal dolphin species and is an internationally significant migratory shorebird habitat as part of the EAAF and an important location for seabird breeding colonies.
Wetlands of National Importance (DAWE, 2019)			
Southern Gulf Aggregation		The site is a complex continuous wetland aggregation in the Gulf of Carpentaria, covering an area of ~5460 km^2 located 58 km east of Burketown, Queensland.	The Southern Gulf Aggregation is the largest continuous estuarine wetland aggregation of its type in northern Australia. It is one of the three most important areas for shorebirds in Australia. The area meets criteria 1, 2, 3, 4, 5 and 6 for inclusion on the Directory of Important Wetlands in Australia.
Australian Marine Parks (DNP, 2018c)			
Arafura Marine Park	VI	Arafura Marine Park covers an area of 22,924 km^2 is located ~256 km north-east of Darwin and 8 km offshore of Croker Island, NT. It extends from NT waters to the limit of Australia's EEZ.	The AMP is significant because it contains habitats, species and ecological communities associated with two bioregions: • Northern Shelf Province • Timor Transition. It includes one KEF: Tributary canyons of the Arafura Depression. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include internesting habitat for marine turtles and important foraging and breeding habitat for seabirds.
Arnhem Marine Park	VI	Arnhem Marine Park covers an area of 7125 km^2 and is located ~100 km south-east of Croker Island and 60 km south-east of the Arafura Marine Park. It extends from NT waters surrounding the Goulburn Islands, to the waters north of Maningrida.	Arnhem Marine Park is significant because it contains habitats, species and ecological communities associated with the Northern Shelf Province bioregion. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat and a migratory pathway for marine turtles and seabirds.
Gulf of Carpentaria Marine Park	II, VI	Gulf of Carpentaria Marine Park covers an area of 23,771 km^2 and is located ~90 km north-west of Karumba, Queensland and is adjacent to the Wellesley Islands in	Gulf of Carpentaria Marine Park is significant because it contains habitats, species and ecological communities associated with the Northern Shelf Province bioregion.

Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
		the south of the Gulf of Carpentaria basin.	It includes four KEFs: Gulf of Carpentaria basin; Gulf of Carpentaria coastal zone; Plateaux and saddle north-west of the Wellesley Islands; and Submerged coral reefs of the Gulf of Carpentaria. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding and foraging areas for seabirds and internesting and foraging areas for turtles.
Joseph Bonaparte Gulf Marine Park	VI	The Joseph Bonaparte Gulf Marine Park is located within both the NWMR and NMR. Refer **Table 10-1** for description and conservation values.	
Limmen Marine Park	IV	Limmen Marine Park covers an area of 1399 km^2 and is located ~315 km south-west of Nhulunbuy, NT, in the south-west of the Gulf of Carpentaria. It extends from NT waters, between the Sir Edward Pellew Group of Islands and Maria Island in the Limmen Bight, adjacent to the NT Limmen Bight Marine Park.	Limmen Marine Park is significant because it contains habitats, species and ecological communities associated with the Northern Shelf bioregion. It includes one KEF: Gulf of Carpentaria coastal zone. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include internesting and foraging habitat for marine turtles.
Oceanic Shoals Marine Park	II, IV, VI	The Oceanic Shoals Marine Park is located within both the NWMR and NMR. Refer **Table 10-1** for description and conservation values.	
Wessel Marine Park	IV, VI	Wessel Marine Park covers an area of 5908 km^2 and is located ~22 km east of Nhulunbuy, NT. It extends from NT waters adjacent to the tip of the Wessel Islands to NT waters adjacent to Cape Arnhem.	Wessel Marine Park is significant because it contains habitats, species and ecological communities associated with the Northern Shelf bioregion. It includes one KEF: Gulf of Carpentaria basin. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding habitat for seabirds and internesting and foraging habitat for marine turtles.
West Cape York Marine Park	II, IV, VI	West Cape York Marine Park covers an area of 16,012 km^2 and is located adjacent to the northern end	West Cape York Marine Park is significant because it contains species and ecological communities associated with two bioregions: • Northeast Shelf Transition

Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
		of Cape York Peninsula ~25 km south-west of Thursday Island and 40 km north-west of Weipa, Queensland.	• Northern Shelf Province. It includes two KEFs: Gulf of Carpentaria basin; and Gulf of Carpentaria coastal zone. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding and foraging habitat for seabirds, internesting and foraging habitat for marine turtles and dugong, and foraging, breeding and calving habitat for dolphins.
Territory Marine Parks and Reserves			
Cobourg Marine Park	II, IV, VI	Cobourg Marine Park covers an area of 2,290 km^2 and is located in the waters surrounding the Cobourg Peninsula ~220 km north-east of Darwin. The Marine Park is part of the larger Garig Gunak Barlu National Park. Garig Gunak Barlu National Park includes both the Marine Park and the Cobourg Sanctuary.	Cobourg Marine Park is located in the Cobourg and Van Diemen Gulf marine bioregions with the northern portion of the Park covered by the Cobourg marine bioregion and the southern portion covered by the Van Diemen Gulf marine bioregion. The Marine Park is characterised by a number of deeply incised bays and estuaries on its northern shores. These bays are ancient river valleys that were drowned during periods of sea level rise and provide a varied environment and habitat that is quite distinct from the open water areas of the Park. The areas of the Park that have been studied and where extensive collections have been made indicates that the Park supports rich and diverse marine life including live coral reefs, seagrass, diverse reef and pelagic fish populations, marine turtles and dugong.

**Conservation objectives for IUCN categories include:*

Ia: Strict Nature Reserve

Ib: Wilderness Area

II: National Park

III: Natural Monument or Feature

IV: Habitat/Species Management Area

V: Protected Landscape

VI: Protected area with sustainable use of natural resources – allow human use but prohibits large scale development.

IUCN categories for the marine park are provided and, in brackets, the IUCN categories for specific zones within each Marine Park as assigned under the North Marine Parks Network Management Plan 2018 (DNP, 2018c)

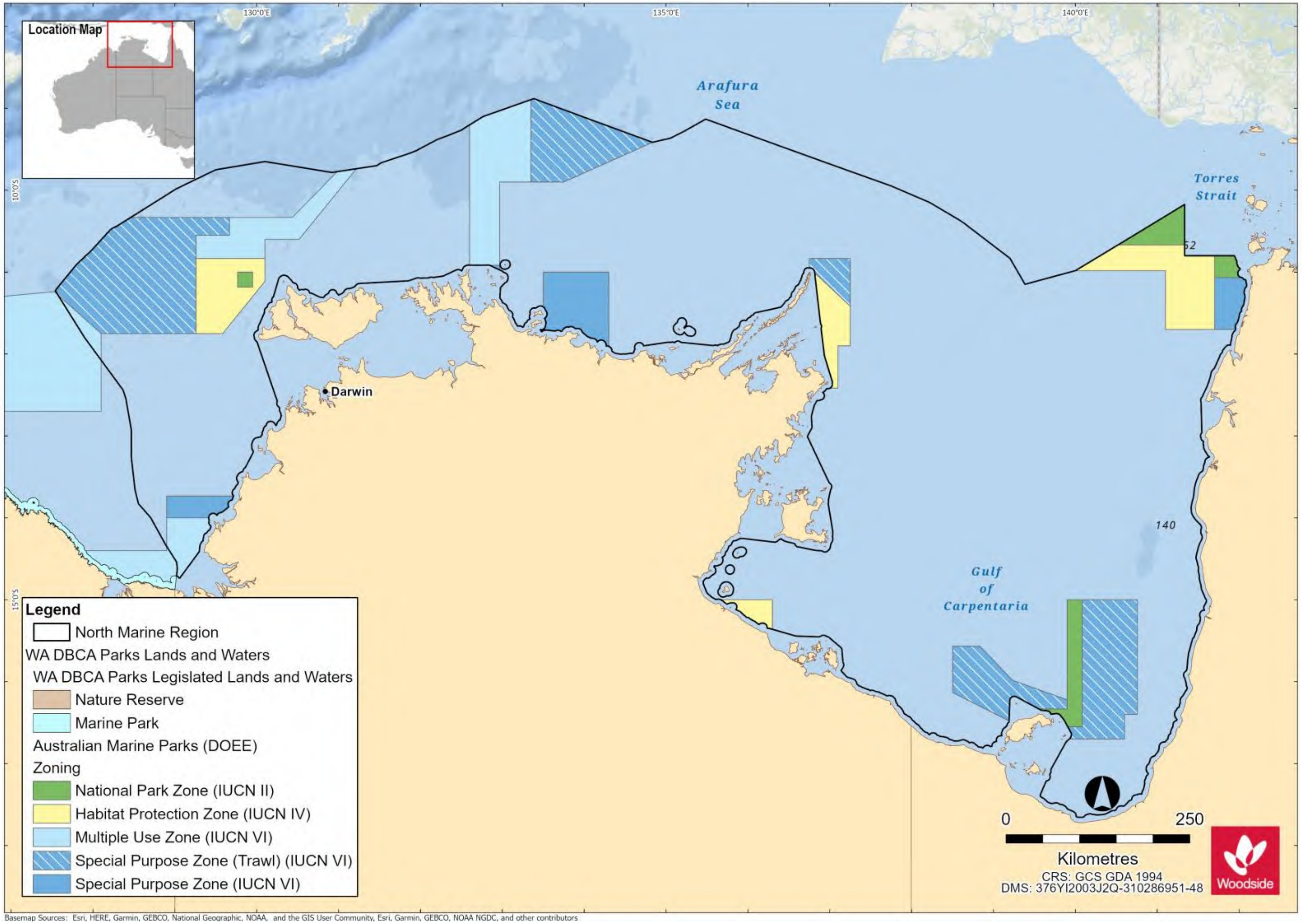

Figure 10-3. Commonwealth and State Marine Protected Areas within the NMR

11. SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

This section summarises the information relating to the socio-economic and cultural environment of the regions offshore Western Australia, with a focus on the NWMR and to a lesser extent the SWMR and NWR.

The cultural environment includes Indigenous and European heritage values, including underwater values such as historic shipwrecks. Socio-economic values include commercial and traditional fishing, tourism and recreation, shipping, oil and gas activities and defence activities.

11.1 Cultural Heritage

11.1.1 Indigenous Sites of Significance

Murujuga (the Burrup Peninsula) has a very high density of significant Indigenous heritage sites and places with tangible and intangible heritage values. The area has one of the largest, densest, and most diverse collections of rock art in the world. It is estimated that the peninsula and surrounding islands contain over a million petroglyphs (rock engravings) covering a broad range of styles and subjects. The landscape also contains quarries, middens, fish traps, rock shelters, ceremonial sites, artefact scatters, grinding patches and stone arrangements that evidence tens of thousands of years of human occupation. These places are linked to Aboriginal cosmology, Dreaming stories and songs through the stories, knowledge and customs that are still held by traditional custodians.

In 2007 the Dampier Archipelago (including the Burrup Peninsula) was included on the National Heritage List due to outstanding heritage values relating to Australia’s cultural history contained in the large number, density, diversity, distribution and fine execution of rock art. Within the National Heritage Place, the Murujuga National Park covers 4913 ha and is co-managed by the Murujuga Aboriginal Corporation and the Department of Biodiversity, Conservation and Attractions. The Murujuga Cultural Landscape was also added to Australia’s Tentative World Heritage List in 2020, with full World Heritage Listing anticipated in 2024.

Woodside also recognises the potential for heritage to survive in submerged landscapes. Sea-level rises since the last ice age mean that areas now under the sea were once exposed, that many of today’s islands would have been connected to the mainland, and that Aboriginal people are highly likely to have inhabited these places. Woodside works with traditional custodians, academics and heritage professionals to identify tangible and intangible heritage values in the submerged landscape to avoid disturbing heritage where possible and to minimise impacts where heritage cannot be avoided.

It is an offence to excavate, destroy, damage, conceal or alter Indigenous heritage onshore or in state waters under section 17 of the *Aboriginal Heritage Act 1972 (WA) (AHA)* without ministerial authorisation. Where there is a risk of injury or desecration to a significant Aboriginal area, even where permitted under the AHA, any Aboriginal person may apply to the federal Environment Minister for a declaration under sections 9 or 10 of the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cth)* for the protection and preservation of that area.

The Department of Planning, Lands and Heritage maintains a register of registered sites and heritage places including middens, burial, ceremonial [sites], artefacts, rock shelters, mythological [sites] and engraving sites. There are over 1600 registered sites on Murujuga and the Dampier Archipelago with around 1100 other heritage places. This register is not comprehensive and will be complemented by heritage surveys where necessary. Protection of National and World Heritage values is also legislated through various provisions of the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)*. Murujuga National Park is managed under the *Conservation and Land Management Act 1984 (WA)*.

11.1.2 European Sites of Significance

European sites of significance and heritage value are found along adjacent foreshores of the SWMR, NWMR and NWR. Heritage values are protected in Western Australia under the *Heritage Act 2018*.

11.1.3 Underwater Cultural Heritage

Places of historic cultural significance are protected under Commonwealth, State and local regimes. Places inscribed on the National or World Heritage list are protected through various provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth). Historic places may also be protected under the *Heritage Act 2018* (WA); under section 129 the prohibited alteration, demolition, damage, despoilment or removal of objects from a registered place may result in a fine of A$1 million. Protection of heritage by local government typically emanates from local planning schemes produced under Part 5 of the *Planning and Development Act 2005* (WA).

The remains of vessels and aircraft in Commonwealth waters, along with any associated article, are automatically protected under the *Underwater Cultural Heritage Act 2018* (Cth) after 75 years. Remains and relics of any ship lost, wrecked or abandoned in Western Australian waters before 1900 are protected by the *Maritime Archaeology Act 1973* (WA).

The Australian National Shipwreck Database and the WA Maritime Museum Shipwreck Database list these protected wrecks.

11.1.4 National and Commonwealth Listed Heritage Places

Australia's National Heritage Sites are those of outstanding natural, historic and/or Indigenous significance to Australia. National Heritage places classed as natural are discussed in **Section 10.3**. Historic and/or Indigenous National Heritage Listed Places of the NWMR include:

- Dampier Archipelago (including Burrup Peninsula)
- Dirk Hartog Landing Site/Cape Inscription
- HMAS Sydney II and the HSK Kormoran Shipwreck Sites
- Batavia Shipwreck Site and Survivor Camps Area 1629 – Houtman Abrolhos

Commonwealth Heritage Places are a collection of sites recognised for their Indigenous, historical and/or natural values, which are owned or controlled by the Australian Government. A number of these sites are owned or controlled by the Department of Defence, as well as Government agencies relating to maritime safety, customs and communication. Commonwealth Heritage places classed as natural are discussed in **Section 10.3**. Listed Heritage Places in the NWMR include:

- Mermaid Reef – Rowley Shoals (refer **Section 10.3**)
- Ashmore Reef National Nature Reserve (refer **Section 10.3**)
- Scott Reef and Surrounds – Commonwealth Area (refer **Section 10.3**)
- Ningaloo Marine Area (refer **Section 10.3**)

World Heritage Properties are those sites that hold universal value which transcends any value they may be held by any one nation. These sites and their qualities are detailed in the Convention concerning the Protection of the World Cultural and Natural Heritage (the World Heritage Convention), to which Australia is a founding member. The Protected Matters Search Report (**Appendix A**) lists two natural World Heritage Properties in the NWMR (refer **Section 10.2**). There are no cultural heritage listings located within the NWMR.

Summary tables of heritage places for NWMR, SWMR and NMR are presented in **Table 11-1,Table 11-2** and **Table 11-3**.

11.2 Summary of Heritage Places within the NWMR

Table 11-1 Heritage Places (Indigenous and Historic) within the NWMR

Heritage Places	Woodside Activity Area			Class	Description	Conservation Values
	Browse	NWS/S	NW Cape			
National Heritage Properties						
Dampier Archipelago (including Burrup Peninsula)	-	✓	-	Indigenous	The Dampier Archipelago (including the Burrup Peninsula) contains one of the densest concentrations of rock engravings in Australia with some sites containing thousands or tens of thousands of images.	The rock engravings comprise images of avian, marine and terrestrial fauna, schematised human figures, figures with mixed human and animal characteristics and geometric designs. At a national level it has an exceptionally diverse and dynamic range of schematised human figures some of which are arranged in complex scenes. The fine execution and dynamic nature of the engravings, particularly some of the composite panels, exhibit a degree of creativity that is unusual in Australian rock engravings.
Dirk Hartog Landing Site 1616 – Cape Inscription Area	-	-	✓	Historic	Cape Inscription is the site of the oldest known landings of Europeans on the WA coastline.	The Cape Inscription area displays uncommon aspects of Australia's cultural history because of the cumulative effect its association with these explorers and surveyors had on growing knowledge of the great southern continent in Europe. The association of the site with these early navigators stimulated the development of the European view of the great southern continent at a time when they began to look at the world with a modern scientific outlook.
Commonwealth Heritage Properties						
N/A						

11.3 Summary of Heritage Places within the NMR

Table 11-2 Heritage Places (Indigenous and Historic) within the NMR

Heritage Places	Class	Description	Conservation Values
National Heritage Properties			
None			
Commonwealth Heritage Properties			
None			

11.4 Summary of Heritage Places within the SWMR

Table 11-3 Heritage Places (Indigenous and Historic) within the SWMR

Heritage Places	Class	Description	Conservation Values
National Heritage Properties			
Cheetup Rock Shelter	Indigenous	Cheetup meaning “place of the birds” is the name of a spacious rock shelter located in Cape Le Grand National Park, about 55 km east of Esperance in WA. Aboriginal people associated with the place identify themselves as Nyungar/Noongar, Ngadju (shortened from Ngadjunmaia) or Mirning.	Cheetup rock shelter provides outstanding evidence for the antiquity of processing and use of cycad seeds by Aboriginal people. The seeds of the cycad are extremely toxic and can cause speedy death if eaten fresh without proper preparation to remove the toxins. The presence of *Macrozamia riedlei* seeds in a pit lined with Xanthorrhoea (grass tree) leaf bases indicates that the Aboriginal people in the Esperance region had the knowledge to remove the toxins of this important source of carbohydrate and protein at least 13,200 years ago.

Heritage Places	Class	Description	Conservation Values
Batavia Shipwreck Site and Survivor Camps Area 1629 – Houtman Abrolhos	Historic	The Batavia and its associated sites hold an important place in the discovery and delineation of the WA coastline. The wreck of the Batavia, and other Dutch ships like her, convinced the VOC (Dutch East India Company) of the necessity of more accurate charts of the coastline and resulted in the commissioning of Vlamingh's 1696 voyage.	Because of its relatively undisturbed nature the archaeological investigation of the wreck itself has revealed a range of objects of considerable value as well as to artefact specialists and historians.
HMAS Sydney II and HSK Kormoran Shipwreck Sites	Historic	The naval battle fought between the Australian warship HMAS Sydney II and the German commerce raider HSK Kormoran off the WA coast during World War II was a defining event in Australia's cultural history. HMAS Sydney II was Australia's most famous warship of the time and this battle has forever linked the stories of these warships to each other. The loss of HMAS Sydney II along with its entire crew of 645 following the battle with HSK Kormoran, remains as Australia's worst naval disaster.	The shipwreck sites of HMAS Sydney II and HSK Kormoran have outstanding heritage value to the nation because of their importance in a defining event in Australia's cultural history and for their part in development of the process of the defence of Australia.
Commonwealth Heritage Properties			
Cliff Point Historic Sites	Historic	Cliff Head is a limestone bluff on the east coast of Garden Island. Evidence of occupation has been reported from the beach just north of the head, the immediate hinterland, the ridge above and on the south face of the ridge.	The Cliff Point Historic Site, individually significant within the area of Garden Island is important as the first site inhabited by Governor Stirling's party in 1829 when founding the colony of WA, and as WA's first official non-convict settlement. The site was occupied in the first instance by Captain Charles Fremantle before the arrival of Captain Stirling. The party occupied the site for two months before a move was made to the Swan River settlement on the mainland.
HMAS Sydney II and HSK Kormoran Shipwreck Sites	Historic	As above	As above
J Gun Battery	Historic	J Battery comprised two 155 mm long range guns, the other similar battery being at Cape Peron on the mainland at the entrance to Cockburn Sound. Located in the dune systems at the north western	J Gun Battery (1942) is individually significant within the area of Garden Island (Register No. 019544) and is historically important as the first gun battery constructed on Garden Island and as one of two long range gun batteries which played a

Heritage Places	Class	Description	Conservation Values
		corner of Garden Island elements of the J Battery complex are now covered in part by sand.	strategic role in the coastal defences of Cockburn Sound and Fremantle following the entry of Japan into the Second World War (1939-45).

11.5 Fisheries - Commercial

11.5.1 Commonwealth and State Fisheries

The diverse range of habitats and species offshore WA has allowed for various fisheries to develop and operate throughout the region.

The Australian Fisheries Management Authority (AFMA) manages fisheries on behalf of the Commonwealth Government and is bound by objectives under the Commonwealth *Fisheries Management Act 1991*.

WA State commercial fisheries are managed by the WA Department of Primary Industries and Regional Development (WA DPIRD) under the WA *Fish Resources Management Act 1994* (FRMA), Fisheries Resources Management Regulations 1995, relevant gazetted notices and licence conditions, and applicable Fishery Management Plans.

Commonwealth and State managed fisheries that operate within the NWMR and in areas beyond this region are summarised in the **Table 11-4**.

Table 11-4 Commonwealth and State managed fisheries

<table>
<tr><th rowspan="2">Fishery</th><th colspan="3">Woodside Activity Area</th><th rowspan="2" colspan="3">Description</th></tr>
<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td colspan="7">Commonwealth Managed Fisheries</td></tr>
<tr><td rowspan="5">Southern Bluefin Tuna Fishery</td><td rowspan="5">✓</td><td rowspan="5">✓</td><td rowspan="5">✓</td><td>Management area</td><td colspan="2">The Southern Bluefin Tuna Fishery (SBTF) covers the entire EEZ around Australia, out to 200 nm from the coast. They do not fish in the Woodside activity area.</td></tr>
<tr><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td>Southern bluefin tuna (Thunnus maccoyii)</td><td>Longline and purse seine fishing.</td><td>Southern bluefin tuna is a pelagic species which can be found to depths of 500 m (AFMA, 2021a)</td></tr>
<tr><td>Fishing effort</td><td colspan="2">Most of the Australian fishing effort is by purse-seine vessels in the Great Australian Bight and waters off South Australia during summer months, and by longline off the New South Wales coastline during winter months (Patterson et al., 2020).
SBTF is a fishery that is shared amongst many countries. Australia currently has a 35% share of the total global allowable catch, and while wild capture fishing in Australia to sell directly to market can occur anywhere throughout the SBTF's range, currently the vast majority of that quota is value-added through ranching (on-growing the wild captured fish for extra 5-6 months). Ranching requires significant infrastructure, a resident labour force, plus proximity to a fishery able to supply a large quantity of natural feed/sardines (40,000+ tonnes) (for example as available in Port Lincoln). North-west WA is critically important regardless of how the quota is fished because of the proximity to the single spawning ground of this global roaming species.
The stock remains classified as overfished.</td></tr>
<tr><td>Active licences/vessels</td><td colspan="2">Seven purse seine vessels, 20 longline vessels (Patterson et al., 2020).</td></tr>
<tr><td>Western Skipjack Tuna Fishery</td><td>✓</td><td>✓</td><td>✓</td><td>Management area</td><td colspan="2">The combined western and eastern skipjack tuna (Katsuwonus pelamis) fisheries (STF) encompass the entire Australian EEZ. The Western Skipjack Tuna Fishery (WSTF) extends westward from the SA/Victorian border across the Great Australian Bight and around the west coast of WA to the Cape York Peninsula.</td></tr>
</table>

<table>
<tr><th rowspan="2">Fishery</th><th colspan="3">Woodside Activity Area</th><th colspan="4" rowspan="2">Description</th></tr>
<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td rowspan="4"></td><td rowspan="4"></td><td rowspan="4"></td><td rowspan="4"></td><th colspan="2">Species targeted</th><th>Fishing methods</th><th>Fishing depth</th></tr>
<tr><td colspan="2">Western skipjack tuna (Katsuwonus pelamis)</td><td>Fishers use purse seine gear (about 98% of catch) and sometimes pole and line when fishing for skipjack tuna.</td><td>Western skipjack tuna is a pelagic species that can be found to depths of 260 m (AFMA, 2021b).</td></tr>
<tr><th>Fishing effort:</th><td colspan="3">The Skipjack Tuna Fishery (STF) has not been actively fished since the 2008-2009 fishing season (Patterson et al., 2020). The management arrangements for this fishery will be reviewed if active boats re-enter the fishery.</td></tr>
<tr><th>Active licences/vessels:</th><td colspan="3">No active vessels operating since 2009.</td></tr>
<tr><td rowspan="5">Western Tuna and Billfish Fishery</td><td rowspan="5">✓</td><td rowspan="5">✓</td><td rowspan="5">✓</td><th>Management area</th><td colspan="3">The Western Tuna and Billfish Fishery (WTBF) extends to the Australian EEZ boundary in the Indian Ocean.</td></tr>
<tr><th colspan="2">Species targeted</th><th>Fishing methods</th><th>Fishing depth</th></tr>
<tr><td colspan="2">Bigeye tuna (Thunnus obesus)
Yellowfin tuna (Thunnus albacares)
Swordfish (Xiphias gladius)
Albacore (Thunnus alalonga)
Striped marlin (Kajikia audax)</td><td>Fishers mainly use pelagic longline fishing gear to catch the targeted species. Minor line (including handline, troll, rod and reel) can also be used.</td><td>Species have a broad depth distribution, with tuna occurring at 150 – 300 m, striped marlin at 150 m and swordfish at up to 600 m (BRS, 2007).</td></tr>
<tr><th>Fishing effort:</th><td colspan="3">The WTBF operates in Australia’s EEZ and high seas of the Indian Ocean. Fishing effort in recent years has been concentrated off south-west WA, with occasional activity off SA.</td></tr>
<tr><th>Active licences/vessels:</th><td colspan="3">Two pelagic longline vessels and two minor longline vessels (Patterson et al., 2020).</td></tr>
<tr><td>Western Deepwater Trawl Fishery</td><td></td><td></td><td>✓</td><th>Management area</th><td colspan="3">The Western Deepwater Trawl Fishery (WDTF) is located in deep water off WA, from the line approximating the 200 m isobath to the edge of the Australian Fishing Zone (AFZ).</td></tr>
</table>

Fishery	Woodside Activity Area			Description		
	Browse	NWS/S	NW Cape			
				Species targeted	**Fishing methods**	**Fishing depth**
				More than 50 species, historically dominated by six commercial finfish species or species groups: Orange roughy (*Hoplostethus atlanticus*) Oreos (Oreosomatidae) Boarfish (Pentacerotidae) Eteline snapper (Lutjanidae: Etelinae) Apsiline snapper (Lutjanidae: Apsilinae) Sea bream (Lethrinidae)	Demersal trawl.	Water deeper than 200 m, stakeholder consultation has indicated that this may be to depths of 800 m.
				Fishing effort:	The number of vessels active in the fishery and total hours trawled have fluctuated from year to year. Notably, total hours trawled were relatively high for a brief period during the early 2000s when fishers targeted ruby snapper and deepwater bugs (Patterson *et al*., 2020). Total fishing effort has been variable but relatively low since then. Effort in 2018-2019 (492 trawl hours) was less than half that of 2017-2018 (1108 trawl hours) (Patterson *et al*., 2020).	
				Active licences/vessels:	One active vessel in 2018-2019 (Patterson *et al.*, 2020).	
North-west Slope Trawl Fishery	✓	✓		**Management area**	The North-west Slope Trawl Fishery (NWSTF) extends, from 114 °E to 125 °E, from the 200 m isobath to the outer limit of the AFZ (200 nm from the coastline, which is the boundary of the Australian EEZ).	
				Species targeted	**Fishing methods**	**Fishing depth**
				Australian scampi (*Metanephrops australiensis*) and smaller quantities of velvet and Boschma's scampi (*M. velutinus* and *M. boschmai*) Mixed snappers have historically been an important component of the catch.	Demersal trawl.	Typically at depths of 350 to 600 m (Patterson *et al*., 2017), however stakeholder consultation has indicated that this may be to depths of 800 m.

Fishery	Woodside Activity Area			Description			
	Browse	NWS/S	NW Cape				
				Fishing effort:	The NWSTF commenced in 1985 and the number of active vessels peaked at 21 in the 1986-1987 season and declined through the 1990s before increasing to 10 vessels in 2000-2001 and 2002-2002 seasons. Four vessels operated in the 2017-2018 and 2018-2019 seasons (Patterson *et. al*. 2020). Fishing for scampi occurs over soft, muddy sediments or sandy habitats, using demersal trawl gear on the continental slope (Patterson *et al*., 2017).		
				Active licences/vessels:	Four vessels (Patterson *et. al*., 2020).		
State Managed Fisheries							
Pilbara Fish Trawl (Interim) Managed Fishery		✓		**Management area**	The Pilbara Trawl (Interim) Managed Fishery is of high intensity and is divided into two zones and an area governed by Schedule 5 (prohibited to trawling). In addition to the Prohibited Trawl Fishing area, no fish trawl units are allocated for use in Zone 1 or Areas 3 and 6 of Zone 2 (which comprises six management areas) (Newman *et al*., 2020a). No fish trawl units have been allocated for use in Area 6 of Zone 2 since the management plan commenced operation in 1998.		
				Species targeted		**Fishing methods**	**Fishing depth**
				The Pilbara Fish Trawl (Interim) Managed Fishery (PFTIMF) targets more than 50 scalefish species. The five main demersal scalefish species landed by the fisheries in the Pilbara region are blue-spotted emperor, crimson snapper, rosy threadfin bream, red emperor and goldband snapper in 2018 (Newman *et al*., 2020a).		Demersal trawl.	The Pilbara Fish Trawl Fishery lands the largest component of the catch and operates in waters between 50 and 200 m water depth (Allen *et al*., 2014, Newman et al. 2015). Stakeholders have advised that trawling can occur in depths of up to approximately 800 m.
				Fishing effort:	Based on State of the Fisheries annual reports provided by DPIRD, catch trends are seen to be increasing over the past reporting years:		

<table>
<tr><th rowspan="2">Fishery</th><th colspan="3">Woodside Activity Area</th><th rowspan="2" colspan="3">Description</th></tr>
<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td></td><td colspan="2">Pilbara Trawl (Interim) Managed Fishery caught 1996 t in 2018-19, 1780 t in 2017-18, 1529 t in 2016-17, 1172 t in 2015-16, 1105 t in 2014-15.</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="2">Two Pilbara Trawl (Interim) Managed Fishery vessels in 2017 (Newman et al., 2020a).
Active vessels data are confidential as there were fewer than three vessels in the Pilbara Fish Trawl Interim Managed Fishery (Newman et al., 2020a).</td></tr>
<tr><td rowspan="4">Pilbara Trap Managed Fishery</td><td rowspan="4"></td><td rowspan="4">✓</td><td rowspan="4">✓</td><td>Management area</td><td colspan="2">The Pilbara Trap Fishery covers the area from Exmouth northwards and eastwards to the 120° line of longitude, and offshore as far as the 200 m isobath. Like the trawl fishery, the trap fishery is also managed using input controls in the form of individual transferable effort allocations monitored with a satellite-based vessel management system. The fishery includes six licences allocated to three vessels, operating principally from Onslow.</td></tr>
<tr><td>Species targeted</td><td>Fishing methods</td><td>Fishing depths</td></tr>
<tr><td>Pilbara Trap Managed Fishery catch is made up of around 45-50 different fish species.
The four main species landed by the fisheries in the Pilbara region are blue-spotted emperor, red emperor, goldband snapper and Rankin cod.</td><td>Demersal fish traps.</td><td>Greatest effort in waters less than 50 m depth targeting high value species such as red emperor and goldband snapper.</td></tr>
<tr><td>Fishing effort</td><td colspan="2">Based on State of the Fisheries annual reports provided by DPIRD, catch trends are seen to be increasing over the past reporting years:
Pilbara Trap Managed Fishery caught 563 t in 2018-19, 573 t in 2017-18, 495 t in 2016-17, 510 t in 2015-16, 268 t in 2014-15.
In 2018, the total catch for the Pilbara Trap Managed Fishery was 563 t, making up 21% of the total catch by the Pilbara Demersal Scale Fishery (Newman et al., 2019).</td></tr>
</table>

Fishery	Woodside Activity Area: Browse	Woodside Activity Area: NWS/S	Woodside Activity Area: NW Cape	Description			
				Active licences/vessels	In the 2019 season, there were six licences in the Pilbara Trap Managed Fishery, (Newman *et al*., 2020a). Active vessels data are confidential as there were fewer than three vessels in the Pilbara Trap Managed Fishery (Newman *et al*., 2019).		
Pilbara Line Managed Fishery		✓	✓	**Management area**	The Pilbara Line Managed Fishery boat licences are permitted to operate anywhere within "Pilbara waters", bounded by a line commencing at the intersection of 21°56'S latitude and the high water mark on the western side of the North-west Cape on the mainland of WA; west along the parallel to the intersection of 21°56'S latitude and the boundary of the AFZ and north to longitude 120°E.		
				Species targeted		**Fishing method**	**Fishing depths**
				The Pilbara Line Managed Fishery catch is made up around 45-50 different fish species. The Pilbara Line Managed Fishery targets similar demersal species to the Pilbara Trap and Trawl fisheries, as well as some deeper offshore species such as ruby snapper and eightbar grouper The Pilbara Line Managed Fishery operates on an exemption basis that enables licence holders to fish for any nominated five-month block during the year.		Demersal long line.	Pilbara Line Fishing Depth: Operates up to a depth of 600 m.
				Fishing effort	Based on State of the Fisheries annual reports provided by DPIRD, catch trends are seen to be increasing over the past reporting years: Pilbara Line Managed Fishery caught 93 t in 2018-19, 143 t in 2017-18, 126 t in 2016-17, 97 t in 2015-16, 40 t in 2014-15. The total catch in 2018 for the Pilbara Line Managed Fishery was 93 t, making up 3% of the total catch by the Pilbara Demersal Scalefish Fishery (Newman *et al*., 2019).		

Fishery	Woodside Activity Area			Description			
	Browse	NWS/S	NW Cape				
				Active licences/vessels	In the 2018 season there are nine individual licences in the Pilbara Line Fishery, held by seven operators. Active vessels data is confidential as there were fewer than three vessels in the Pilbara Line Fishery (Newman *et al*., 2018).		
Mackerel Managed Fishery	✓	✓	✓	**Management area**	The commercial fishery extends from Geraldton to the Northern Territory border. There are three managed fishing areas: Kimberley (Area 1), Pilbara (Area 2), and Gascoyne and West Coast (Area 3).		
				Species targeted		**Fishing methods**	**Fishing depth**
				Spanish mackerel (*Scomberomorus commerson*) Grey mackerel (*S. semifasciatus*) Other species from the genus *Scomberomorus*		Near-surface trawling gear. Jig fishing.	Previous engagement with WAFIC suggests that the depth of fisheries may extend to 70 m.
				Fishing effort:	Most of the catch is taken from waters off the Kimberley coasts (Lewis and Brand-Gardner, 2018), reflecting the tropical distribution of mackerel species (Molony *et al.*, 2015). Most fishing activity occurs around the coastal reefs of the Dampier Archipelago and Port Hedland area, with the seasonal appearance of mackerel in shallower coastal waters most likely associated with feeding and gonad development before spawning (Mackie *et al.*, 2003). Based on State of the Fisheries annual reports provided by DPIRD, catch trends are as follows: 213 t in 2018-19 (the lowest on record (Lewis *et al*., 2020), 283 t in 2017-18, 276 t in 2016-17, 302 t in 2015-16, 322 t in 2014-15.		
				Active licences/vessels:	Fifteen boats fished in 2018, with approximately 35-40 people directly employed in the Mackerel Managed Fishery, primarily from May-November (Lewis *et al*., 2020).		
Marine Aquarium Managed Fishery	✓	✓	✓	**Management area**	The Marine Aquarium Managed Fishery is able to operate in all State waters. The fishery is typically more active in waters south of Broome and higher levels of effort around the Capes region, Perth, Geraldton, Exmouth, Dampier and Broome (Newman *et al.*, 2020b).		
				Species targeted		**Fishing methods**	**Fishing depth**

<table>
<tr><th rowspan="2">Fishery</th><th colspan="3">Woodside Activity Area</th><th colspan="4" rowspan="2">Description</th></tr>
<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td colspan="2">Finfish, hard coral, soft coral, tridacnid clams, syngnathids (seahorses and pipefish), other invertebrates (including molluscs, crustaceans, echinoderms etc.), algae, seagrasses and ‘live rock’.</td><td>The fishery is diver-based, which typically restricts effort to safe diving depths (less than 30 m).</td><td>Less than 30 m, as advised by WAFIC.</td></tr>
<tr><td>Fishing effort:</td><td colspan="3">Total catch for the Marine Aquarium Managed Fishery in 2018 was 156,188 fishes, 32.025 t of coral, live rock and living sand and 176.02 L of marine plants and live feed.</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="3">Eleven licences were active in 2019 (Newman et al., 2020b).</td></tr>
<tr><td rowspan="5">Beche-de-mer Fishery</td><td rowspan="5">✓</td><td rowspan="5">✓</td><td rowspan="5">✓</td><td>Management area</td><td colspan="3">Fishing occurs in the northern half of WA from Exmouth Gulf to the NT border and is managed under Ministerial Exemptions.</td></tr>
<tr><td colspan="2">Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td colspan="2">The sea cucumber fishery targets two main species: sandfish (Holothuria scabra) and redfish (Actinopyga echinites).</td><td>Diving</td><td>The targeted species typically inhabit nearshore in shallow depths.</td></tr>
<tr><td>Fishing effort</td><td colspan="3">Based on State of the Fisheries annual reports provided by DPRID, catch trends are as follows:
62t in 2018 (Gaughan and Santoro, 2020), 135t in 2017, 93t in 2016, 38t in 2015</td></tr>
<tr><td>Active licences/vessels</td><td colspan="3">Six active licences in 2019 (Hart et al., 2019). Active vessels data is confidential as there were fewer than three vessels.</td></tr>
<tr><td rowspan="2">Onslow Prawn Managed Fishery</td><td rowspan="2"></td><td rowspan="2">✓</td><td rowspan="2"></td><td>Management area</td><td colspan="3">The Onslow Prawn Managed Fishery encompasses a portion of the continental shelf off the Pilbara.</td></tr>
<tr><td colspan="2">Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
</table>

Fishery	Woodside Activity Area			Description		
	Browse	NWS/S	NW Cape			
				The fishery targets: Western king prawns (*Penaeus esculentus*) Brown tiger prawns (*Penaeus esculentus*) Blue endeavour prawns (*Metapenaeus endeavouri*	Low opening, otter prawn trawl systems.	Prawn trawling takes place in water depths of approximately 30 metres and less (licence holder feedback). Fishery and or fishing activity overlaps the Beadon Creek dredging scope (Sporer *et al*., 2015).
				Fishing effort:	The total landings for the Onslow Prawn Managed Fishery in 2018 were less than 60 t below the target catch range (Kangas *et al*., 2020a).	
				Active licences/vessels:	One vessel (Kangas *et al*., 2020a).	
Pearl Oyster Managed Fishery	✓	✓	✓	**Management area**	Located in shallow coastal waters with the pearl oyster managed fishery designated by four zones extending from Exmouth to Kununurra and the seaward boundary demarcated by the 200 nm EEZ.	
				Species targeted	**Fishing methods**	**Fishing depth**
				Pearl oysters (*Pinctada maxima*).	Drift diving.	Fishing effort is mostly focussed in shallow coastal waters (10-15 m depth), with a maximum depth of 35 m (Lulofs *et al.* 2002).
				Fishing effort:	In 2018, catch was taken from Zones 2 and 3 with no fishing in Zone 1. The number of pearl oysters caught for 2018-19 was 614,002. Total effort was 15,637 dive hours, this was an increase from 2017 effort of 12,845 hours. No fishing occurred in Zone 1 in 2017 and 2018 (Gaughan and Santoro, 2020).	
				Active licences/vessels:	15,637 diver hours (Hart *et al.*, 2020a).	
		✓	✓	**Management area**	The Pilbara Crab Managed Fishery comprises WA waters off the north-western coast of WA north of 23° 34′ south latitude and west of 120° 00′ east longitude. Areas of the fishery north and east of Exmouth and	

Fishery	Woodside Activity Area: Browse	Woodside Activity Area: NWS/S	Woodside Activity Area: NW Cape	Description		
Pilbara Crab Managed Fishery					nearshore are currently closed as per Schedule 2 of the Draft Management Plan for the Pilbara Crab Managed Fishery.	
				Species targeted	**Fishing methods**	**Fishing depth**
				Crabs of the Family Portunidae, excluding crabs of the genus *Scylla*.	Traps.	Up to 50 m deep.
				Fishing effort:	The capacity of the fishery is 600 traps.	
				Active licences/vessels:	No information available at this time.	
South-west Coast Salmon Managed Fishery	✓	✓	✓	**Management area**	The South-west Coast Salmon Managed Fishery operates on various beaches south of the metropolitan area and includes all WA waters north of Cape Beaufort except Geographe Bay.	
				Species targeted	**Fishing methods**	**Fishing depth**
				Western Australian salmon (*Arripis truttaceus*)	Beach seine nets.	Information not available however, species generally found in shallow waters (up to 30 m).
				Fishing effort:	No fishing occurs north of the Perth metropolitan area, despite the managed fishery boundary extending to Cape Beaufort (WA/Northern Territory border), as advised by WAFIC. The 2018 commercial catch was 191 t, with 72% taken by the South West Coast Salmon Managed Fishery, 25% by the South Coast Salmon Managed Fishery and 3% by other fisheries (Duffy and Blay, 2020a).	
				Active licences/vessels:	Six licences.	
	✓	✓	✓	**Management area**	The Specimen Shell Managed Fishery (SSMF) encompasses the entire WA coastline, but effort is concentrated in areas adjacent to the population centres such as Broome, Exmouth, Shark Bay,	

<table>
<tr><th rowspan="2">Fishery</th><th colspan="3">Woodside Activity Area</th><th colspan="3" rowspan="2">Description</th></tr>
<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td rowspan="6">Specimen Shell Managed Fishery</td><td rowspan="6"></td><td rowspan="6"></td><td rowspan="6"></td><td></td><td colspan="2">Geraldton, Perth, Mandurah, the Capes area and Albany (Hart et al., 2020b). There are a number of closed areas where the SSMF is not permitted to operate. These include various marine parks and aquatic reserves, such as Ningaloo Marine Park.</td></tr>
<tr><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td>The Specimen Shell Managed Fishery targets the collection of specimen shells for display, collection, cataloguing and sale.</td><td>Collection is predominantly by hand when diving to wading in shallow, coastal waters, though in deeper water collection may be conducted by remotely operated vehicles (limited to one per licence).</td><td>For collection by hand, (diver-based) this typically restricts effort to safe diving depths (less than 30 m).
ROV collection could enable depths up to 300 m (Hart et al., 2017). In the past there has been one licence holder in the Specimen Shell Managed Fishery who has trialled ROV means of shell collection, WAFIC have provided advice that this fishery is no longer active.</td></tr>
<tr><td>Fishing effort:</td><td colspan="2">Information not available.</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="2">In 2018 there were 31 licences with only two divers allowed in the water per licences at one time (Hart et al., 2018). The number of people employed regularly in the fishery is likely to be about 21 (Hart et al., 2018).</td></tr>
<tr></tr>
<tr><td rowspan="3">West Australian Abalone Fishery</td><td rowspan="3">✓</td><td rowspan="3">✓</td><td rowspan="3">✓</td><td>Management area</td><td colspan="2">The Western Australian Abalone Fishery includes all coastal waters from the WA and SA border to the WA and NT border. The fishery is concentrated on the south coast and the west coast.</td></tr>
<tr><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td>Greenlip abalone (Haliotis laevigata)
Brownlip abalone (Haliotis conicopora)
Roe's abalone (Haliotis roei)</td><td>Divers.</td><td>Distribution to 5 m depth for Roe's abalone and 40 m depth for greenlip / brownlip abalone (DOF, 2011).</td></tr>
</table>

Fishery	Woodside Activity Area			Description		
	Browse	NWS/S	NW Cape			
				Fishing effort:	In 2018, the total commercial catch was 48 t, 1 t less than the catch in each of the last two seasons. No commercial fishing for abalone north of Moore River (Zone 8 of the managed fishery) has occurred since 2011–2012 (Strain *et al.*, 2018).	
				Active licences/vessels:	26 vessels active in Roe's abalone fishery (WAFIC[5]).	
West Coast Deep Sea Crustacean Managed Fishery	✓	✓	✓	**Management area**	The West Coast Deep Sea Crustacean Managed Fishery extends north from Cape Leeuwin to the WA/NT border in water depths greater than 150 m within the AFZ.	
				Species targeted	**Fishing methods**	**Fishing depth**
				The fishery targets deepwater crustaceans. Catches were dominated by crystal crabs of which 99% of their Total Allowable Catch (TAC) was landed (How and Orme, 2020a). Crystal (snow) crab (*Chaceon albus*) Giant (king) crab (*Pseudocarcinus gigas*) Champagne (spiny) crabs (*Hypothalassia acerba*)	Baited pots, or traps, are operated in long-lines which have between 80 and 180 pots attached to a main line marked by a float at each end.	Deeper than 150 m (and mostly at depths of between 500 m – 800 m). Most of the commercial Crystal crab catch is taken in depths of 500 m – 800 m (WAFIC[6]).
				Fishing effort:	The total landings in 2018 was 168. t. Two vessels operated in the fishery in 2017, using baited pots operated in a longline formation in the shelf edge waters, mostly in depths between 500 and 800 m (How and Orme, 2020a). Fishing effort was concentrated between Fremantle and Carnarvon.	
				Active licences/vessels:	There were four active vessels in 2018 (How and Orme, 2020a).	

[5] https://www.wafic.org.au/fishery/roes-abalone-fishery/
[6] https://www.wafic.org.au/fishery/west-coast-deep-sea-crustacean-fishery/

Fishery	Woodside Activity Area			Description		
	Browse	NWS/S	NW Cape			
Abrolhos Islands and Mid-West Trawl Fishery			✓	**Management area**	The Abrolhos Islands and Mid-West Trawl Fishery (AIMWTMF) operates around the Abrolhos Islands within the SWMR.	
				Species targeted	**Fishing methods**	**Fishing depth**
				Saucer scallops (*Ylistrum balloti,* formerly *Amusium balloti*)	Trawl.	Information not available, however, the species occurs at depth of around 30-60 m and therefore fishing effort would likely be at these depths (Himmelman *et al*., 2009).
				Fishing effort:	The scallop landings in the AIMWTMF were 31.0 t meat weight (154.8 t whole weight). Between 2011 and 2015, the annual pre-season surveys showed very low recruitment (1-year old), as a result of the 2011 extreme marine heatwave and subsequent poor pawning stock (Kangas *et al.*, 2020b). The fishery was closed between 2011 and 2016.	
				Active licences/vessels:	Information about licences or vessels is not available but the Department of Primary Industry and Regional Development reported 774 t of catch from this fishery in the 2019 annual report (DPIRD, 2019).	
Broome Prawn Managed Fishery	✓			**Management area**	The Broome Prawn Managed Fishery (BPMF) operates off Broome and forms part of the North Coast Prawn Fishery.	
				Species targeted	**Fishing methods**	**Fishing depth**
				Western king prawn (*Penaeus latisulcatus*) Coral prawn	Trawl.	Trawling is generally in waters between 30 and 60 m deep, however can occur down to 100 m (DOEH, 2004).
				Fishing effort:	BPMF recorded extremely low fishing effort in 2018. Only two vessels undertook trial fishing to investigate whether the catch rates were sufficient for commercial fishing. This resulted in negligible landings of Western king prawn (Kangas *et al*., 2020a).	

Fishery	Woodside Activity Area			Description		
	Browse	NWS/S	NW Cape			
				Active licences/vessels:	Two vessels conducting fishing trial operated in 2018 (Kangas *et al*., 2020a).	
Exmouth Gulf Prawn Managed Fishery			✓	**Management area**	The estimated employment in the fishery in 2017 was 18 people including skippers and other crew (Kangas *et al*., 2018). The fishery occupies a total area of 4000 km², with only half of this area being trawled (Fletcher and Santoro, 2015).	
				Species targeted	**Fishing methods**	**Fishing depth**
				Western king prawn (*Penaeus latisulcatus*) Brown tiger prawn (*Penaeus esculentus*) Blue endeavour prawn (*Metapenaeus endeavouri*) Banana prawn (*Penaeus merguinensis*)	Trawl.	Information not available.
				Fishing effort:	The total landings of prawns in 2018 were 880 t (Kangas *et al*., 2020a). In the 2016 season, a fishing effort of about 23,000 hours resulted in a catch of 822 t.	
				Active licences/vessels:	The precise number of vessels is unreported. Eighteen people were said to be employed in this fishery in 2018 (Kangas *et al.*, 2019); however, in 2013 it was reported that 18 skippers as well as other crew and support staff were employed (WAFIC[7]).	
Gascoyne Demersal Scalefish Managed Fishery			✓	**Management area**	The Gascoyne Demersal Scalefish Fishery (GDSF) is located between the southern Ningaloo Coast to south of Shark Bay (23°07.30'S to 26°.30'S) with a closure area at Point Maud to Tantabiddi (21°56.30'S) (WAFIC[8]).	
				Species targeted	**Fishing methods**	**Fishing depth**

[7] https://www.wafic.org.au/fishery/exmouth-gulf-prawn-fishery/
[8] https://www.wafic.org.au/fishery/gascoyne-demersal-scalefish-fishery/

Fishery	Woodside Activity Area			Description		
	Browse	NWS/S	NW Cape			
				Pink snapper (*Chrysophrys auratus*) Goldband snapper (*Pristipomoides multidens*) Red emperor (*Lutjanus sebae*) Cods (*Gadus morhua*) Emperors (*Lethrinus miniatus*)	Mechanised handlines.	Information not available.
				Fishing effort:	The GDSF reported a total commercial catch of 210 t in 2017-18.	
				Active licences/vessels:	In 2018, 13 vessels fished during the season, in the 2017 season there were 16 vessels (Gaughan and Santoro, 2018).	
Kimberley Developing Mud Crab Fishery	✓			**Management area**	The Kimberley Developing Mud Crab Fishery is one of two small trap-based crab fisheries that exist in the North Coast Bioregion between Cambridge Gulf and Broome (Gaughan and Santoro, 2018).	
				Species targeted	**Fishing methods**	**Fishing depth**
				Brown mud crab (*Scylla olivacea*) Green mud crab (*Scylla serrata*)	Trap.	Information not available.
				Fishing effort:	The catch landed represents all commercially caught mud crabs landed in WA for 2018. A nominal catch rate of 0.66 kg/traplift was recorded for 2018, which is a 28% decrease from 2017 but remains above the harvest strategy threshold (Johnston *et al*., 2020).	
				Active licences/vessels:	There are currently three licences issued to commercial operators (600 trap limit), and three exemptions issued to Indigenous groups (total of 210 traps currently allocated of a maximum 600 traps) (Johnston *et al*., 2020).	
Nickol Bay Prawn Managed Fishery		✓		**Management area**	The Nickol Bay Prawn Managed Fishery operates in nearshore and offshore waters of the Pilbara region along the NWS.	
				Species targeted	**Fishing methods**	**Fishing depth**

<table>
<tr><th rowspan="2">Fishery</th><th colspan="3">Woodside Activity Area</th><th rowspan="2" colspan="4">Description</th></tr>
<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td colspan="2">Banana prawn (Penaeus merguiensis)
Western king prawn (Penaeus latisulcatus)
Brown tiger prawn (Penaeus esculentus)
Blue endeavour prawn (Metapenaeus endeavouri)</td><td>Trawl.</td><td>Information not available.</td></tr>
<tr><td>Fishing effort:</td><td colspan="3">Trawling has been reported to occur at several locations along the Pilbara coast to the east of the Burrup Peninsula, including within the waters of Nickol Bay (Fletcher and Santoro, 2015). The total landings for the 2018 season were 81 t. Fishing effort was less than half at 138 days, compared to 281 boat days in 2017 (Kangas et al., 2020a).</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="3">The precise number of vessels is unreported, though low effort produced a catch of 17 t in 2016 (Kangas et al., 2018).</td></tr>
<tr><td rowspan="3">Northern Demersal Scalefish Managed Fishery</td><td rowspan="3">✓</td><td rowspan="3"></td><td rowspan="3"></td><td>Management area</td><td colspan="3">The fishery is divided into two fishing areas: an inshore sector (Area 1) and an offshore sector (Area 2) (Newman et al., 2018). Area 1 permits line fishing only, between the high water mark and the 30 m isobath. Area 2 permits handline, dropline and fish trap fishing methods and is further divided into zones. Zone A is an inshore area, Zone B comprises the area with most historical fishing activity, and Zone C is an offshore deep slope area representing waters deeper than 200 m (Fletcher et al., 2017).</td></tr>
<tr><td colspan="2">Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td colspan="2">Goldband snapper (Pristipomoides multidens)
Blue-spotted emperor (Lethrinus punctulantus)
Red emperor (Lutjanus sebae)
Rankin cod (Epinephelus multinotatus)</td><td>Line fishing, handline, dropline and fish trap fishing.</td><td>Information not available.</td></tr>
</table>

<table>
<tr><th rowspan="2">Fishery</th><th colspan="3">Woodside Activity Area</th><th rowspan="2" colspan="3">Description</th></tr>
<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td>Fishing effort:</td><td colspan="2">In 2018, the fishery reported a total catch of 1297 t. Most of the catch is landed from Zone B, with a catch of 1106 t in 2018. The level of catch in Zone B is the highest reported since zoning was implemented in 2006 (Newman et al., 2019).</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="2">Six vessels fished in the 2018 season and at least 20 people were directly employed (Gaughan and Santoro, 2018).</td></tr>
<tr><td rowspan="5">Octopus Interim Management Fishery</td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td><td>Management area</td><td colspan="2">The developing Octopus Fishery operates from Kalbarri Cliffs in the north to Esperance in the south.</td></tr>
<tr><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td>Octopus sp. cf. tetricus</td><td>Passive shelter pots and active traps.</td><td>In inshore waters to a depth of 70 m (DPIRD, 2018).</td></tr>
<tr><td>Fishing effort:</td><td colspan="2">In 2019, the total commercial octopus catch was 314 t, which was 22% higher than the 2017 catch of 257 t. In 2016, about 200 vessels reported a total catch of 252 t (Hart et al., 2020c).</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="2">About 21 vessels fish within the octopus specific fisheries, and about 200 vessels from the West Coast Rock Lobster Fishery catch octopus as bycatch (Gaughan and Santoro, 2018).</td></tr>
<tr><td rowspan="3">Shark Bay Beach Seine and Mesh Net Managed Fishery</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td>Management area</td><td colspan="2">The Shark Bay Beach Seine and Mesh Net Managed Fishery operates from Denham.</td></tr>
<tr><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td>Whiting (yellowfin Sillago schomburgkii and goldenline S. analis)
Sea mullet (Mugil cephalus)
Tailor (Pomatomus saltatrix)
Western yellowfin bream (Acanthopagrus australis)</td><td>Beach seine and mesh net.</td><td>Information not available.</td></tr>
</table>

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<tr><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td>Fishing effort:</td><td colspan="3">In 2018, the total catch was 176 t (Gaughan and Santoro, 2020). The fishery currently employs about 14 fishers based on the seven fishery licences in operation (WAFIC[9]).</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="3">Six vessels operated employing around 12 fishers (Gaughan and Santoro, 2018).</td></tr>
<tr><td rowspan="5">Shark Bay Crab Managed Fishery</td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td><td>Management area</td><td colspan="3">The Shark Bay Crab Managed Fishery operates within the NWMR.</td></tr>
<tr><td colspan="2">Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td colspan="2">Blue swimmer crab (Portunus armatus)</td><td>Trap and trawl.</td><td>Information not available.</td></tr>
<tr><td>Fishing effort:</td><td colspan="3">Commercial fishing for blue swimmer crabs in Shark Bay was voluntarily halted by industry in 2012 to facilitate stock rebuilding. The stock is still in a recovery phase; however, the fishery has resumed and reported a total commercial catch of 518 t in the 2017/18 season. The average commercial trap catch rate was 1.5 kg/traplift during 2017/18 (Chandrapavan et al., 2017).</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="3">The precise number of vessels in the Shark Bay Blue Swimmer Crab Fishery is unreported. There are five crab trap permits. These permits are consolidated onto three active vessels (WAFIC[10]).</td></tr>
<tr><td rowspan="3">Shark Bay Prawn and Scallop Managed Fishery</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td>Management area</td><td colspan="3">The Shark Bay Prawn Managed Fishery is the highest producing WA fishery for prawns.</td></tr>
<tr><td colspan="2">Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td colspan="2">Western king prawn (Penaeus latisulcatus)
Brown tiger prawn (Penaeus esculentus)</td><td>Low-opening otter trawls.</td><td>Information not available.</td></tr>
</table>

9 https://www.wafic.org.au/fishery/inner-shark-bay-scalefish-fishery/
10 https://www.wafic.org.au/fishery/shark-bay-prawn-and-scallop-managed-fisheries/

Fishery	Woodside Activity Area: Browse	Woodside Activity Area: NWS/S	Woodside Activity Area: NW Cape	Description		
				Endeavour prawns (*Metapenaeus endeavouri*) Coral prawns (*Metapenaeopsis sp.*) Saucer scallop (*Amusium balloti*)		
				Fishing effort:	The Shark Bay Scallop Managed Fishery is currently in a recovery phase due to the results from the pre-season survey of stock abundance (Fletcher and Santoro, 2015; Kangas *et al.*, 2018).	
				Active licences/vessels:	The precise number of vessels in the Shark Bay Prawn Managed Fishery is unreported; however, about 100 people are employed in this fishery (Gaughan and Santoro, 2018). About 20 skippers and crew are employed in scallop fishing in the Shark Bay and South Coast fisheries across 18 vessels in 2015 (Sporer *et al.*, 2015).	
South Coast Crustacean Managed Fishery	-	-	-	**Management area**	The South Coast Crustacean Managed Fishery comprises four fisheries: the Windy Harbour/Augusta Rock Lobster Managed Fishery, the Esperance Rock Lobster Managed Fishery, the Southern Rock Lobster Pot Regulation Fishery and the South Coast Deep-Sea Crab Fishery.	
				Species targeted	**Fishing methods**	**Fishing depth**
				Southern rock lobster (*Jasus edwardsii*) Western rock lobster (*Panulirus cygnus*) Giant crab (*Pseudocarcinus gigas*) Crystal crab (*Chaceon albus*) Champagne crab (*Hypothalassia acerba*)	Pots.	Information not available.
				Fishing effort:	The South Coast Crustacean Managed Fishery reported a total catch of 101.2 t in 2018 season and the value of the fishery for 2017/2018 was about $5.9 million (Howe and Orme, 2020b).	
				Active licences/vessels:	The number of vessels is unknown; however, a total of 1977 pots are licensed to be used.	
	-	-	-	**Management area**	The fishery is active in coastal waters between Cape Leeuwin and the South Australia border. Landings are primarily at Albany, Bremer Bay and Esperance (Norriss and Blazeski, 2020).	

Fishery	Woodside Activity Area			Description			
	Browse	NWS/S	NW Cape				
South Coast Purse Seine Managed Fishery				**Species targeted**		**Fishing methods**	**Fishing depth**
				Small pelagic finfish such as pilchards and yellowtail scad using purse seine nets from vessels. Sandy sprat (*Hyperlophus vittatus*) Blue sprat (*Spratelloides robustus*)		Purse seine.	Information not available.
				Fishing effort:	In the 2017/18 season the total catch effort was 2,168 t (Norriss and Blazeski, 2020).		
				Active licences/vessels:	Nine active vessels in 2017/18 (Norriss and Blazeski, 2020).		
South-west Trawl Managed Fishery	-	-	-	**Management area**	The South-west Trawl Managed Fishery is a multi-species fishery and includes two of WA's smaller scallop fishing grounds at Fremantle and north of Geographe Bay (Fairclough and Walters, 2018).		
				Species targeted		**Fishing methods**	**Fishing depth**
				Scallops (*Ylistrum balloti,* formerly *Amusium balloti*) and associated by-products Western king prawn (*Penaeus latisulcatus*) In years of low scallop catches licencees may use other trawl gear to target fin-fish species.		Trawl.	Information not available.
				Fishing effort:	Effort in the fishery is highly variable and typically fluctuates in response to recruitment variability in saucer scallops and prawns. The fishery was not active in 2015 or 2016 (Fairclough and Walters, 2018).		
				Active licences/vessels:	Only one boat fished in 2018 for a total of 5 boat days for minimal catch (Fairclough and Walters, 2018).		

<table>
<tr><th rowspan="2">Fishery</th><th colspan="3">Woodside Activity Area</th><th rowspan="2" colspan="4">Description</th></tr>
<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td rowspan="5">The South Coast Salmon Managed Fishery</td><td rowspan="5">-</td><td rowspan="5">-</td><td rowspan="5">-</td><td>Management area</td><td colspan="3">The South Coast Salmon Managed Fishery is one of two fisheries operating in the South Coast Bioregion that target nearshore and estuarine finfish.</td></tr>
<tr><td colspan="2">Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td colspan="2">Western Australian salmon (Arripis truttaceus)
Southern school whiting (Sillago bassensis)
Australian herring (Arripis georgianus)
King George whiting (Sillaginodes punctatus)
Sea mullet (Mugil cephalus)
Estuary cobbler (Cnidoglanis macrocephalus)
Black bream (Acanthopagrus butcheri)</td><td>Beach seines, haul nets and gill nets.</td><td>Information not available.</td></tr>
<tr><td>Fishing effort:</td><td colspan="3">The total catch for 2018 was 243 t (Duffy and Blay, 2020b).</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="3">Number of vessels is unknown; however, 12 commercial fishers were employed in 2018 (Duffy and Blay, 2020b).</td></tr>
<tr><td rowspan="4">West Coast Beach Bait Managed Fishery</td><td rowspan="4">-</td><td rowspan="4">-</td><td rowspan="4">-</td><td>Management area</td><td colspan="3">Primarily active in the Bunbury areas in the SWMR.</td></tr>
<tr><td colspan="2">Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td colspan="2">Whitebait</td><td>Beach-based haul nets.</td><td>Information not available.</td></tr>
<tr><td>Fishing effort:</td><td colspan="3">In recent years the fishery is primarily active in the Bunbury area. Total catch of whitebait in 2015 was 40.2 t (Duffy and Blay, 2020c).</td></tr>
</table>

<table>
<tr><th rowspan="2">Fishery</th><th colspan="3">Woodside Activity Area</th><th colspan="3" rowspan="2">Description</th></tr>
<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td></td><td></td><td></td><td></td><td>Active licences/vessels:</td><td colspan="2">Number of vessels is unknown; however, only one license was issued (DPIRD, 2019).</td></tr>
<tr><td rowspan="5">West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery</td><td rowspan="5">-</td><td rowspan="5">-</td><td rowspan="5">-</td><td>Management area</td><td colspan="2">The West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery (WCDGDLF) is part of the Temperate Demersal Gillnet and Demersal Longline Fishery (TDGDLF), which operates between 26° and 33° S, and the Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery (JASDGDLF), which operates from 33° S to the WA/SA border (Braccini and Blay, 2020).</td></tr>
<tr><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td>Gummy shark (Mustelus antarcticus)
Dusky shark (Carcharhinus obscurus)
Whiskery shark (Furgaleus macki)
Sandbar shark (C. plumbeus)</td><td>Gillnet and longline.</td><td>Information not available.</td></tr>
<tr><td>Fishing effort:</td><td colspan="2">Catch estimated annual value of the fishery was $0.2 million for 2017 to 2018 (Braccini and Blay, 2020).</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="2">Vessel numbers are unknown; however, 17 interim managed fishery permits were held in 2019 (DPIRD, 2019) and between 18 and 21 skippers and crew were employed between 2016 and 2017.</td></tr>
<tr><td rowspan="3">West Coast Demersal Scalefish Fishery</td><td rowspan="3">-</td><td rowspan="3">-</td><td rowspan="3">-</td><td>Management area</td><td colspan="2">These fisheries include the West Coast Demersal Scalefish (Interim) Managed Fishery (51 boats), the West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery and the temperate Demersal Gillnet and Demersal Longline Fisheries. The West Coast Demersal Scalefish Managed Fishery is the main commercial fishery that targets demersal species in the West Coast Bioregion. It encompasses the waters from just south of Shark Bay down to just east of Augusta and extends seaward to the 200 nm boundary. The fishery is divided into four inshore management areas and one offshore management area.</td></tr>
<tr><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td>Baldchin groper (Choerodon rubescens)
Dhufish (Glaucosoma hebraicum)
Pink snapper (Pagrus auratus)</td><td>Lines.</td><td>Inshore species – 20 to 250 m water depth.</td></tr>
</table>

Fishery	Woodside Activity Area: Browse	Woodside Activity Area: NWS/S	Woodside Activity Area: NW Cape	Description		
						Offshore species – more than 250 m water depth.
				Fishing effort:	In 2016, the West Coast Demersal Scalefish (interim) Managed Fishery reported a total catch of 256 t.	
				Active licences/vessels:	The precise number of vessels in the West Coast Demersal Scalefish Fisheries is unreported; however, it is restricted to 60 interim managed fishery permit holders.	
West Coast Purse Seine Managed Fishery	-	-	-	**Management area**	Located in waters from Cape Bouvard extending to Lancelin.	
				Species targeted	**Fishing methods**	**Fishing depth**
				Small pelagic finfish such as: Scaly mackerel (*Sardinella lemuru*) Pilchards (*Sardinops sagax*) Australian anchovy (*Engraulis australis*) Yellowtail scad (*Trachurus novaezelandiae*) Maray (*Etrumeus teres*)	Purse seine.	Information not available.
				Fishing effort:	Information not available	
				Active licences/vessels:	Seven vessels in 2017 (Gaughan and Santoro, 2018).	
West Coast Rock Lobster Managed Fishery			✓	**Management area**	The West Coast Rock Lobster Fishery operates from Shark Bay south to Cape Leeuwin. The fishery is managed using zones, seasons and total allowable catch. The recreational fishery targets the western rock lobsters using baited pots and by diving between North-west Cape and Augusta.	

Fishery	Woodside Activity Area			Description		
	Browse	NWS/S	NW Cape			
				Species targeted	**Fishing methods**	**Fishing depth**
				Western rock lobster (*Panulirus cygnus)*	Baited pots.	Less than 20 m.
				Fishing effort:	In 2018, 234 vessels reported a total catch of 6400 t in 2017 (de Lestang *et al*., 2018). In 2016, 226 vessels reported a total catch of 6,086 t (Gaughan and Santoro, 2018).	
				Active licences/vessels:	234 vessels operated in 2017 and 233 vessels operated in 2018 (Gaughan and Santoro, 2018).	

11.5.2 Aquaculture

Aquaculture operations in the northwest are typically restricted to inland and shallow coastal waters.

West Coast Bioregion

Aquaculture activities in the West Coast bioregion, defined by the Department of Primary Industries and Regional Development (DPIRD) (as the government body responsible management of primary industries in WA) are focused on blue mussels and edible oysters (mainly in Cockburn Sound) and marine algae for production of beta-carotene, used as a food additive and as a nutritional supplement. Offshore marine finfish production is also being developed, initially focusing on yellowtail kingfish.

There is also an emerging black pearl industry (from the *Pinctada margaritifera* oyster) in the Abrolhos Islands. As well as expansion in the production of Akoya pearls (small white pearls from *Pinctada fucata martensi*), *Pinctada albina* (small, yellow pearls) and *Pteria penguin*, which are often used to produce half (mabe) pearls in pink and bluish shades.

Aquaculture licences for producing coral and live rock (pieces of old coral reefs colonised by marine life, such as beneficial bacteria, for aquariums) at the Abrolhos Islands have also been issued and other applications are being assessed.

Gascoyne Coast Bioregion

In the Gascoyne Coast bioregion, aquaculture activities are focused on the blacklip oyster (*Pinctada margaritifera*) and Akoya pearl oyster (*Pinctada imbricata*) (Gaughan and Santoro, 2020). Several hatcheries supply *P. margaritifera* juveniles to the region's developing black pearl farms.

Other aquaculture developments in the Gascoyne Coast bioregion include emerging producers of coral and live rock species for aquariums.

North Coast Bioregion

Aquaculture activities in the North Coast bioregion is dominated by the production of pearls. A large number of pearl oysters for seeding are obtained from wild stocks and supplemented by hatchery produced oysters, with major hatcheries operating at Broome and around the Dampier Peninsula (Gaughan and Santoro, 2018). Primary spawning of the pearl oyster occurs from mid-October to December. A smaller secondary spawning occurs in February and March (Gaughan and Santoro, 2020).

Other aquaculture developments in the North Coast include emerging producers of coral and live rock species for aquariums as well as barramundi (*Lates calcarifer)* farms and microalgae culturing for Omega-3, biofuels and protein biomass (Gaughan and Santoro, 2020).

11.6 Fisheries – Traditional

Traditional or customary fisheries are typically restricted to shallow coastal waters and/or areas with structures such as reef.

Dugong, fish and marine turtles that move between coastal and Commonwealth waters are important components of the Aboriginal people's culture and diet. Aboriginal people continue to actively manage their sea country in coastal waters of WA in order to protect and manage the marine environment, its resources and cultural values.

Indonesian fishers can fish within designated areas under the Australia-Indonesia Memorandum of Understanding regarding the Operations of Indonesian Traditional Fishermen in Areas of the Australian Fishing Zone and Continental Shelf – 1974 (MoU 74). Traditional fishing is allowed within the MoU Box (**Figure 11-1)**, which encompasses: Ashmore Reef (Pulau Pasir), Cartier Island (Pulau Baru), Seringapatam Reef (Afringan), Scott Reef (Pulau Dato) and Browse Island (Berselan). Restrictions have since been introduced around Ashmore Reef and Cartier Island following their designation as Nature Reserves under the Commonwealth's *National Parks and Wildlife Conservation Act 1975* in 1983 and 2000, respectively.

The MoU allows Indonesian fishers to fish in designated areas using traditional methods only. These methods include reef gleaning, free-diving, hand lining and other non-mechanised methods. Scott Reef is currently the principal reef in the MoU 74 Box and is utilised seasonally by Indonesian fishers to harvest trepang, trochus shells and other reef species. The peak season is July to October due to more favourable wind conditions, and to allow fishers to sun dry their catch on their boat decks (ERM, 2009). Browse Island is also frequently visited by shark fishers who mostly fish along the eastern margin of the MoU 74 Box.

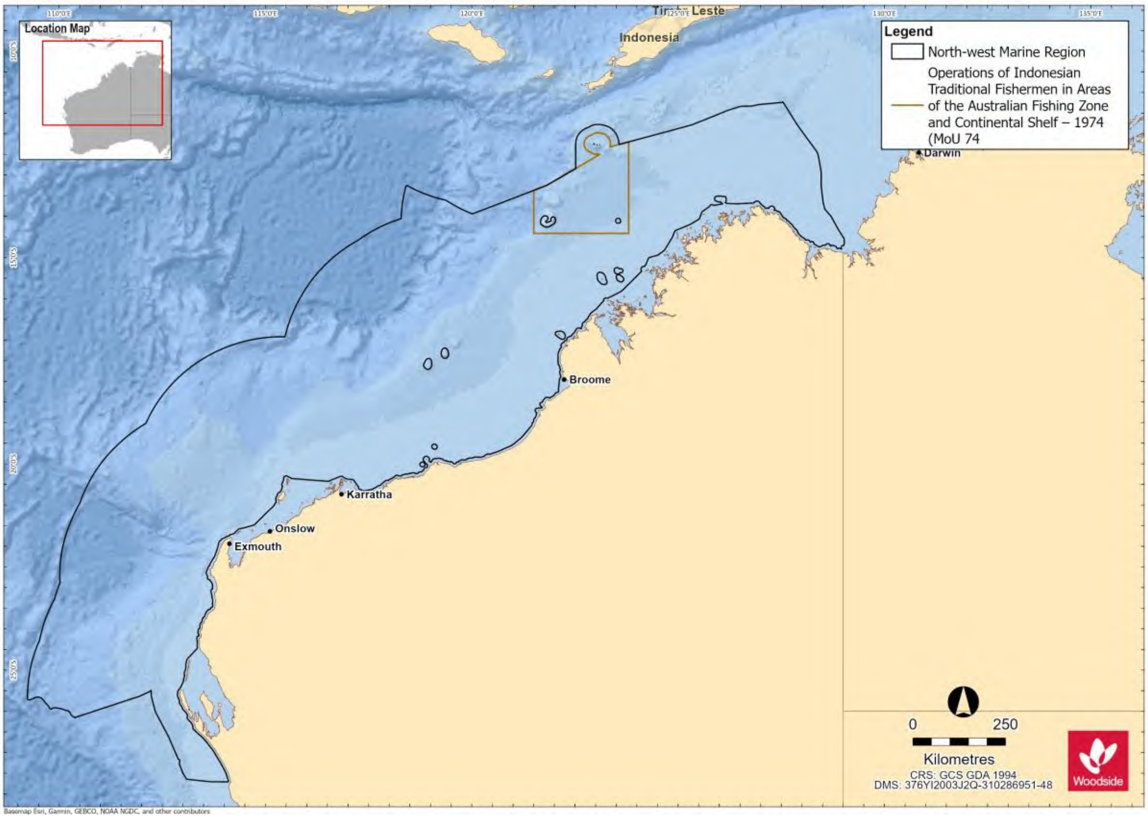

Figure 11-1 MOU 74 Box. Operations of Indonesian Traditional Fishermen in Areas of the Australian Fishing Zone and Continental Shelf – 1974

11.7 Tourism and Recreation

There are growing tourism and recreational sectors in WA. The Kimberley, Pilbara and Gascoyne regions are popular visitor destinations for Australian and international tourists. Tourism is concentrated in the vicinity of population centres including Broome, Dampier, Exmouth, Coral Bay and Shark Bay.

Recreational and tourism activities include: charter fishing, other recreational fishing, diving, snorkelling, marine fauna watching, and yachting.

11.7.1 Gascoyne Region

Outside the petroleum industry, tourism is the largest revenue earner of all the major industries of the Gascoyne region. It contributes significantly to the local economy in terms of both income and employment. In 2018 there was an average of 337,400 visitors with a visitor spend of $359 million (Gascoyne Development Commission[11]).

In 2018-19, the Ningaloo region (Ningaloo Reef and the surrounding coastal region Exmouth Gulf, communities of Exmouth and Coral Bay, and adjacent proposed southern coastal reserves and pastoral leases) contributed an estimated $110 million in value added to the WA economy (DCBA, 2020). Ningaloo's economic contribution to WA is attributed to four key types of economic activity, tourism expenditure by international, interstate and WA visitors to the Ningaloo region, commercial fishing in the Exmouth Gulf, recreation activity involving the Reef by residents of the Ningaloo region and management and research relating to the Reef (DCBA, 2020). More than 90% of this value added is attributed to the domestic and international tourists who visit Ningaloo each year (DCBA, 2020). The main marine nature-based tourist activities are concentrated around and within the Ningaloo WHA.

11.7.2 Pilbara region

Recreation and tourism activities within the Pilbara are of high social value. Tourism is a key economic driver for the Pilbara with more than 1 million visitors to the region every year, generating $413 million in gross revenue annually (Pilbara Development Commission[12]).

Recreational fishing within the Pilbara region tends to be concentrated in State waters adjacent to population centres. Recreational fishing is known to occur around the Dampier Archipelago with boats launched from boat ramps around Dampier and Karratha (Williamson *et al.*, 2006). Once at sea, charter vessels may also frequent the waters surrounding the Montebello Islands.

11.7.3 Kimberley Region

Recreation and tourism activities in the Kimberley region occur predominantly in WA State waters (extending offshore 3 nm from the mainland), adjacent to coastal population centres (e.g. Broome), with a peak in activity during the winter months (dry season). These activities include recreational fishing, diving, snorkelling, wildlife watching and boating.

Primary dive locations in the Kimberley region include the Rowley Shoals, including Mermaid Reef AMP, Scott Reef, Seringapatam Reef, Ashmore Reef AMP and Cartier Island.

11.8 Shipping

Commercial shipping traffic is high within the NWMR with vessel activities including commercial fisheries, tourism such as cruises, international shipping and oil and gas operations. There are 12 ports adjacent to the NWMR, including the major ports of Dampier, Port Hedland and Broome, which are operated by their respective port authorities. These ports handle large tonnages of iron ore and petroleum exports in addition to salt, manganese, feldspar chromite and copper (DEWHA, 2008).

Heavy vessel traffic exists within the Pilbara Port Authority management area which recorded 10,064 vessel movements in Port of Dampier 2019/20 annual reporting period (PPA, 2020). Twenty-six designated anchorages for bulk carriers, petroleum and gas tankers, drilling rigs, offshore platforms, and pipelay vessels are located offshore of Rosemary Island.

In 2012, AMSA established a network of shipping fairways off the northwest coast of Australia. The shipping fairways, while not mandatory, aim to reduce the risk of collision between transiting vessels and offshore infrastructure. The fairways are intended to direct large vessels such as bulk carriers and LNG ships trading to the major ports into pre-defined routes to keep them clear of existing and planned offshore infrastructure (AMSA, 2013).

[11] https://www.gdc.wa.gov.au/industry-profiles/tourism/
[12] https://www.pdc.wa.gov.au/our-focus/strategicinitiatives/tourism

11.9 Oil and Gas Infrastructure

The NWMR supports a number of industries including petroleum exploration and production.

Within the NWMR there are seven sedimentary petroleum basins: Northern and Southern Carnarvon basins, Perth, Browse, Roebuck, Offshore Canning and Bonaparte basins. Of these, the Northern Carnarvon, Browse and Bonaparte basins hold large quantities of gas and comprise most of Australia's reserves of natural gas (DEWHA, 2008), which is reflected by the level of development in the area. In addition to existing facilities, there are proposed developments in the region. This includes proposals to develop gas and condensate from a number of fields within the NWMR.

In addition to the oil and gas industry, other land-based industries depend upon the marine environment in the nearshore area. These include ports, salt mines such as Karratha and Onslow, LNG onshore processing facilities such as Burrup Hub, Thevenard Island, Barrow Island, Varanus Island, and small-scale desalination plants at Barrow Island, Burrup, Cape Preston, and Onslow.

11.10 Defence

Key Australian Department of Defence (DoD) operational areas and facilities areas of the NWMR for training and operational activities, include:

- An operating logistics base has been established in Dampier to support vessels patrolling the waters around offshore oil and gas facilities. A dedicated navy administrative support facility is also being constructed at the nearby township of Karratha.
- The Royal Australian Air Force currently maintains two 'bare bases' in remote areas of WA that are used for military exercises. One of these is the Royal Australian Air Force Base in Learmonth. The Royal Australian Air Force maintains the Commonwealth Heritage listed Learmonth Air Weapons Range Facility, which is located between Ningaloo Station and the Cape Range National Park. The air training area associated with the Learmonth base extends over the offshore region.
- The Royal Australian Air Force Base Curtin is located on the north coast of WA, south-east of Derby and 170 km east of Broome. It provides support for land, air and sea operations aimed to support Australia's northern approaches.
- The Naval Communications Station Harold E. Holt is located ~6 km north of Exmouth. The main role of the station is to communicate at very low frequencies (19.8 kHz) with Australian and United States submarines and ships in the eastern Indian Ocean and the western Pacific Ocean.

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APPENDIX A. PROTECTED MATTER SEARCH REPORTS FOR NWMR, SWMR AND NMR

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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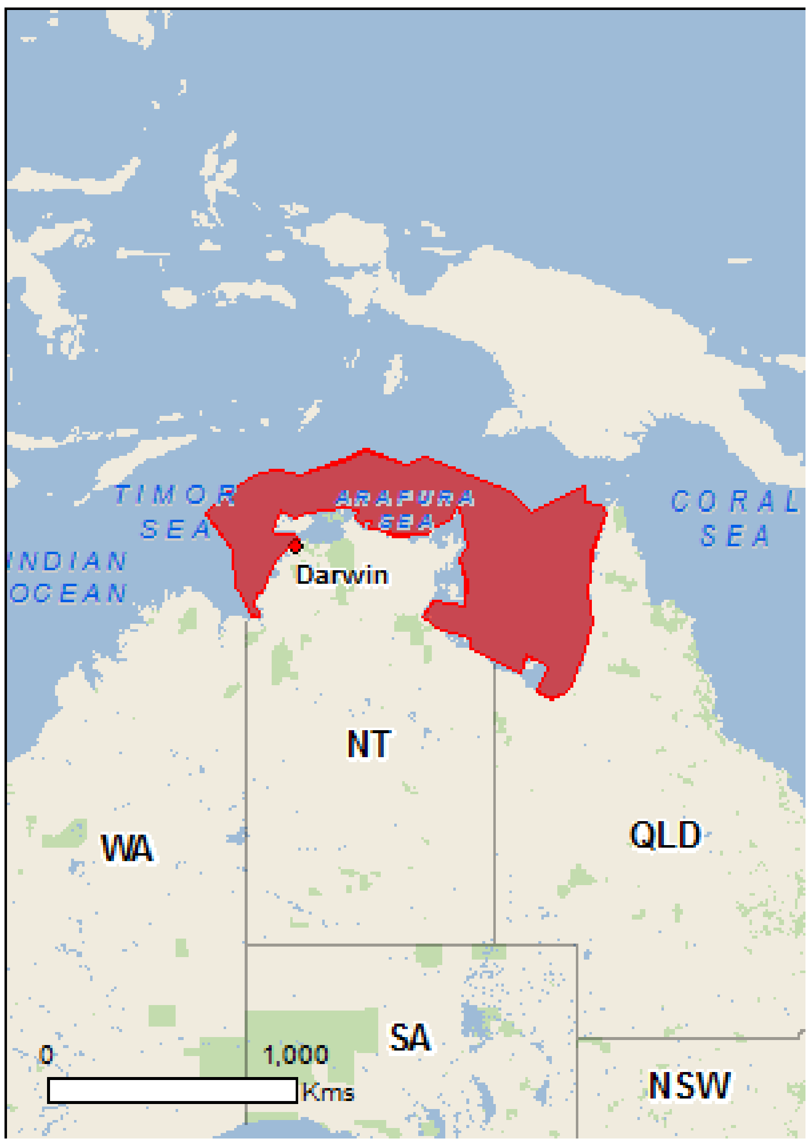

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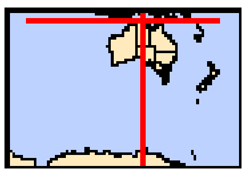

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	33
Listed Migratory Species:	70

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	127
Whales and Other Cetaceans:	25
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	15

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	1
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	8

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat may occur within area
Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-	Vulnerable	Species or species

Name	Status	Type of Presence
tailed Godwit [86380]		habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Notomys aquilo Northern Hopping-mouse, Woorrentinta [123]	Endangered	Species or species habitat may occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat may occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Cryptoblepharus gurrmul Arafura Snake-eyed Skink [83106]	Endangered	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat known to occur within area
Glyphis glyphis Speartooth Shark [82453]	Critically Endangered	Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Foraging, feeding or related behaviour known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation known to occur within area
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat likely to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat may occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding likely to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat may occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Foraging, feeding or related behaviour known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Species or species habitat known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding likely to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Stiltia isabella Australian Pratincole [818]		Species or species habitat known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area
Fish		

Name	Threatened	Type of Presence
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys haematopterus Reef-top Pipefish [66201]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys ocellatus Orange-spotted Pipefish, Ocellated Pipefish [66203]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Cosmocampus maxweberi Maxweber's Pipefish [66209]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus macrorhynchus Whiskered Pipefish, Ornate Pipefish [66222]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys heptagonus Madura Pipefish, Reticulated Freshwater Pipefish [66229]		Species or species habitat may occur within area
Hippichthys parvicarinatus Short-keel Pipefish, Short-keeled Pipefish [66230]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippichthys spicifer Belly-barred Pipefish, Banded Freshwater Pipefish [66232]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Hippocampus zebra Zebra Seahorse [66241]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Micrognathus brevirostris thorntail Pipefish, Thorn-tailed Pipefish [66254]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Microphis brachyurus Short-tail Pipefish, Short-tailed River Pipefish [66257]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis atriceps Black-headed Seasnake [1101]		Species or species habitat may occur within area
Hydrophis caerulescens Dwarf Seasnake [1103]		Species or species habitat may occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis gracilis Slender Seasnake [1106]		Species or species habitat may occur within area
Hydrophis inornatus Plain Seasnake [1107]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis melanosoma Black-banded Robust Seasnake [1109]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Hydrophis pacificus Large-headed Seasnake, Pacific Seasnake [1112]		Species or species habitat may occur within area
Hydrophis vorisi a seasnake [25927]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Laticauda colubrina a sea krait [1092]		Species or species habitat may occur within area
Laticauda laticaudata a sea krait [1093]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Parahydrophis mertoni Northern Mangrove Seasnake [1090]		Species or species habitat may occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area

Name	Status	Type of Presence
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Arafura	Multiple Use Zone (IUCN VI)
Arafura	Special Purpose Zone (Trawl) (IUCN VI)
Arnhem	Special Purpose Zone (IUCN VI)
Gulf of Carpentaria	National Park Zone (IUCN II)
Gulf of Carpentaria	Special Purpose Zone (Trawl) (IUCN VI)
Joseph Bonaparte Gulf	Multiple Use Zone (IUCN VI)

Name	Label
Joseph Bonaparte Gulf	Special Purpose Zone (IUCN VI)
Limmen	Habitat Protection Zone (IUCN IV)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	Special Purpose Zone (Trawl) (IUCN VI)
Wessel	Habitat Protection Zone (IUCN IV)
Wessel	Special Purpose Zone (Trawl) (IUCN VI)
West Cape York	Habitat Protection Zone (IUCN IV)
West Cape York	National Park Zone (IUCN II)
West Cape York	Special Purpose Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Anindilyakwa	NT
Marthakal	NT

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Plants		
Andropogon gayanus		
Gamba Grass [66895]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Southern Gulf Aggregation	QLD

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Carbonate bank and terrace system of the Van	North
Gulf of Carpentaria basin	North
Gulf of Carpentaria coastal zone	North
Pinnacles of the Bonaparte Basin	North
Plateaux and saddle north-west of the Wellesley	North
Shelf break and slope of the Arafura Shelf	North
Submerged coral reefs of the Gulf of Carpentaria	North
Tributary Canyons of the Arafura Depression	North

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-14.758882 129.178077,-13.960657 128.826514,-13.768665 128.606788,-12.484784 128.496924,-11.183724 127.563087,-10.460737 128.233253,-9.746889 129.518653,-9.660256 130.254737,-9.779371 130.935889,-9.280976 132.528907,-8.901286 133.385841,-9.411062 134.858008,-9.129149 135.473243,-10.363488 138.582374,-11.129831 139.395362,-10.190527 141.339942,-10.806262 141.317969,-10.817053 141.922217,-11.10827 142.087012,-12.527687 141.559669,-13.330764 141.515723,-13.960657 141.40586,-15.045535 141.570655,-15.945419 141.317969,-17.22994 140.823585,-17.513041 140.53794,-17.659661 140.032569,-17.429205 139.593116,-16.630864 139.966651,-16.409675 139.812842,-16.177683 139.208594,-16.820251 138.966895,-15.924291 137.165137,-15.575354 137.132178,-15.458909 136.934424,-15.289418 136.11045,-14.822615 135.45127,-14.269641 135.846778,-14.418655 136.97837,-13.608551 137.011329,-12.784952 136.780616,-12.388227 137.055274,-10.957305 136.76963,-10.957305 136.703712,-11.399198 136.407081,-11.679068 135.824805,-11.904912 135.616065,-11.947909 134.473487,-11.679068 133.869239,-11.700585 133.50669,-11.431505 133.528663,-11.442273 133.363868,-11.64679 133.254005,-11.313028 132.979346,-11.04358 133.067237,-10.90337 132.583839,-11.151389 131.221534,-11.3238 130.782081,-11.054363 130.287696,-11.474575 130.111915,-11.765126 129.958106,-11.947909 130.067969,-11.894162 130.760108,-12.119827 130.913917,-12.441874 130.474464,-12.870649 130.100928,-13.939333 129.584571,-13.971319 129.419776,-14.47185 129.28794,-14.631358 129.507667,-14.843856 129.452735,-14.769505 129.178077,-14.758882 129.178077

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- -Office of Environment and Heritage, New South Wales
- -Department of Environment and Primary Industries, Victoria
- -Department of Primary Industries, Parks, Water and Environment, Tasmania
- -Department of Environment, Water and Natural Resources, South Australia
- -Department of Land and Resource Management, Northern Territory
- -Department of Environmental and Heritage Protection, Queensland
- -Department of Parks and Wildlife, Western Australia
- -Environment and Planning Directorate, ACT
- -Birdlife Australia
- -Australian Bird and Bat Banding Scheme
- -Australian National Wildlife Collection
- -Natural history museums of Australia
- -Museum Victoria
- -Australian Museum
- -South Australian Museum
- -Queensland Museum
- -Online Zoological Collections of Australian Museums
- -Queensland Herbarium
- -National Herbarium of NSW
- -Royal Botanic Gardens and National Herbarium of Victoria
- -Tasmanian Herbarium
- -State Herbarium of South Australia
- -Northern Territory Herbarium
- -Western Australian Herbarium
- -Australian National Herbarium, Canberra
- -University of New England
- -Ocean Biogeographic Information System
- -Australian Government, Department of Defence
- Forestry Corporation, NSW
- -Geoscience Australia
- -CSIRO
- -Australian Tropical Herbarium, Cairns
- -eBird Australia
- -Australian Government – Australian Antarctic Data Centre
- -Museum and Art Gallery of the Northern Territory
- -Australian Government National Environmental Science Program
- -Australian Institute of Marine Science
- -Reef Life Survey Australia
- -American Museum of Natural History
- -Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
- -Tasmanian Museum and Art Gallery, Hobart, Tasmania
- -Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 10/05/21 13:07:00

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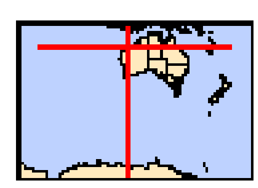
Coordinates
Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	2
National Heritage Places:	5
Wetlands of International Importance:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	70
Listed Migratory Species:	84

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	1
Listed Marine Species:	149
Whales and Other Cetaceans:	34
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	17

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	10
Regional Forest Agreements:	None
Invasive Species:	23
Nationally Important Wetlands:	3
Key Ecological Features (Marine)	5

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
Shark Bay, Western Australia	WA	Declared property
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
Shark Bay, Western Australia	WA	Listed place
The Ningaloo Coast	WA	Listed place
The West Kimberley	WA	Listed place
Indigenous		
Dampier Archipelago (including Burrup Peninsula)	WA	Listed place
Historic		
Dirk Hartog Landing Site 1616 - Cape Inscription Area	WA	Listed place

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Eighty-mile beach	Within Ramsar site
Ord river floodplain	Within 10km of Ramsar

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat known to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area
Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
Geophaps smithii blaauwi Partridge Pigeon (western) [66501]	Vulnerable	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Critically Endangered	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Malurus leucopterus leucopterus White-winged Fairy-wren (Dirk Hartog Island), Dirk Hartog Black-and-White Fairy-wren [26004]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Bettongia lesueur lesueur Burrowing Bettong (Shark Bay), Boodie [66659]	Vulnerable	Species or species habitat likely to occur within area
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat likely to occur within area
Conilurus penicillatus Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat may occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Isoodon auratus auratus Golden Bandicoot (mainland) [66665]	Vulnerable	Species or species habitat likely to occur within area
Lagostrophus fasciatus fasciatus Banded Hare-wallaby, Merrnine, Marnine, Munning [66664]	Vulnerable	Translocated population known to occur within area
Leporillus conditor Wopilkara, Greater Stick-nest Rat [137]	Vulnerable	Translocated population known to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat known to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area
Perameles bougainville bougainville Western Barred Bandicoot (Shark Bay) [66631]	Endangered	Translocated population known to occur within area
Petrogale concinna monastria Nabarlek (Kimberley) [87607]	Endangered	Species or species habitat known to occur within area
Phascogale tapoatafa kimberleyensis Kimberley brush-tailed phascogale, Brush-tailed Phascogale (Kimberley) [88453]	Vulnerable	Species or species habitat likely to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat may occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat likely to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat likely to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Egernia stokesii badia Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Lerista nevinae Nevin's Slider [85296]	Endangered	Species or species habitat known to occur within area
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat known to occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Breeding known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species

Name	Threatened	Type of Presence
		habitat likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Foraging, feeding or related behaviour likely to occur within area
Sterna dougallii Roseate Tern [817]		Breeding likely to occur within area
Sternula albifrons Little Tern [82849]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat likely to occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur

Name	Threatened	Type of Presence
		within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Breeding known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat may occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Ningaloo Marine Area - Commonwealth Waters	WA	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat may occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Foraging, feeding or related behaviour likely to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Pterodroma macroptera Great-winged Petrel [1035]		Foraging, feeding or

Name	Threatened	Type of Presence
		related behaviour known to occur within area
[Pterodroma mollis](#) Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Puffinus assimilis](#) Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area
[Puffinus carneipes](#) Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
[Puffinus pacificus](#) Wedge-tailed Shearwater [1027]		Breeding known to occur within area
[Recurvirostra novaehollandiae](#) Red-necked Avocet [871]		Species or species habitat known to occur within area
[Rostratula benghalensis (sensu lato)](#) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
[Sterna albifrons](#) Little Tern [813]		Breeding known to occur within area
[Sterna anaethetus](#) Bridled Tern [814]		Breeding known to occur within area
[Sterna bengalensis](#) Lesser Crested Tern [815]		Breeding known to occur within area
[Sterna bergii](#) Crested Tern [816]		Breeding known to occur within area
[Sterna caspia](#) Caspian Tern [59467]		Breeding known to occur within area
[Sterna dougallii](#) Roseate Tern [817]		Breeding likely to occur within area
[Sterna fuscata](#) Sooty Tern [794]		Breeding known to occur within area
[Sterna nereis](#) Fairy Tern [796]		Breeding known to occur within area
[Sula leucogaster](#) Brown Booby [1022]		Breeding known to occur within area
[Sula sula](#) Red-footed Booby [1023]		Breeding known to occur within area
[Thalassarche carteri](#) Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
[Thalassarche cauta](#) Shy Albatross [89224]	Endangered	Species or species habitat may occur within area
[Thalassarche impavida](#) Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
[Thalassarche melanophris](#) Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat likely to occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnstone's Crocodile [1773]		Species or species habitat may occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis atriceps Black-headed Seasnake [1101]		Species or species habitat may occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis inornatus Plain Seasnake [1107]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within

Name	Status	Type of Presence
		area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Indopacetus pacificus Longman's Beaked Whale [72]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species

Name	Status	Type of Presence
		habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Abrolhos	Habitat Protection Zone (IUCN IV)
Abrolhos	Multiple Use Zone (IUCN VI)
Abrolhos	Special Purpose Zone (IUCN VI)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	National Park Zone (IUCN II)
Dampier	Habitat Protection Zone (IUCN IV)
Dampier	Multiple Use Zone (IUCN VI)
Eighty Mile Beach	Multiple Use Zone (IUCN VI)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)
Gascoyne	National Park Zone (IUCN II)
Joseph Bonaparte Gulf	Multiple Use Zone (IUCN VI)
Kimberley	Multiple Use Zone (IUCN VI)
Ningaloo	Recreational Use Zone (IUCN IV)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Roebuck	Multiple Use Zone (IUCN VI)
Shark Bay	Multiple Use Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Bardi Jawi	WA
Dambimangari	WA
Dambimangari	WA
Dirk Hartog Island	WA
Faure Island	WA
Little Rocky Island	WA
Tent Island	WA
Unnamed WA36913	WA
Unnamed WA36915	WA
Uunguu	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat may occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Jatropha gossypifolia		
Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Lantana camara		
Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat may occur within area
Lycium ferocissimum		
African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp.		
Prickly Pears [82753]		Species or species habitat likely to occur within area
Parkinsonia aculeata		
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Tamarix aphylla		
Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Ramphotyphlops braminus		
Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Exmouth Gulf East	WA
Hamelin Pool	WA
Shark Bay East	WA

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Carbonate bank and terrace system of the Sahul	North-west
Commonwealth waters adjacent to Ningaloo Reef	North-west
Continental Slope Demersal Fish Communities	North-west
Pinnacles of the Bonaparte Basin	North-west
Wallaby Saddle	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-11.269933 127.440005,-12.516962 128.274966,-13.416271 128.362857,-13.854015 128.406802,-14.652617 128.879214,-14.833236 128.956119,-14.737633 128.439761,-14.280288 127.769595,-13.864681 127.385074,-13.864681 127.143375,-13.67261 126.934634,-13.875347 126.418277,-13.843348 126.242496,-13.896678 125.967837,-14.077907 125.934878,-14.34416 125.836001,-14.216398 125.649234,-14.461212 125.099918,-14.641988 125.044986,-14.88633 125.143863,-14.971254 124.990054,-15.257624 124.649478,-15.268222 124.231998,-15.416549 124.16608,-15.490673 124.407779,-16.293713 124.286929,-16.072142 123.616763,-16.219884 123.429996,-16.567693 123.408023,-16.778181 123.561832,-16.914874 123.704654,-17.114478 123.397037,-16.546631 123.034488,-16.251529 123.078433,-16.704537 122.540103,-17.135476 122.144595,-17.502564 122.056705,-18.244939 122.078677,-18.432649 121.738101,-18.76585 121.551334,-19.45099 121.100894,-19.999097 119.584781,-19.906155 119.101382,-20.236365 118.727847,-20.308506 118.112613,-20.648142 117.321597,-20.555589 116.948062,-20.360014 117.01398,-20.318809 116.816226,-20.802273 116.26691,-20.822812 116.113101,-21.468342 115.377017,-21.754335 114.629947,-22.344932 114.355289,-22.202601 114.146548,-21.67268 114.245425,-21.886924 113.849918,-22.669716 113.586246,-23.003846 113.751041,-23.458145 113.696109,-24.031352 113.300601,-24.51208 113.311587,-25.893759 114.135562,-26.258875 114.003726,-25.953045 113.926822,-25.398562 113.45441,-25.686027 113.366519,-26.249022 113.641177,-26.229314 113.509341,-25.378711 112.949039,-25.557248 112.839175,-26.485263 113.256656,-27.161748 113.816959,-27.571531 114.036685,-27.552052 113.113834,-27.151972 112.981998,-25.368784 112.278873,-26.022173 110.389224,-25.893759 110.323306,-25.804776 109.872867,-25.537424 109.587222,-25.626608 109.23566,-24.582033 109.389468,-23.306884 109.872867,-22.882439 110.026675,-21.621623 110.169498,-20.945986 110.510074,-20.030065 110.949527,-19.025706 112.092105,-17.816621 112.981998,-17.271909 113.773013,-16.935895 115.442935,-15.681156 116.014224,-14.790751 116.89313,-14.056594 118.266421,-13.266614 118.42023,-13.949995 120.046207,-13.234532 121.825992,-12.838516 122.529117,-12.15205 122.51813,-11.883411 122.726871,-11.786636 123.067447,-11.926411 123.440982,-12.248693 123.583804,-11.63603 125.737125,-11.334573 126.539126,-11.280707 127.440005,-11.269933 127.440005

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- -Office of Environment and Heritage, New South Wales
- -Department of Environment and Primary Industries, Victoria
- -Department of Primary Industries, Parks, Water and Environment, Tasmania
- -Department of Environment, Water and Natural Resources, South Australia
- -Department of Land and Resource Management, Northern Territory
- -Department of Environmental and Heritage Protection, Queensland
- -Department of Parks and Wildlife, Western Australia
- -Environment and Planning Directorate, ACT
- -Birdlife Australia
- -Australian Bird and Bat Banding Scheme
- -Australian National Wildlife Collection
- -Natural history museums of Australia
- -Museum Victoria
- -Australian Museum
- -South Australian Museum
- -Queensland Museum
- -Online Zoological Collections of Australian Museums
- -Queensland Herbarium
- -National Herbarium of NSW
- -Royal Botanic Gardens and National Herbarium of Victoria
- -Tasmanian Herbarium
- -State Herbarium of South Australia
- -Northern Territory Herbarium
- -Western Australian Herbarium
- -Australian National Herbarium, Canberra
- -University of New England
- -Ocean Biogeographic Information System
- -Australian Government, Department of Defence
- Forestry Corporation, NSW
- -Geoscience Australia
- -CSIRO
- -Australian Tropical Herbarium, Cairns
- -eBird Australia
- -Australian Government – Australian Antarctic Data Centre
- -Museum and Art Gallery of the Northern Territory
- -Australian Government National Environmental Science Program
- -Australian Institute of Marine Science
- -Reef Life Survey Australia
- -American Museum of Natural History
- -Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
- -Tasmanian Museum and Art Gallery, Hobart, Tasmania
- -Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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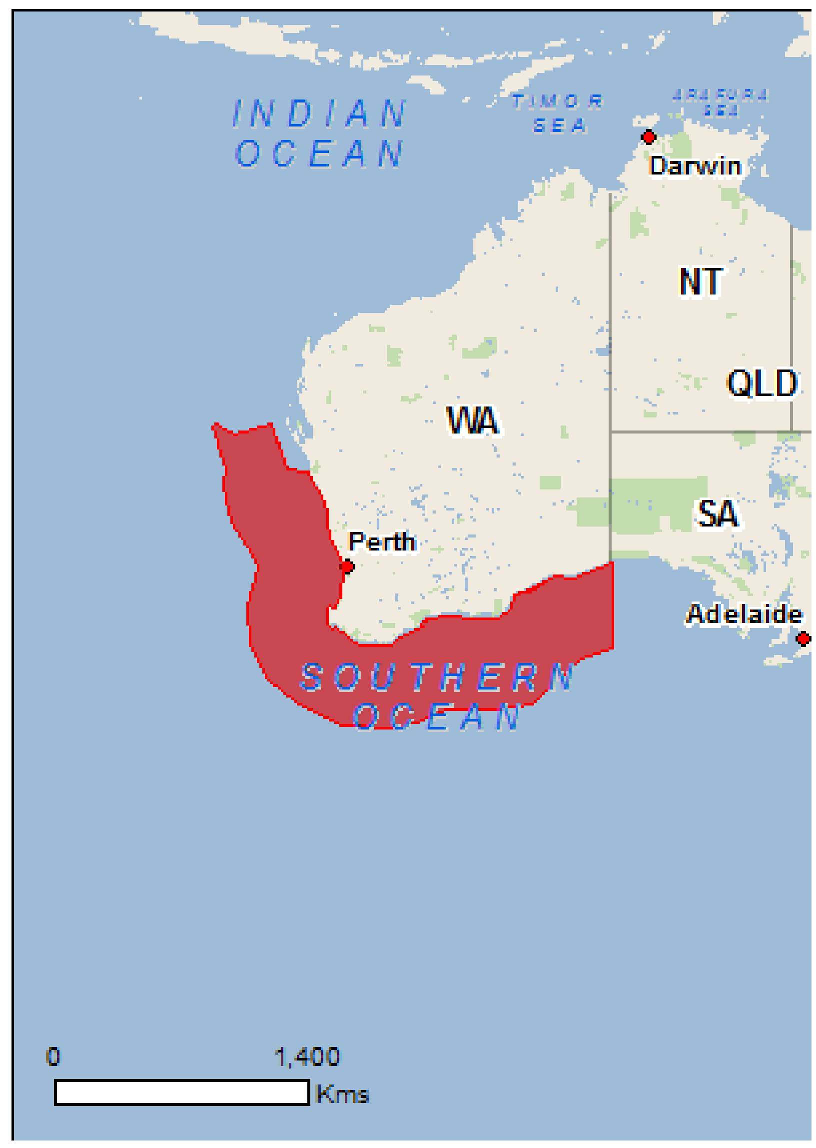
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

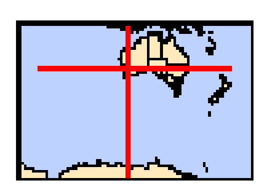
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 10/05/21 12:51:00



Coordinates

Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance:	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	65
Listed Migratory Species:	67

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	2
Commonwealth Heritage Places:	1
Listed Marine Species:	106
Whales and Other Cetaceans:	40
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	21

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	10
Regional Forest Agreements:	None
Invasive Species:	42
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	8

Details

Matters of National Environmental Significance

National Heritage Properties [Resource Information]

Name	State	Status
Indigenous		
Cheetup Rock Shelter	WA	Listed place

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Becher point wetlands	Within 10km of Ramsar
Forrestdale and thomsons lakes	Within 10km of Ramsar
Peel-yalgorup system	Within 10km of Ramsar
Vasse-wonnerup system	Within 10km of Ramsar

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
South-west

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community may occur within area
Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia	Endangered	Community may occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris_melanops		
Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Atrichornis clamosus		
Noisy Scrub-bird, Tjimiluk [654]	Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Cereopsis novaehollandiae grisea Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]	Vulnerable	Breeding known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Critically Endangered	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel	Endangered	Species or species

Name	Status	Type of Presence
[1060]		habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Pezoporus flaviventris Western Ground Parrot, Kyloring [84650]	Critically Endangered	Species or species habitat likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Breeding known to occur within area
Parantechinus apicalis Dibbler [313]	Endangered	Species or species habitat known to occur within area
Petrogale lateralis hacketti Recherche Rock-wallaby [66849]	Vulnerable	Species or species habitat known to occur within area
Potorous gilbertii Gilbert's Potoroo, Ngilkat [66642]	Critically Endangered	Translocated population known to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat may occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat known to occur within area
Plants		
Caladenia elegans Elegant Spider-orchid [56775]	Endangered	Species or species habitat may occur within area
Caladenia granitora [65292]	Endangered	Species or species habitat may occur within area
Caladenia hoffmanii Hoffman's Spider-orchid [56719]	Endangered	Species or species habitat may occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Drummondita ericoides Morseby Range Drummondita [9193]	Endangered	Species or species habitat likely to occur within area
Eucalyptus insularis Twin Peak Island Mallee [3057]	Endangered	Species or species habitat likely to occur within area
Isopogon uncinatus Albany Cone Bush, Hook-leaf Isopogon [20871]	Endangered	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Name	Status	Type of Presence
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Egernia stokesii badia		
Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat may occur within area
Liopholis pulchra longicauda		
Jurien Bay Skink, Jurien Bay Rock-skink [83162]	Vulnerable	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharias taurus (west coast population)		
Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus		
Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Breeding known to occur within area
Ardenna grisea		
Sooty Shearwater [82651]		Species or species habitat may occur within area
Ardenna pacifica		
Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Ardenna tenuirostris		
Short-tailed Shearwater [82652]		Breeding known to occur within area
Diomedea amsterdamensis		
Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis		
Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena		
Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora		
Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Diomedea exulans		
Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi		
Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel		
Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Hydroprogne caspia		
Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus		
Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli		
Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Onychoprion anaethetus		
Bridled Tern [82845]		Breeding known to occur within area
Phoebetria fusca		
Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Sterna dougallii		
Roseate Tern [817]		Breeding known to occur within area
Thalassarche carteri		
Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta		
Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma		
Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida		
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi		
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaena glacialis australis		
Southern Right Whale [75529]	Endangered*	Breeding known to occur within area
Balaenoptera bonaerensis		
Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Foraging, feeding or related behaviour known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Defence - HMAS STIRLING-ROCKINGHAM ;HMAS STIRLING - GARDEN ISLAND

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Garden Island	WA	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris alba Sanderling [875]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Cereopsis novaehollandiae grisea Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]	Vulnerable	Breeding known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area

Name	Threatened	Type of Presence
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Species or species habitat known to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Breeding known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pelagodroma marina White-faced Storm-Petrel [1016]		Breeding known to occur within area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma macroptera Great-winged Petrel [1035]		Breeding known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely

Name	Threatened	Type of Presence
		to occur within area
Puffinus assimilis Little Shearwater [59363]		Breeding known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Breeding known to occur within area
Puffinus griseus Sooty Shearwater [1024]		Species or species habitat may occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Puffinus tenuirostris Short-tailed Shearwater [1029]		Breeding known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		

Name	Threatened	Type of Presence
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus subelongatus West Australian Seahorse [66722]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Breeding known to occur within area
Reptiles		
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans

[Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within

Name	Status	Type of Presence
		area
[Hyperoodon planifrons](#) Southern Bottlenose Whale [71]		Species or species habitat may occur within area
[Kogia breviceps](#) Pygmy Sperm Whale [57]		Species or species habitat may occur within area
[Kogia simus](#) Dwarf Sperm Whale [58]		Species or species habitat may occur within area
[Lagenodelphis hosei](#) Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
[Lagenorhynchus obscurus](#) Dusky Dolphin [43]		Species or species habitat likely to occur within area
[Lissodelphis peronii](#) Southern Right Whale Dolphin [44]		Species or species habitat may occur within area
[Megaptera novaeangliae](#) Humpback Whale [38]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Mesoplodon bowdoini](#) Andrew's Beaked Whale [73]		Species or species habitat may occur within area
[Mesoplodon densirostris](#) Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
[Mesoplodon ginkgodens](#) Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area
[Mesoplodon grayi](#) Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
[Mesoplodon hectori](#) Hector's Beaked Whale [76]		Species or species habitat may occur within area
[Mesoplodon layardii](#) Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area
[Mesoplodon mirus](#) True's Beaked Whale [54]		Species or species habitat may occur within area
[Orcinus orca](#) Killer Whale, Orca [46]		Species or species habitat may occur within area
[Peponocephala electra](#) Melon-headed Whale [47]		Species or species habitat may occur within area
[Physeter macrocephalus](#) Sperm Whale [59]		Foraging, feeding or related behaviour known to occur within area
[Pseudorca crassidens](#) False Killer Whale [48]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Stenella attenuata		
Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba		
Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris		
Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis		
Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tasmacetus shepherdi		
Shepherd's Beaked Whale, Tasman Beaked Whale [55]		Species or species habitat may occur within area
Tursiops aduncus		
Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str.		
Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris		
Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Abrolhos	Habitat Protection Zone (IUCN IV)
Abrolhos	Multiple Use Zone (IUCN VI)
Abrolhos	Special Purpose Zone (IUCN VI)
Bremer	National Park Zone (IUCN II)
Bremer	Special Purpose Zone (Mining
Eastern Recherche	National Park Zone (IUCN II)
Eastern Recherche	Special Purpose Zone (IUCN VI)
Geographe	Habitat Protection Zone (IUCN IV)
Geographe	Multiple Use Zone (IUCN VI)
Geographe	National Park Zone (IUCN II)
Geographe	Special Purpose Zone (Mining
Great Australian Bight	Special Purpose Zone (Mining
Jurien	Special Purpose Zone (IUCN VI)
South-west Corner	Habitat Protection Zone (IUCN IV)
South-west Corner	Multiple Use Zone (IUCN VI)
South-west Corner	National Park Zone (IUCN II)
South-west Corner	Special Purpose Zone (IUCN VI)
South-west Corner	Special Purpose Zone (Mining
Twilight	National Park Zone (IUCN II)
Twilight	Special Purpose Zone (Mining
Two Rocks	Multiple Use Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Bald Island	WA
Boullanger, Whitlock, Favourite, Tern And Osprey Islands	WA
Eclipse Island	WA
Escape Island	WA
Flinders Bay	WA
Penguin Island	WA
Recherche Archipelago	WA
St Alouarn Island	WA
Unnamed WA44682	WA
Unnamed WA48968	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 90-120m depth	South-west
Commonwealth marine environment surrounding	South-west
Commonwealth marine environment within and	South-west
Commonwealth marine environment within and	South-west
Diamantina Fracture Zone	South-west
Naturaliste Plateau	South-west
Western demersal slope and associated fish	South-west
Western rock lobster	South-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-25.765206 109.237891,-25.725623 109.501563,-25.992551 109.732276,-25.992551 109.875098,-26.071525 110.182716,-26.229314 110.325538,-25.656321 112.127296,-27.717513 112.984229,-27.814726 114.02793,-28.202708 114.159766,-28.483117 114.445411,-28.695347 114.577247,-28.974447 114.599219,-29.147305 114.818946,-29.530391 114.950782,-29.921554 114.89585,-30.746498 115.082618,-31.517621 115.533057,-31.863505 115.730811,-32.523601 115.67588,-32.634692 115.544044,-33.16049 115.620948,-33.619137 115.302344,-33.49096 114.994727,-33.737988 114.928809,-34.275319 114.972755,-34.46575 115.126563,-34.366055 115.269385,-34.818257 115.917579,-34.908402 116.060401,-35.106373 116.598731,-35.11536 117.389747,-35.169263 117.774268,-35.169263 118.081885,-34.980447 118.312598,-34.402321 119.663917,-34.30255 119.56504,-34.029844 119.883643,-33.938746 120.960303,-33.911398 121.399757,-34.011632 121.949073,-34.102652 122.476417,-34.038948 123.432227,-33.591687 124.091407,-33.10529 124.212257,-32.902593 125.014258,-32.319576 126.134864,-32.375265 127.123633,-31.760809 129.035255,-35.294897 129.068214,-35.634921 127.541114,-37.453004 125.157081,-37.696807 123.058692,-37.688114 120.817481,-38.46644 118.664161,-38.337294 115.697852,-37.418109 113.368751,-36.584603 112.028419,-34.998448 111.061622,-33.545916 110.973731,-31.984725 111.512061,-31.414542 111.270362,-30.026241 110.182716,-28.396173 109.798194,-27.756409 109.875098,-25.765206 109.237891,-25.765206 109.237891

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- -Office of Environment and Heritage, New South Wales
- -Department of Environment and Primary Industries, Victoria
- -Department of Primary Industries, Parks, Water and Environment, Tasmania
- -Department of Environment, Water and Natural Resources, South Australia
- -Department of Land and Resource Management, Northern Territory
- -Department of Environmental and Heritage Protection, Queensland
- -Department of Parks and Wildlife, Western Australia
- -Environment and Planning Directorate, ACT
- -Birdlife Australia
- -Australian Bird and Bat Banding Scheme
- -Australian National Wildlife Collection
- -Natural history museums of Australia
- -Museum Victoria
- -Australian Museum
- -South Australian Museum
- -Queensland Museum
- -Online Zoological Collections of Australian Museums
- -Queensland Herbarium
- -National Herbarium of NSW
- -Royal Botanic Gardens and National Herbarium of Victoria
- -Tasmanian Herbarium
- -State Herbarium of South Australia
- -Northern Territory Herbarium
- -Western Australian Herbarium
- -Australian National Herbarium, Canberra
- -University of New England
- -Ocean Biogeographic Information System
- -Australian Government, Department of Defence
- Forestry Corporation, NSW
- -Geoscience Australia
- -CSIRO
- -Australian Tropical Herbarium, Cairns
- -eBird Australia
- -Australian Government – Australian Antarctic Data Centre
- -Museum and Art Gallery of the Northern Territory
- -Australian Government National Environmental Science Program
- -Australian Institute of Marine Science
- -Reef Life Survey Australia
- -American Museum of Natural History
- -Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
- -Tasmanian Museum and Art Gallery, Hobart, Tasmania
- -Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX B. SUPPORTING FIGURES FOR SECTION 2.3 METEOROLOGY AND OCEANOGRAPHY

Browse

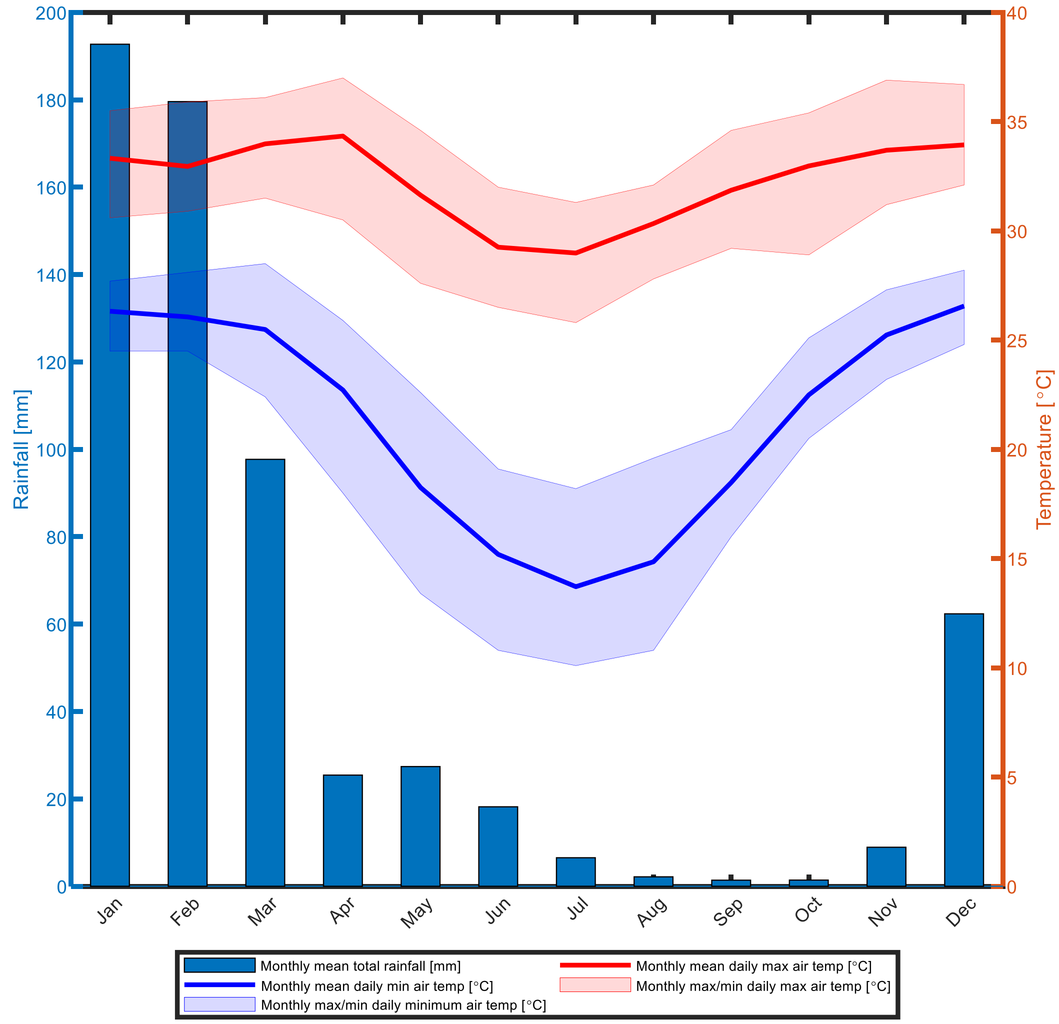
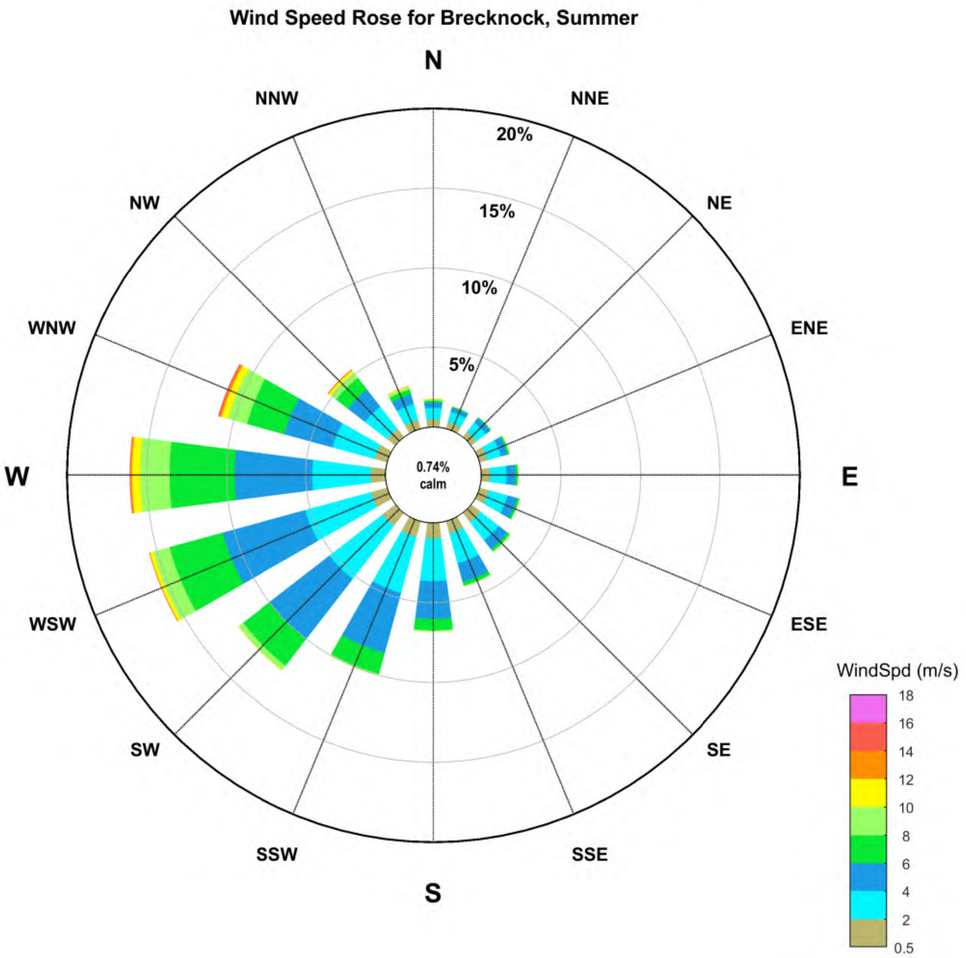


Figure 1. Monthly average total rainfall [mm] and air temperature [°C], calculated based on observations at the Broome Airport weather station from 1939-2020 (Bureau of Meteorology 2020). Bars show the monthly average total rainfall values, and thick blue and red lines denote monthly average daily minimum and maximum air temperatures, respectively. Shaded blue and red areas denote monthly recorded extremes of daily minimum and maximum air temperature, respectively.

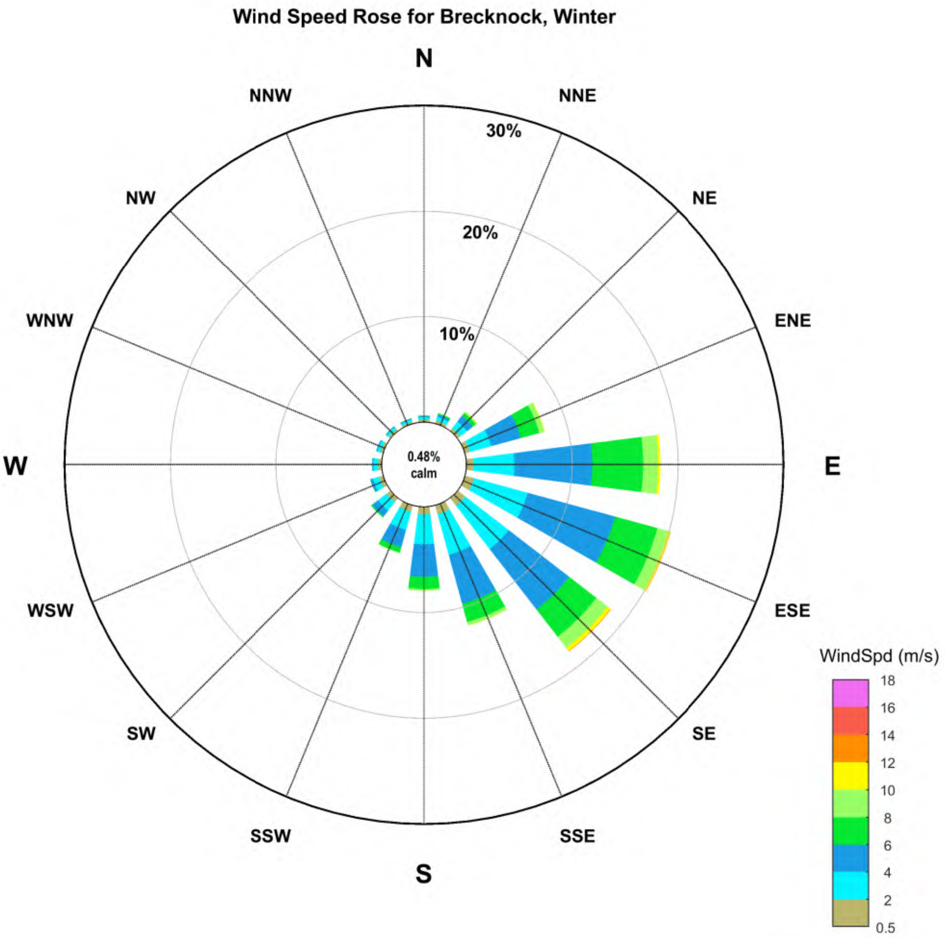


Data Information:
Project: Browse
Location: Brecknock [121.6500°E, 14.5300°S]
Data Period: Summer (01-Jan-1979 to 01-Jan-2019)
Data Source: Modelled Hindcast
Record Elevation: 10 m AMSL
Local Water Depth (m): 560
Data Summary: Summer
Number of Records: 164812
Missing Data (%): 5.80
Calm (% < 0.50m/s): 0.74
Measurement Format: 10-minute avg.

Key Statistics for Data Shown:
Max Wind Speed: 20.60 m/s
Mean Wind Speed: 4.55 m/s
StdDev. Wind Speed: 2.31 m/s

Woodside

Figure 2. Summer distributions of 10-minute average wind speeds by 22.5° directional sectors at the Brecknock site (Metocean Solutions Ltd, 2019). Note tropical cyclone events were not included in this distribution. Winds at Brecknock in summer are predominantly from the WNW to SW due to the North West Monsoon (WEL, 2019).



Data Information:	**Key Statistics for Data Shown:**
Project: Browse	Max Wind Speed: 14.34 m/s
Location: Brecknock [121.6500°E, 14.5300°S]	Mean Wind Speed: 4.71 m/s
Data Period: Winter (01-Apr-1979 to 30-Sep-2018)	StdDev. Wind Speed: 2.01 m/s
Data Source: Modelled Hindcast	
Record Elevation: 10 m AMSL	
Local Water Depth (m): 560	
Data Summary: Winter	
Number of Records: 173751	
Missing Data (%): 1.10	
Calm (% < 0.50m/s): 0.48	
Measurement Format: 10-minute avg.	

Figure 3. Winter distributions of 10-minute average wind speeds by 22.5° directional sectors at the Brecknock site (Metocean Solutions Ltd, 2019). Note tropical cyclone events were not included in this distribution. Winds at Brecknock in winter are predominantly from the E to SE due to the South East Trade Winds coming from the Australian mainland (WEL, 2019).

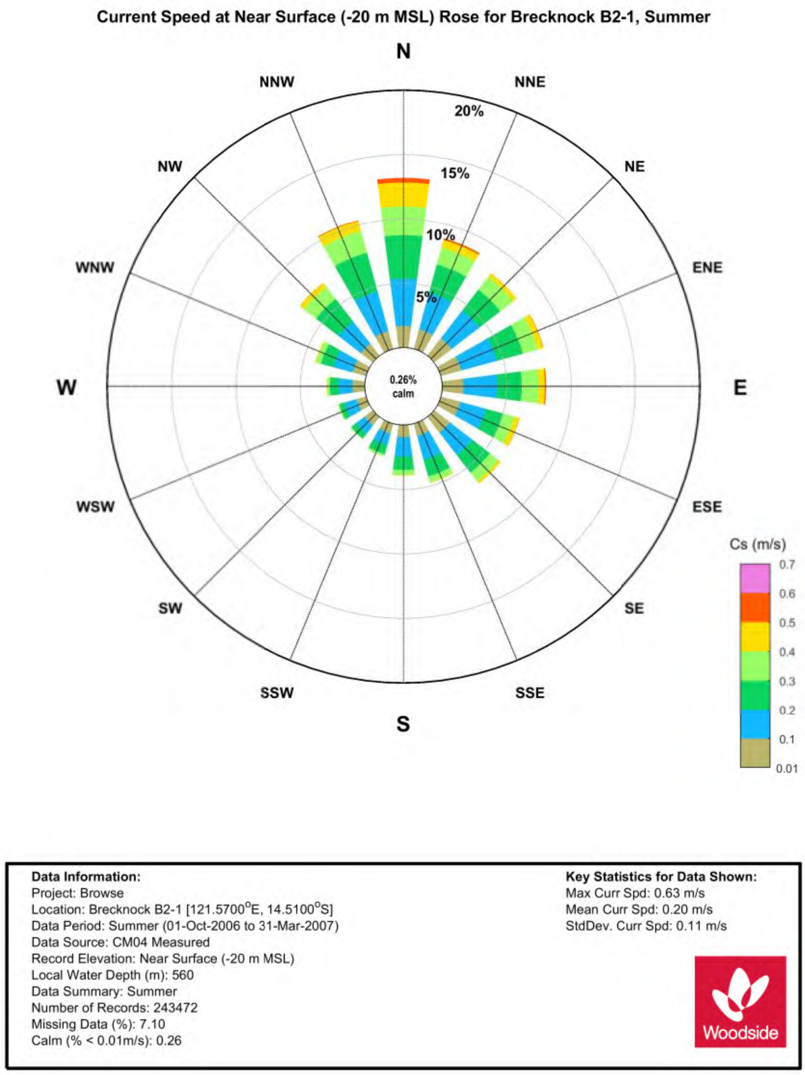


Figure 4. Summer (Nov-Apr) near surface combined frequency of 1-minute mean current speed and direction (towards) measured at Brecknock B2-1 location (cyclones removed) (RPS Metocean Ltd. 2008).

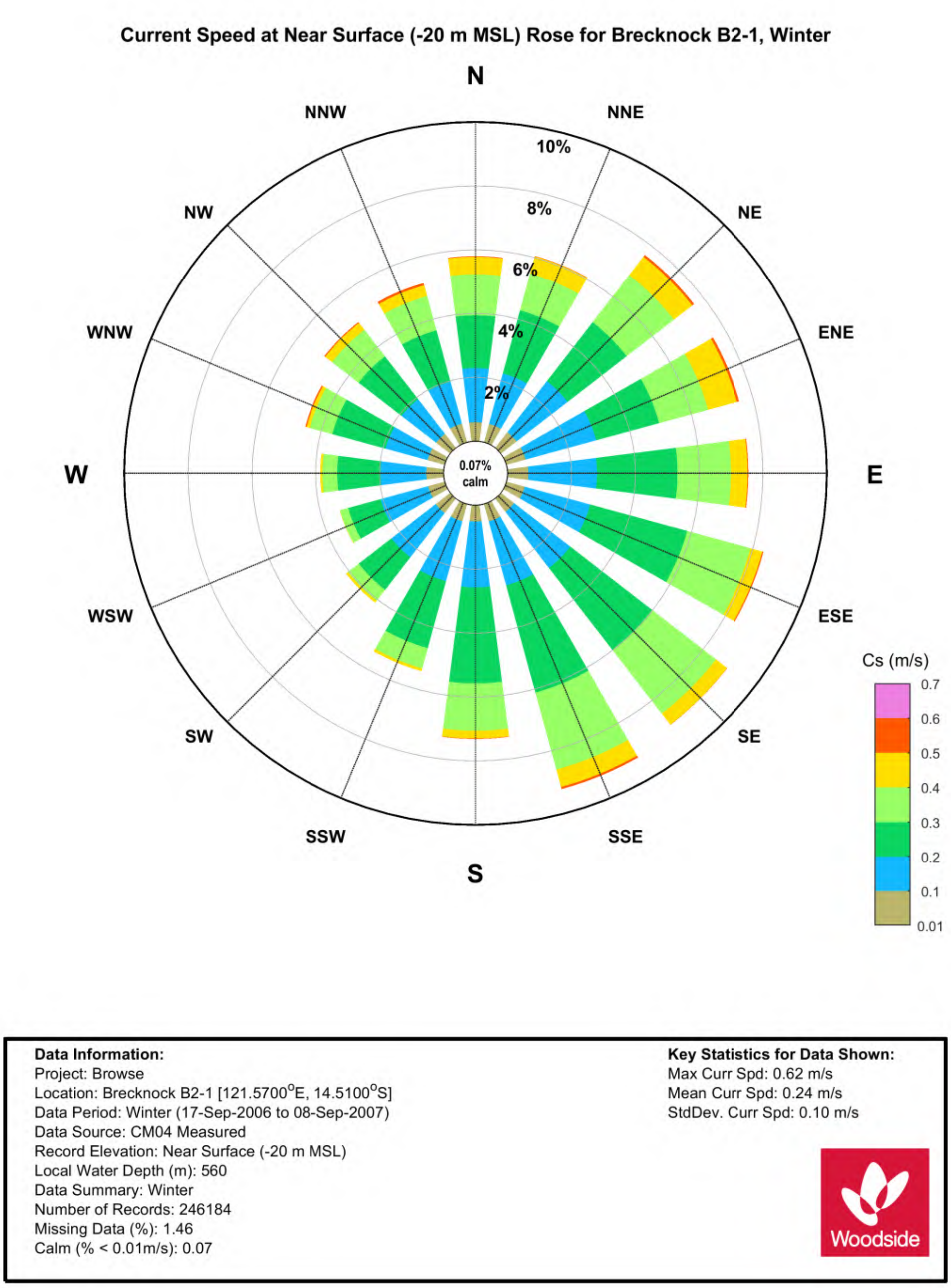


Figure 5. Winter (May-Sep) near surface combined frequency of 1-minute mean current speed and direction (towards) measured at Brecknock B2-1 location (cyclones removed) (RPS Metocean Ltd. 2008).

North-west Shelf/Scarborough

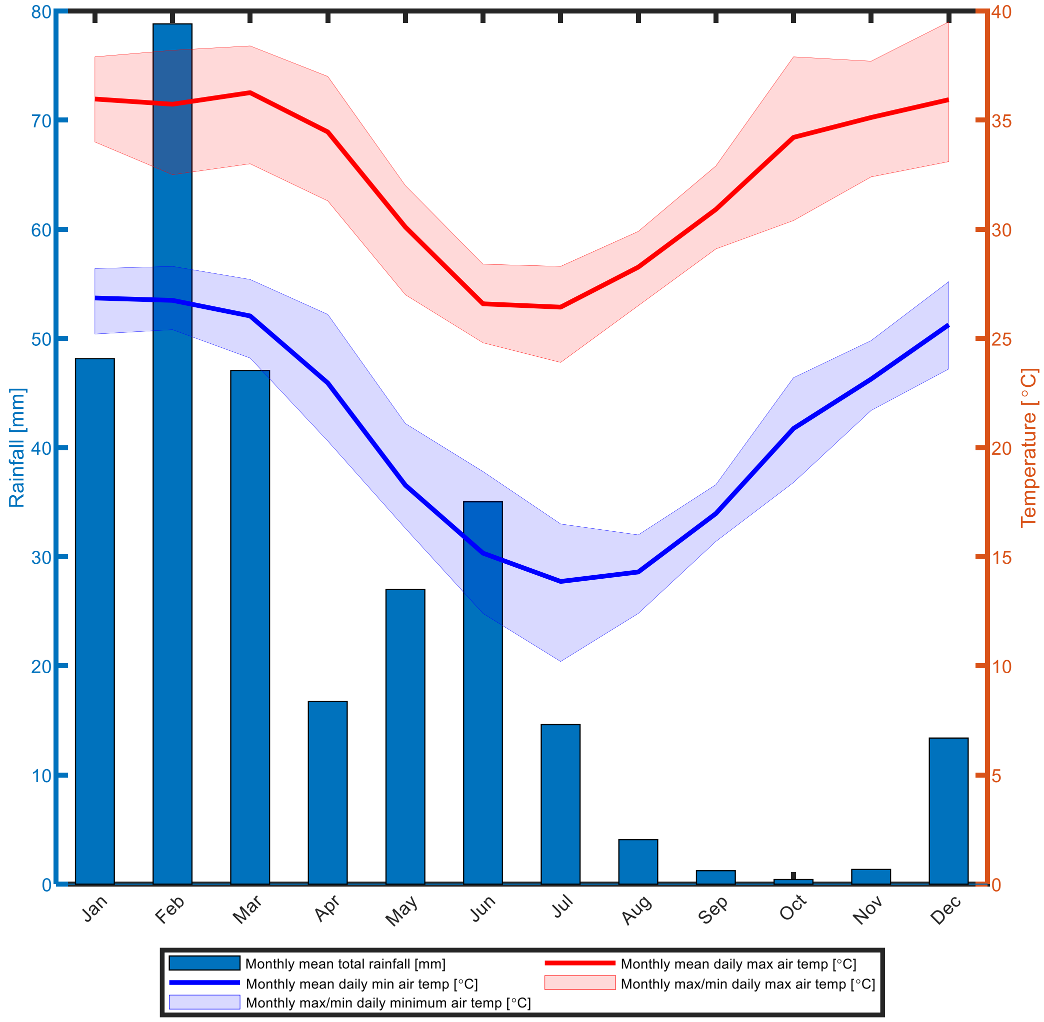
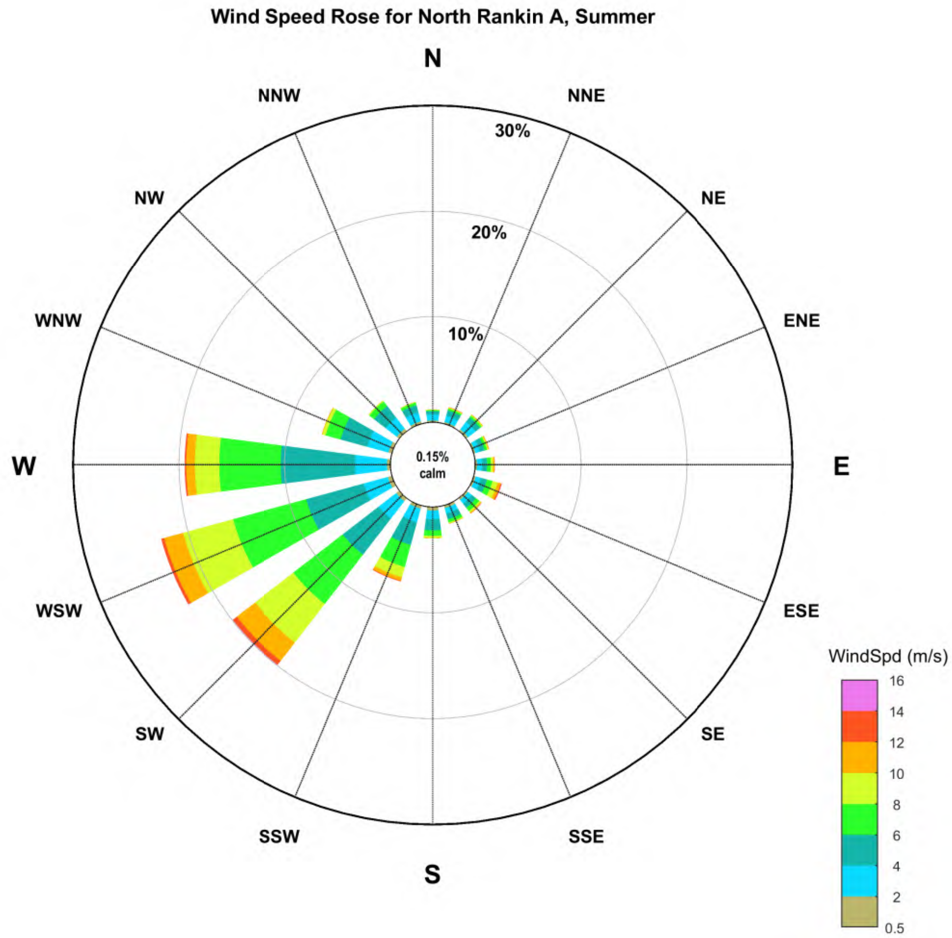


Figure 1. Monthly average total rainfall [mm] and air temperature [°C], calculated based on observations at the Karratha Aero weather station from 1972-2020 and 1993-2020 respectively (Bureau of Meteorology 2020). Bars show the monthly average total rainfall values, and thick blue and red lines denote monthly average daily minimum and maximum air temperatures, respectively. Shaded blue and red areas denote monthly recorded extremes of daily minimum and maximum air temperature, respectively.



Data Information:
Project: North West Shelf
Location: North Rankin A [116.1200°E, 19.6100°S]
Data Period: Summer (01-Oct-1995 to 30-Nov-2015)
Data Source: Measured Winds
Record Elevation: 10 m AMSL
Local Water Depth (m): 125
Data Summary: Summer
Number of Records: 674659
Missing Data (%): 7.24
Calm (% < 0.50m/s): 0.15
Measurement Format: 10-minute avg.

Key Statistics for Data Shown:
Max Wind Speed: 18.50 m/s
Mean Wind Speed: 6.04 m/s
StdDev. Wind Speed: 2.55 m/s

Figure 2. Summer distributions of 10-minute average wind speeds by 22.5° directional sectors at the North Rankin A site (WEL, 2015). Note tropical cyclone events were not included in this distribution. Winds at North Rankin A in summer are characterised by W to SW driven by the North West Monsoon (RPS, 2016).

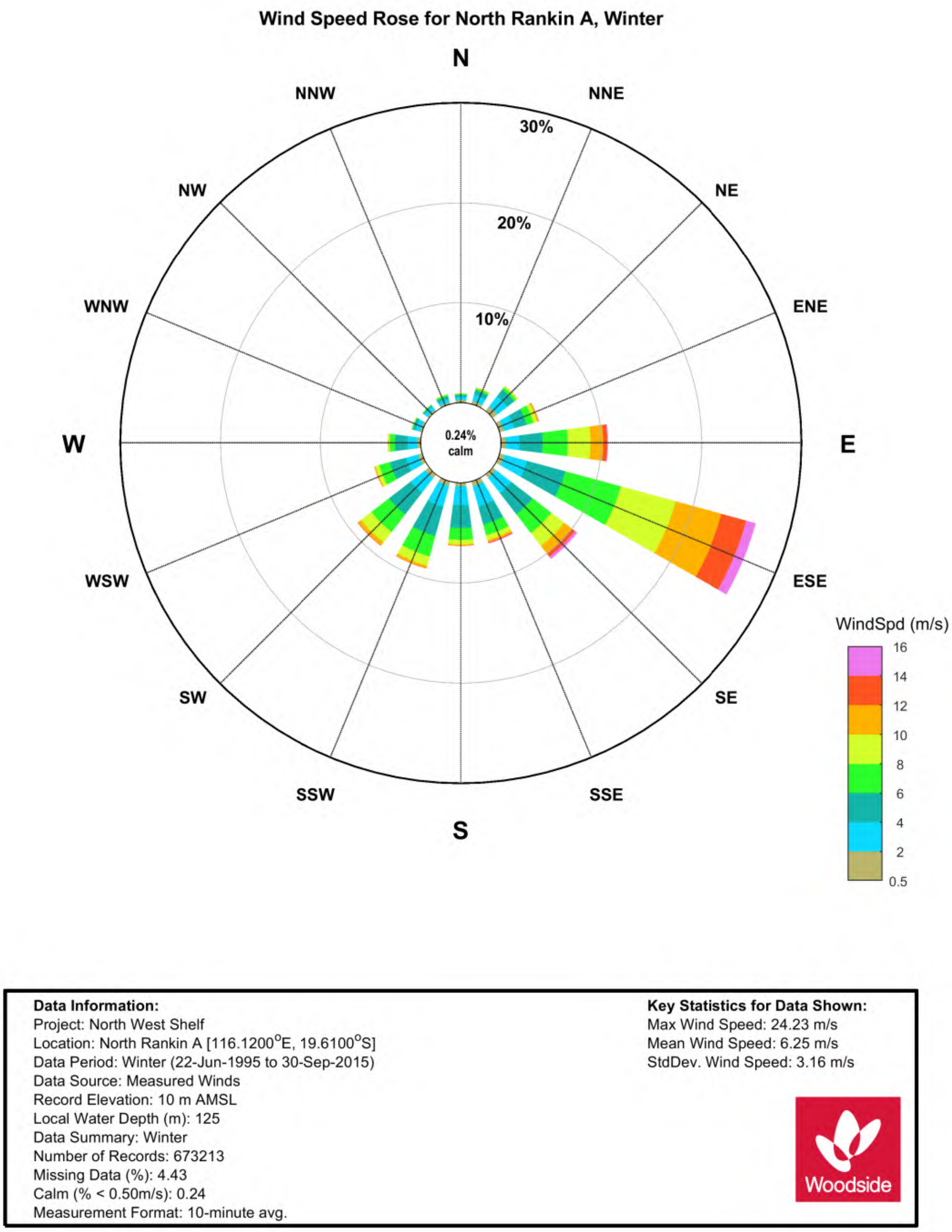
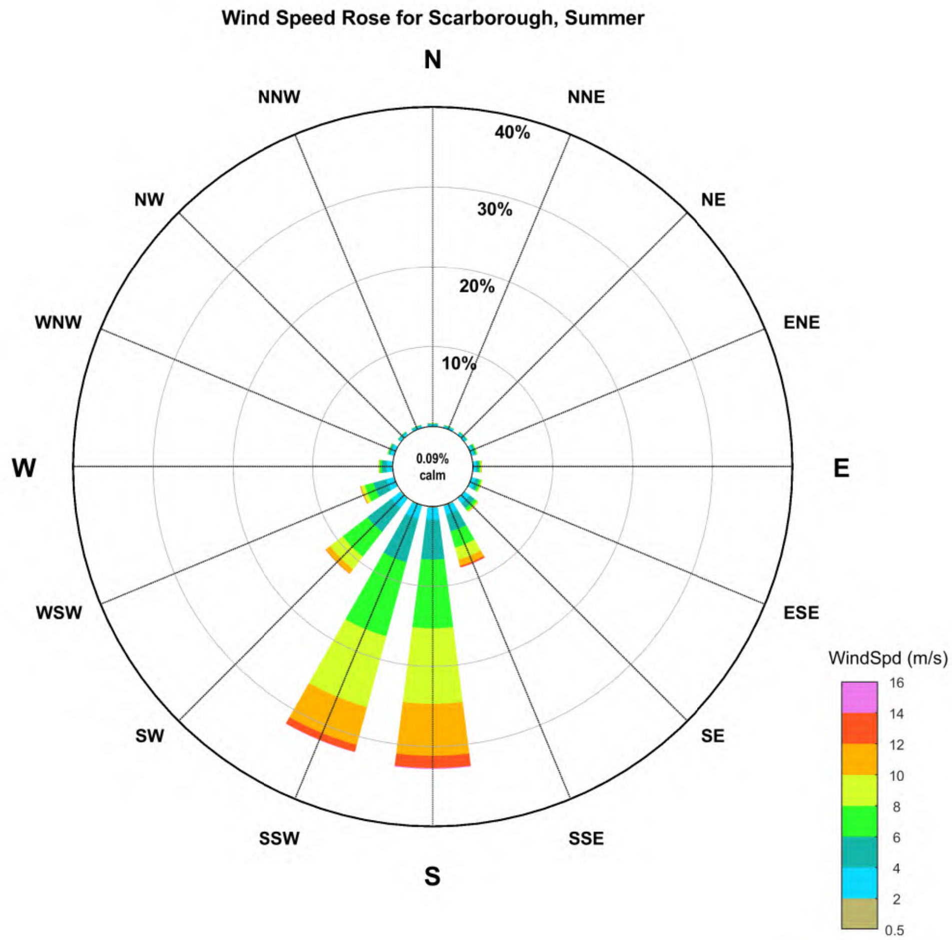


Figure 3. Winter distributions of 10-minute average wind speeds by 22.5° directional sectors at the North Rankin A site (WEL, 2015). Note tropical cyclone events were not included in this distribution. Winds at North Rankin in winter are predominantly influenced by the South East Trade Winds over Australia (RPS, 2016).

Scarborough



Data Information:
Project: North West Shelf
Location: Scarborough [113.2000°E, 19.8800°S]
Data Period: Summer (01-Jan-1979 to 01-Jan-2011)
Data Source: CSFR
Record Elevation: 10 m AMSL
Local Water Depth (m): 950
Data Summary: Summer
Number of Records: 129521
Missing Data (%): 7.46
Calm (% < 0.50m/s): 0.09
Measurement Format: 10-minute avg.

Key Statistics for Data Shown:
Max Wind Speed: 16.75 m/s
Mean Wind Speed: 7.23 m/s
StdDev. Wind Speed: 2.64 m/s

Woodside

Figure 4. Summer distributions of wind speeds (10-minute at 10m ASL) by 22.5° directional sectors at the Scarborough site (WEL, 2018). Note tropical cyclone events were not included in this distribution. Winds at Scarborough in summer are predominantly from the S to SSW due to a Pilbara Heat Low forming over the northwest coast of Western Australia [R8] SW winds are also experienced at this site due to the monsoon trough.

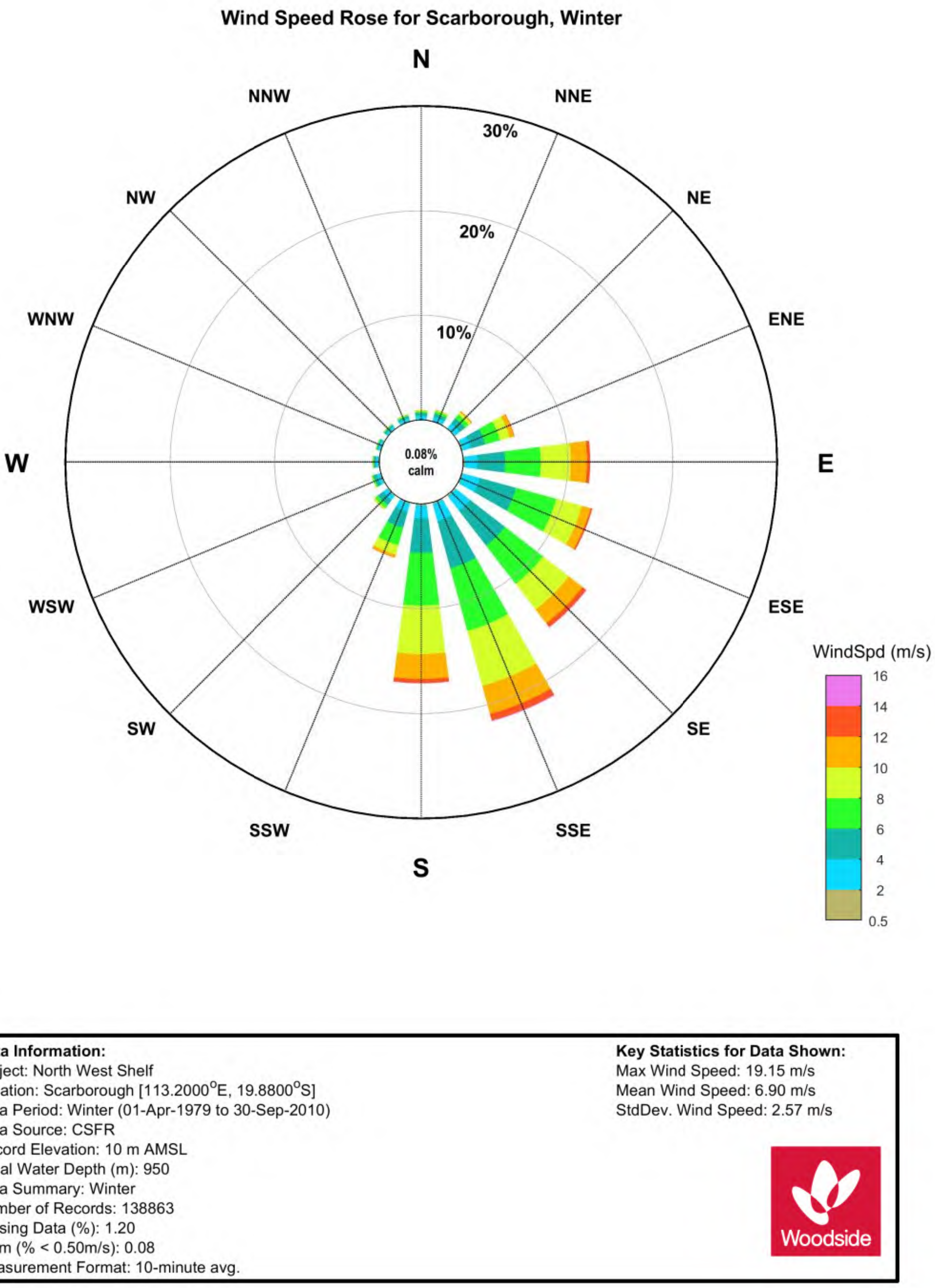
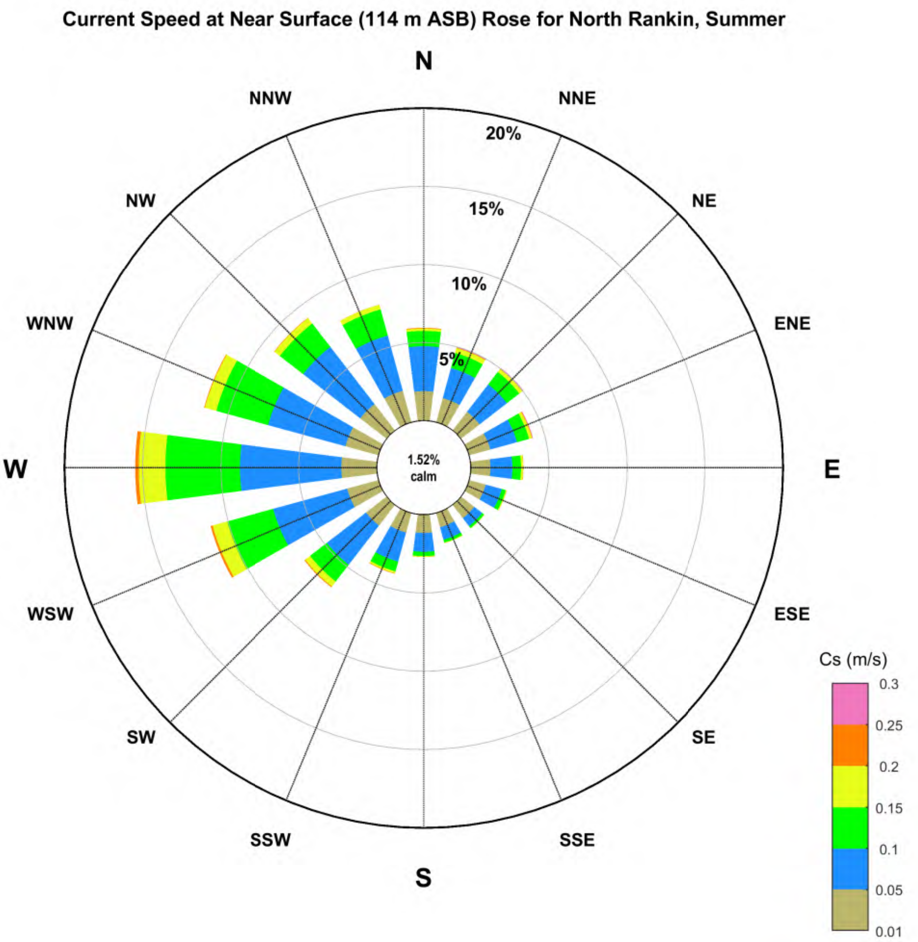


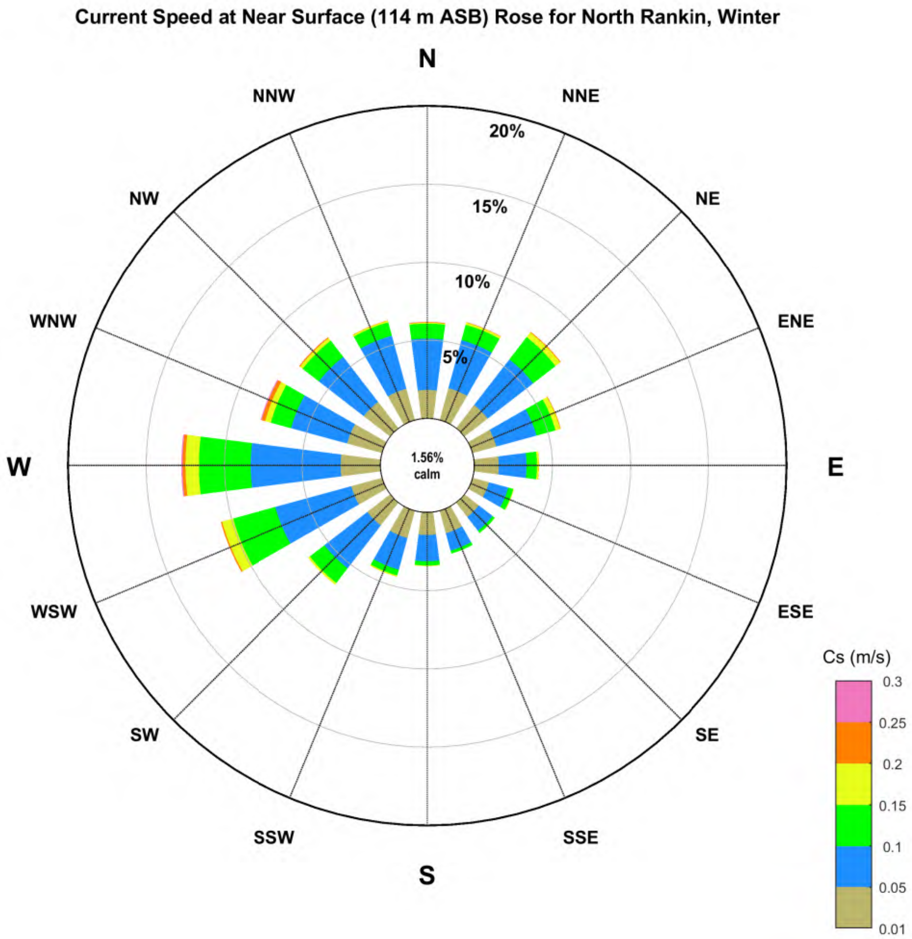
Figure 5. Winter distributions of wind speeds (10-minute at 10 m ASL) by 22.5° directional sectors at the Scarborough site (WEL, 2018). Note tropical cyclone events were not included in this distribution. Winds at Scarborough in winter are predominantly from the S to E driven by the South East Trade Winds over Australia (RPS, 2016).

North-west Shelf



Data Information: Project: North West Shelf Location: North Rankin [116.1400°E, 19.5800°S] Data Period: Summer (01-Oct-2004 to 31-Mar-2009) Data Source: Measured Data Record Elevation: Near Surface (114 m ASB) Local Water Depth (m): 124.5 Data Summary: Summer Number of Records: 496705 Missing Data (%): 6.63 Calm (% < 0.01m/s): 1.52	**Key Statistics for Data Shown:** Max Curr Spd: 0.49 m/s Mean Curr Spd: 0.08 m/s StdDev. Curr Spd: 0.04 m/s Woodside

Figure 6. Summer (Nov-Apr) near surface combined frequency of 1-minute mean current speed and direction (towards) measured at the North Rankin location (cyclones removed) (WEL, 2011).

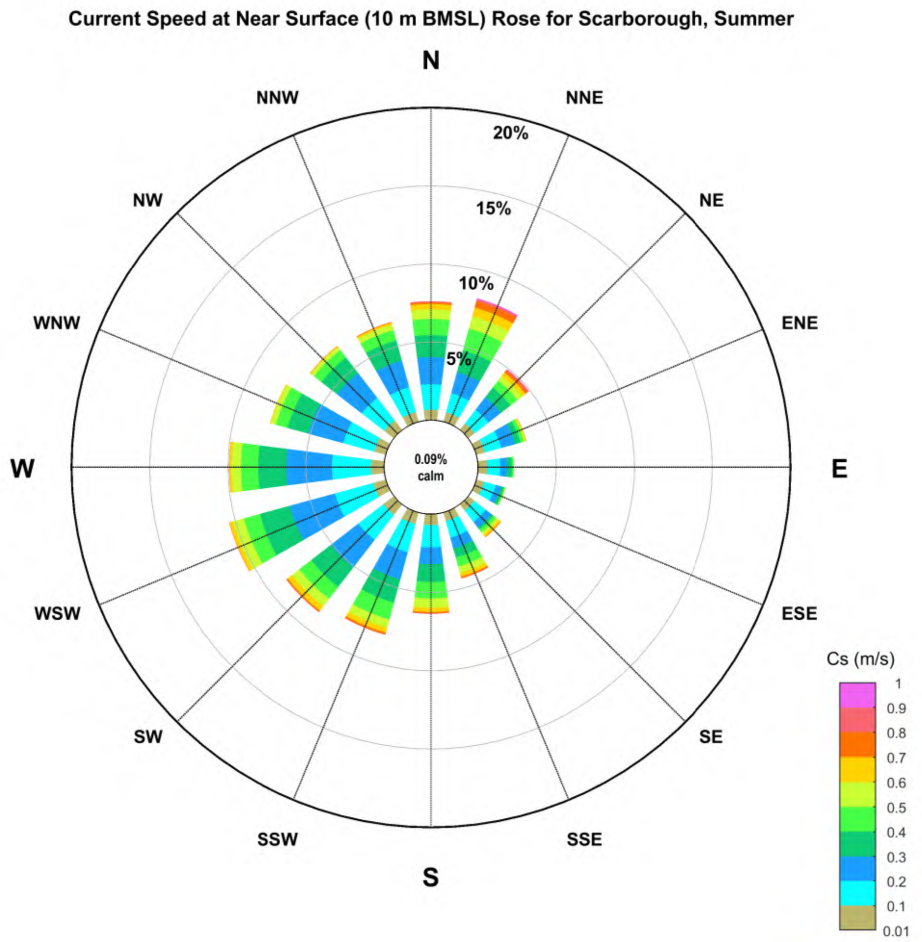


Data Information:
Project: North West Shelf
Location: North Rankin [116.1400°E, 19.5800°S]
Data Period: Winter (21-Sep-2004 to 08-May-2009)
Data Source: Measured Data
Record Elevation: Near Surface (114 m ASB)
Local Water Depth (m): 124.5
Data Summary: Winter
Number of Records: 337723
Missing Data (%): 0.88
Calm (% < 0.01m/s): 1.56

Key Statistics for Data Shown:
Max Curr Spd: 0.32 m/s
Mean Curr Spd: 0.07 m/s
StdDev. Curr Spd: 0.04 m/s

Figure 7. Winter (May-Sep) near surface combined frequency of 1-minute mean current speed and direction (towards) measured at the North Rankin location (cyclones removed) (WEL, 2011).

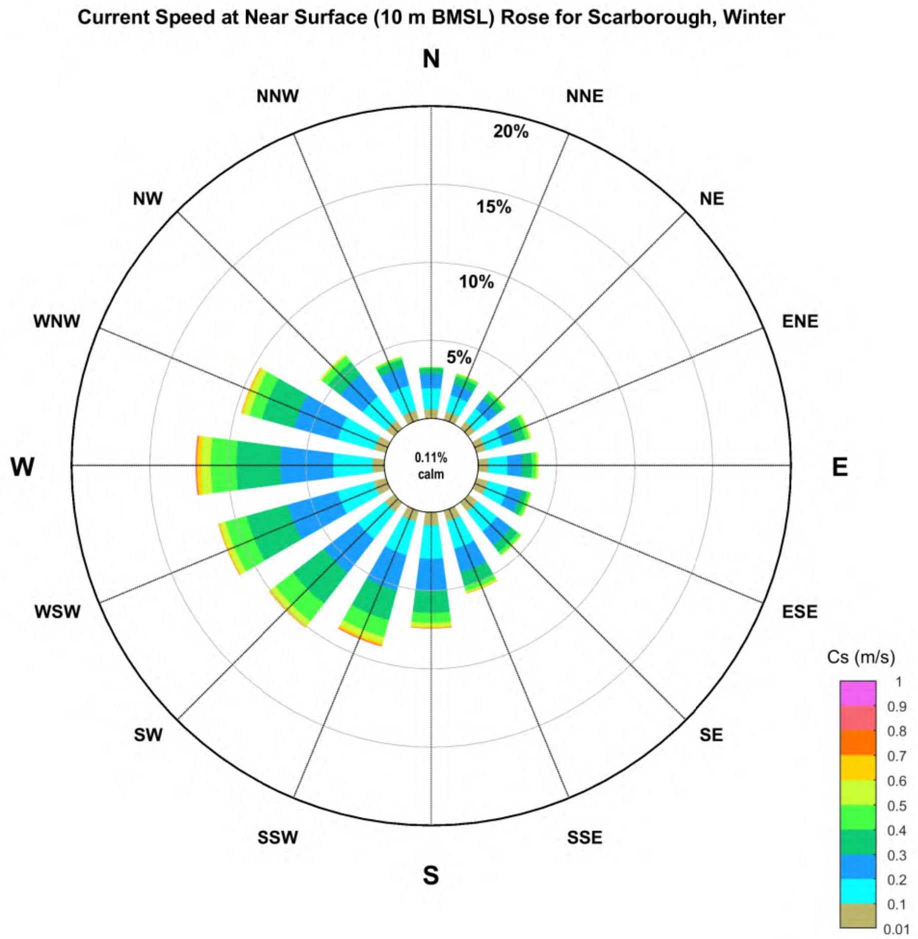
Scarborough



Data Information:
Project: North West Shelf
Location: Scarborough [113.2000°E, 19.8800°S]
Data Period: Summer (15-Jan-2010 to 29-Feb-2012)
Data Source: Measured Data
Record Elevation: Near Surface (10 m BMSL)
Local Water Depth (m): 950
Data Summary: Summer
Number of Records: 43600
Missing Data (%): 7.11
Calm (% < 0.01m/s): 0.09

Key Statistics for Data Shown:
Max Curr Spd: 1.03 m/s
Mean Curr Spd: 0.29 m/s
StdDev. Curr Spd: 0.17 m/s

Figure 8. Summer (Nov - April) near surface combined frequency of 1-minute mean current speed and direction (towards) measured at the Scarborough location (cyclones removed) (WEL, 2018).



Data Information:
Project: North West Shelf
Location: Scarborough [113.2000°E, 19.8800°S]
Data Period: Winter (01-Apr-2010 to 30-Sep-2011)
Data Source: Measured Data
Record Elevation: Near Surface (10 m BMSL)
Local Water Depth (m): 950
Data Summary: Winter
Number of Records: 49345
Missing Data (%): 3.01
Calm (% < 0.01m/s): 0.11

Key Statistics for Data Shown:
Max Curr Spd: 1.03 m/s
Mean Curr Spd: 0.25 m/s
StdDev. Curr Spd: 0.13 m/s

Woodside

Figure 9. Winter (May-Sep) near surface combined frequency of 1-min mean current speed and direction (towards) measured at the Scarborough location (cyclones removed) (WEL, 2018).

North-west Cape

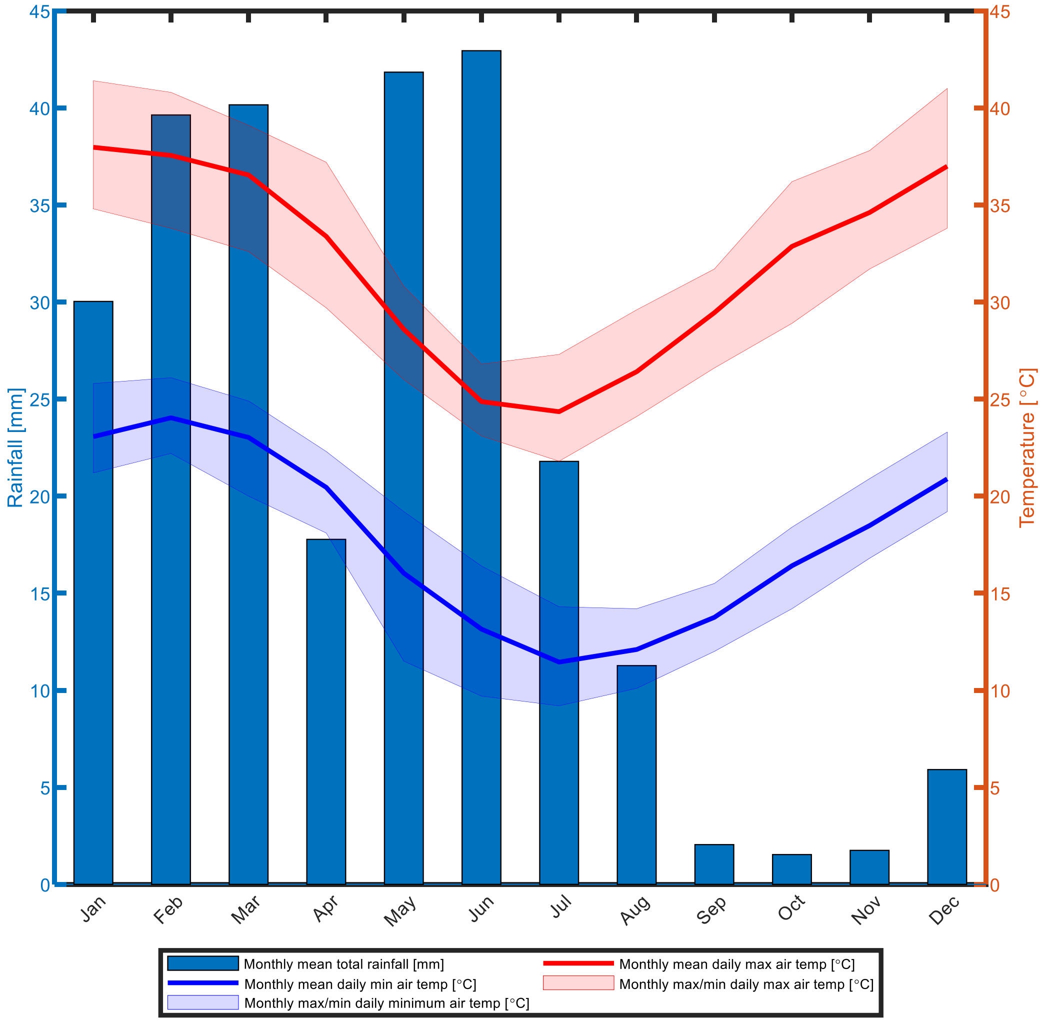
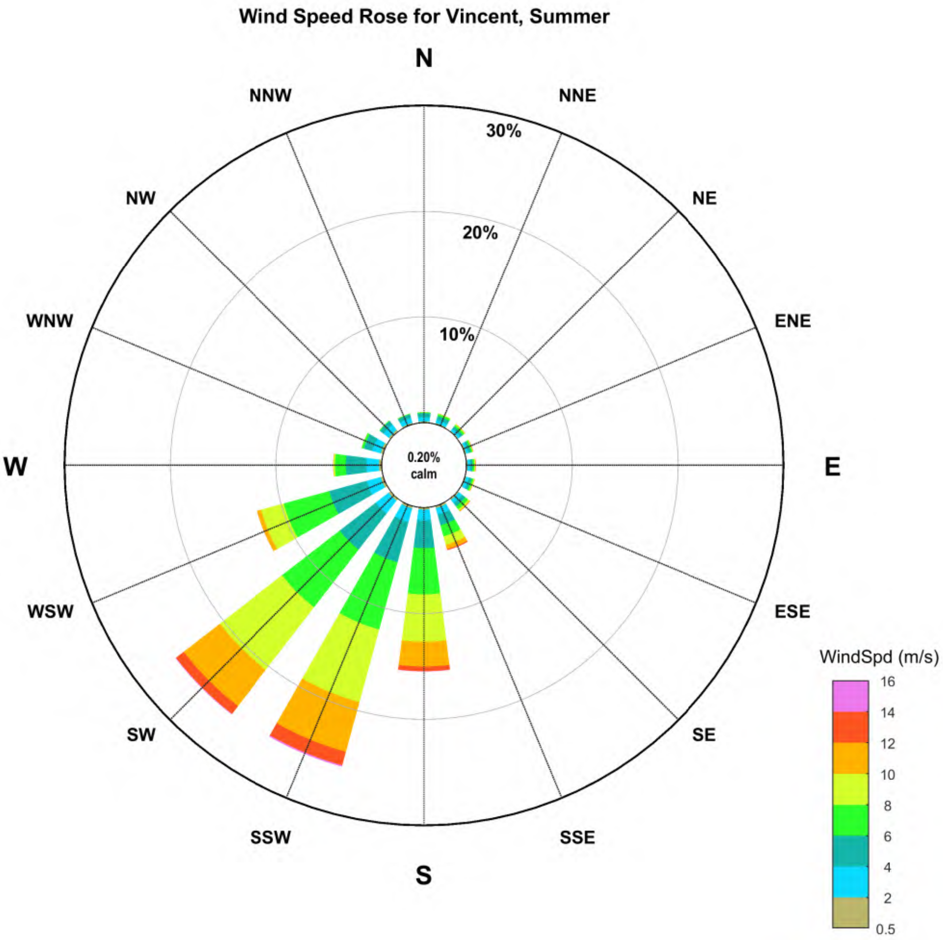


Figure 1. Monthly average total rainfall [mm] and air temperature [°C], calculated based on observations at the Learmonth Airport weather station from 1945-2020 and 1975-2020 respectively (Bureau of Meteorology 2020). Bars show the monthly average total rainfall values, and thick blue and red lines denote monthly average daily minimum and maximum air temperatures, respectively. Shaded blue and red areas denote monthly recorded extremes of daily minimum and maximum air temperature, respectively.

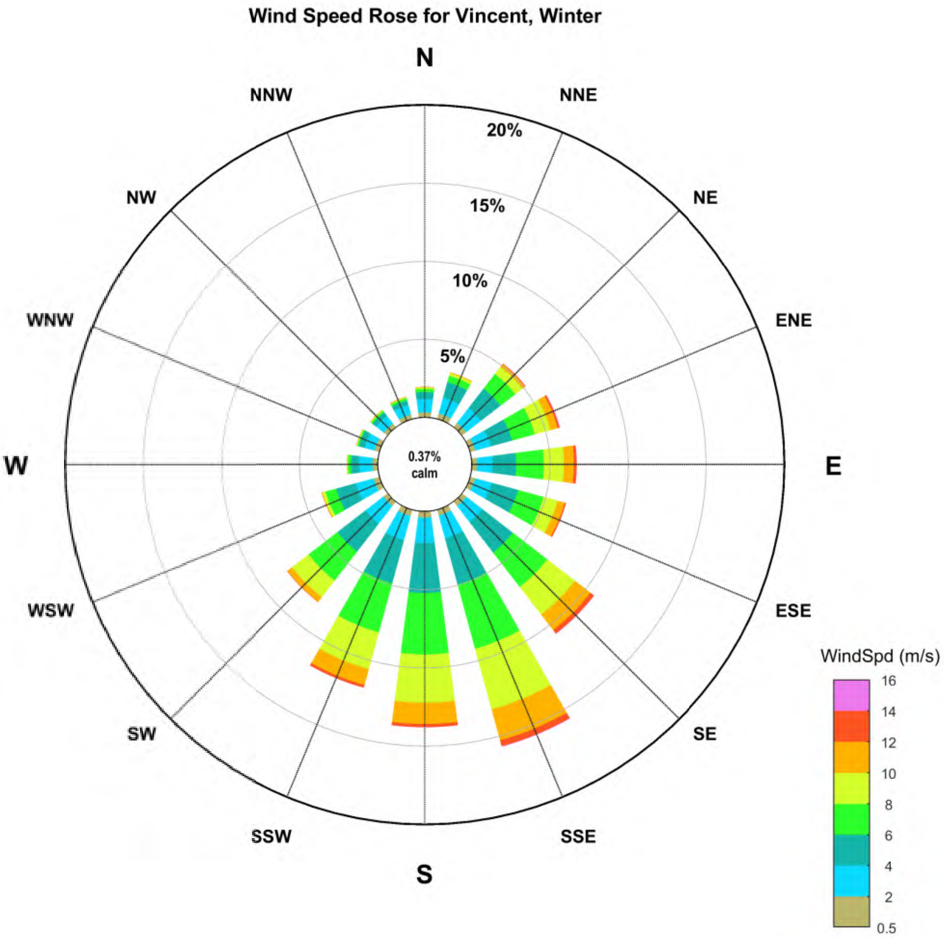


Data Information:
Project: North West Cape
Location: Vincent [114.0600°E, 21.4400°S]
Data Period: Summer (01-Jan-1979 to 01-Jan-2019)
Data Source: Modelled Hindcast
Record Elevation: 10 m AMSL
Local Water Depth (m): 350
Data Summary: Summer
Number of Records: 159379
Missing Data (%): 8.91
Calm (% < 0.50m/s): 0.20
Measurement Format: 10-minute avg.

Key Statistics for Data Shown:
Max Wind Speed: 18.86 m/s
Mean Wind Speed: 7.10 m/s
StdDev. Wind Speed: 2.75 m/s

Woodside

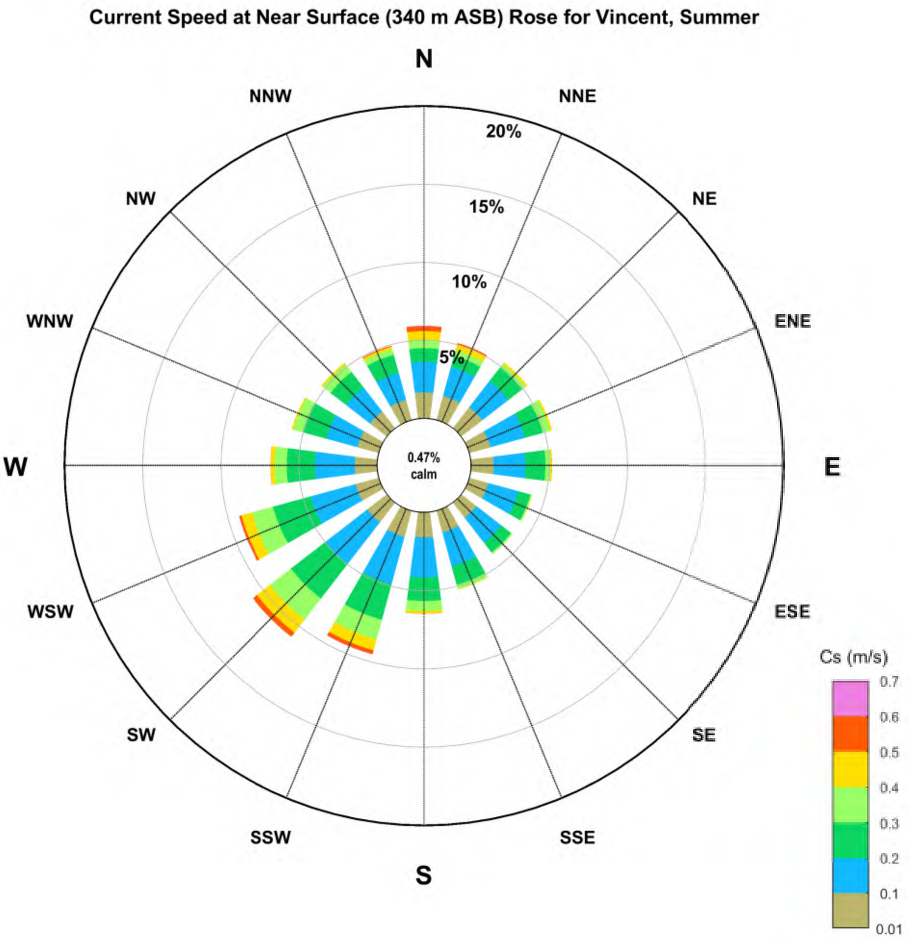
Figure 2. Summer distributions of wind speeds (10-minute at 10 m ASL) by 22.5° directional sectors at the Vincent site (Vincent Metocean). Note tropical cyclone events were not included in this distribution. Winds at Vincent in summer are predominantly from the SW to SSW in summer due to the presence of the Pilbara Heat Low (MetOcean Engineers, 2005).



Data Information:
Project: North West Cape
Location: Vincent [114.0600°E, 21.4400°S]
Data Period: Winter (01-Apr-1979 to 30-Sep-2018)
Data Source: Modelled Hindcast
Record Elevation: 10 m AMSL
Local Water Depth (m): 350
Data Summary: Winter
Number of Records: 173626
Missing Data (%): 1.17
Calm (% < 0.50m/s): 0.37
Measurement Format: 10-minute avg.

Key Statistics for Data Shown:
Max Wind Speed: 19.39 m/s
Mean Wind Speed: 6.23 m/s
StdDev. Wind Speed: 2.78 m/s

Figure 3. Winter distributions of wind speeds (10-minute at 10 m ASL) 22.5° directional sectors at the Vincent site (Vincent Metocean). Note tropical cyclone events were not included in this distribution. In winter, winds at are predominantly from the S to SE, associated with the South East Trades. Easterly gales are experienced at the Vincent location due to high pressure systems generating from the Great Australian Bight area to the site (MetOcean Engineers, 2005).

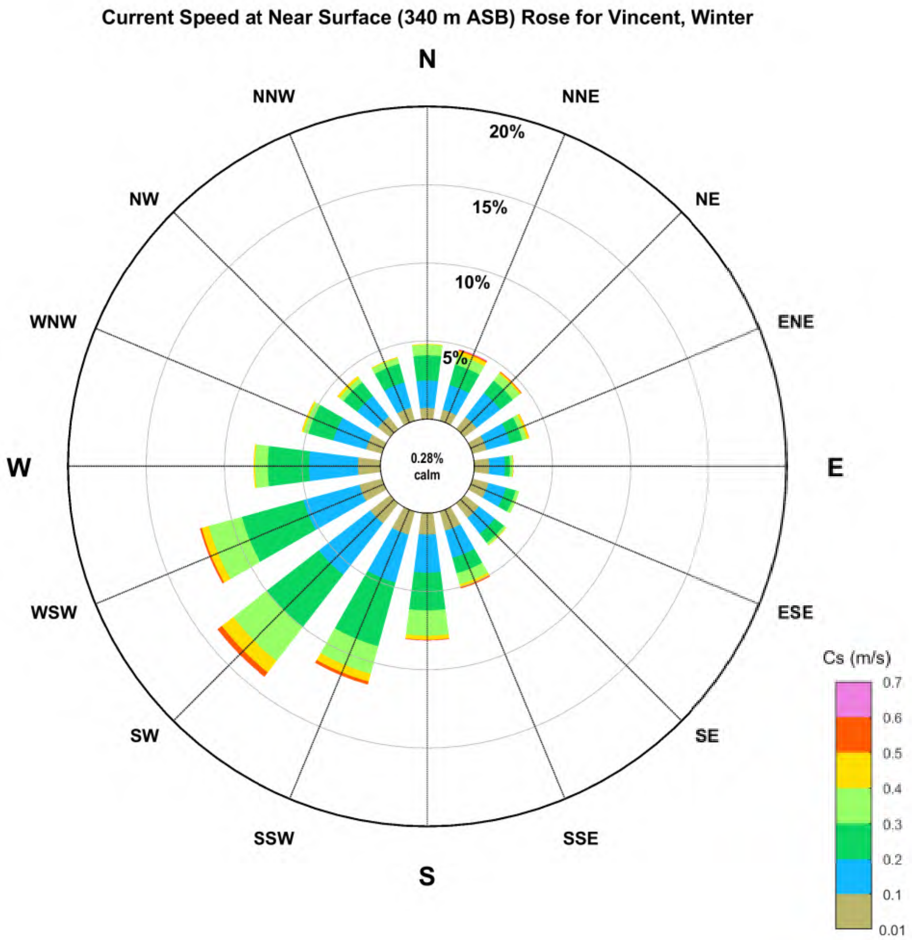


Data Information:
Project: North West Cape
Location: Vincent [114.0600°E, 21.4400°S]
Data Period: Summer (21-Nov-2000 to 13-Dec-2001)
Data Source: Measured Data
Record Elevation: Near Surface (340 m ASB)
Local Water Depth (m): 350
Data Summary: Summer
Number of Records: 144668
Missing Data (%): 1.59
Calm (% < 0.01m/s): 0.47

Key Statistics for Data Shown:
Max Curr Spd: 0.75 m/s
Mean Curr Spd: 0.19 m/s
StdDev. Curr Spd: 0.11 m/s

Woodside

Figure 4. Summer (May – Sep) near surface combined frequency of 1-minute mean current speed and direction (towards) measured at the Vincent location (cyclones removed) (WEL, 2016).



Data Information:
Project: North West Cape
Location: Vincent [114.0600°E, 21.4400°S]
Data Period: Winter (01-Apr-2001 to 30-Sep-2001)
Data Source: Measured Data
Record Elevation: Near Surface (340 m ASB)
Local Water Depth (m): 350
Data Summary: Winter
Number of Records: 126313
Missing Data (%): 4.13
Calm (% < 0.01m/s): 0.28

Key Statistics for Data Shown:
Max Curr Spd: 0.64 m/s
Mean Curr Spd: 0.20 m/s
StdDev. Curr Spd: 0.11 m/s

Woodside

Figure 5. Winter (Nov – Apr) near surface combined frequency of 1-minute mean current speed and direction (towards) measured at the Vincent location (cyclones removed) (WEL, 2016).

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APPENDIX I SCARBOROUGH DEVELOPMENT DREDGED SEDIMENT DISPERSION MODELLING REPORT

SCARBOROUGH DEVELOPMENT DREDGED SEDIMENT DISPERSION MODELLING

Report

MAW0753J.002
Scarborough Development
Dredged Sediment
Dispersion Modelling
Rev 3
22 March 2022

www.rpsgroup.com/mst

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1 INTRODUCTION

1.1 Background

RPS was commissioned by Woodside Energy Ltd (Woodside) to undertake sediment dispersion modelling of dredging, disposal and backfill operations associated with the development of Scarborough, in support of the State and Commonwealth referrals and an Offshore Project Proposal to NOPSEMA. The Scarborough gas field is located within offshore permit WA-1-R.

Dredging, disposal and backfill operations along the Scarborough pipeline route, from the mainland of the Burrup Peninsula outwards to a chainage of KP50, are proposed as part of the project (Figure 1.1).

RPS has conducted sediment dispersion modelling to quantify the potential magnitude, intensity and spatial distribution of suspended sediment concentrations (SSC) and sedimentation that would be expected for the dredging, disposal and backfill operations proposed for the development of Scarborough. The predicted outcomes are to be used to inform the assessment of the potential for influence or impact upon water quality and benthic habitats in the region.

This technical report contains a summary of the sediment fate model inputs, methodologies and assumptions, and the model outcomes following analysis of specified threshold criteria.

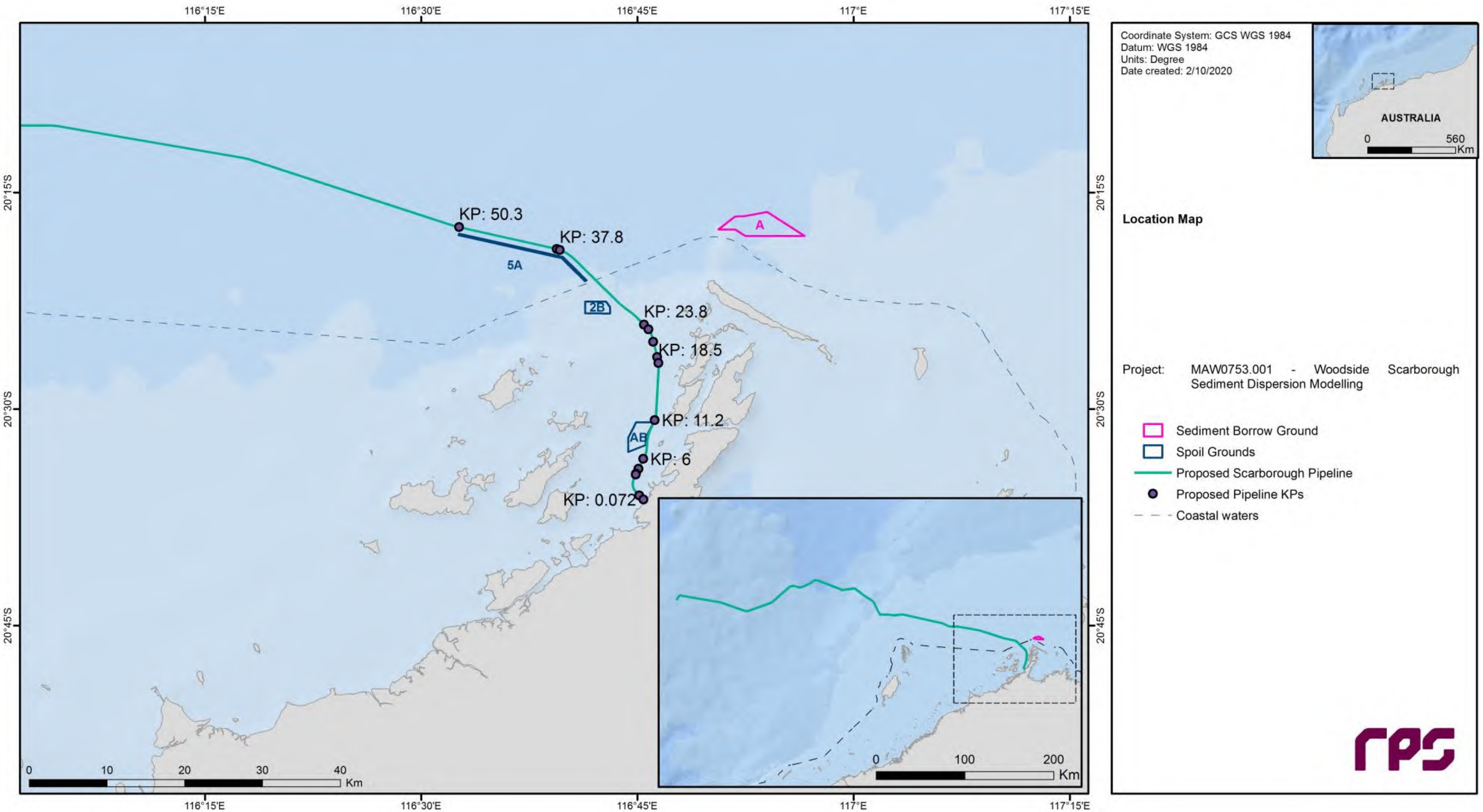


Figure 1.1 Route of the inner sections (KP0 to KP50) of the proposed Scarborough pipeline on the North West Shelf of Australia, and locations of the existing spoil grounds (AB, 2B and 5A) and sediment borrow ground A that will be utilised during disposal and backfill activities.

1.2 Modelling Scope

RPS was commissioned to conduct sediment dispersion modelling for the following activities:

- Dredging of sediment along the pipeline route and disposal of dredged sediment at three nominated spoil grounds.
- Dredging of the borrow ground and backfill and stabilisation of the pipeline.

The scope of work required to complete the sediment dispersion modelling included:

1. Hydrodynamic Modelling.
    a. An initial assessment of the existing D-FLOW hydrodynamic model framework in the Mermaid Sound region determined that refinements were necessary to suit the requirements of this scope of work. Reconfiguration of the model was conducted, followed by re-validation of the model predictions against available measurements of water levels and currents for the same validation period as utilised previously.
    b. Two years (2016-2017) of hydrodynamic simulation data was produced for use as input to the sediment dispersion model.
2. Wave Modelling.
    a. An initial assessment of the existing D-WAVE wave model framework in the Mermaid Sound region determined that refinements were necessary to suit the requirements of this scope of work. Reconfiguration of the model was conducted, followed by re-validation of the model predictions against available predictions from an operational RPS model for the same validation period as utilised previously.
    b. Two years (2016-2017) of wave simulation data was produced for use as input to the sediment dispersion model.
3. Sediment Dispersion Modelling.
    a. Inputs for the dredging program were prepared for the DREDGEMAP model, accounting for all potential concurrent sources of sediment characterised by location, intensity, particle size distribution, vertical distribution in the water column, and levels of cohesivity.
    b. Two dredging, disposal and backfill scenarios were simulated: (i) dredging commencing in winter; and (ii) dredging commencing in summer.
    c. Simulation outputs from each separate dredging, disposal and backfill activity were post-processed, combined and analysed to determine outcomes including zones of impact and influence for each scenario based on specified threshold criteria.
    d. Key model outcomes were provided as spatial datasets in GIS shapefile format.
4. Reporting. A technical report detailing the sediment fate model inputs, methodologies, assumptions and model outcomes following analysis of specified threshold criteria was provided.

1.3 Definitions of Relevant Terms and Abbreviations

BHD:

Backhoe Dredge. A pontoon equipped with a hydraulic excavator. The pontoon is stabilised and secured by three spuds. The excavator uses a large arm fitted with a bucket to excavate material from the seabed and discharge it into (typically) a split hopper barge moored alongside. BHDs are mainly used for dredging or breaking up the sedimentary rock below a layer of unconsolidated sediments, or for dredging in areas inaccessible to larger self-propelled vessels.

Dewatering:

Draining of excess water from a split hopper barge using its drainage system.

Overflow:

Excess water and suspended solids that leave a TSHD hopper and are discharged to the water column via a weir and discharge pipe located at the base of the vessel.

Resuspension:

Removal of deposited material from the seabed to the water column as a result of natural or artificial agitation.

Sedimentation rate:

Rate of sediment accumulation on the seabed following deposition of SSC from the water column.

Side-dump vessel:

Self-propelled vessel that is capable of transporting and installing a variety of different sizes of rock. Large cranes of fall pipes are used to dump rocks from the vessels to the seabed.

Split hopper barge:

Vessel with a large open hold used to load and transport dredged material. The unloading is performed by splitting the two halves of the hull to release the material towards the seabed.

SSC:

Suspended Solids Concentration (or Suspended Sediment Concentration). The concentration of sediment material in the water column following natural or artificial resuspension from the seabed.

TSHD:

Trailer Suction Hopper Dredge. A self-propelled vessel with one or two suction tubes/arms, equipped with drag-heads that are lowered to the seabed and trailed over the bottom. The vessel has a powerful pump system that sucks up a mixture of sediment and water and discharges it in the hopper (hold) of the vessel. TSHDs are mainly used for dredging loose and soft soils such as sand, gravel, silt or clay.

2 HYDRODYNAMIC AND WAVE MODELLING

2.1 Overview

Modelling of the potential sediment dispersion from the dredging, disposal and backfill activities associated with the development of Scarborough required temporal and spatial representation of the hydrodynamic and wave conditions within the project area. A hydrodynamic and wave model framework for the Mermaid Sound area was constructed, calibrated and validated for a past marine modelling study of dredge spoil stability and navigation for Woodside (RPS, 2016). This model framework has been refined for the Scarborough scope of work and is described in the following sections.

The hydrodynamic and wave modelling for the project was conducted using the Delft3D suite of software. The Delft3D suite is a fully integrated computer software package composed of several modules (e.g. flow, waves, sediment, water quality, and ecology) grouped around a common interface. This software suite has been developed to carry out studies with a multi-disciplinary approach and multi-dimensional calculations (e.g. 2-D and 3-D) for a range of systems, such as oceanic, coastal, estuarine and river environments. It can simulate the interaction of flows, waves, sediment transport, morphological developments, water quality and aquatic ecology. Specific modules of the Delft3D suite are referenced in this report, following the convention of the software developers, with the suffix D- (e.g. D-FLOW for the Delft3D Hydrodynamics module and D-WAVE for the Delft3D Spectral Wave module).

The Delft3D suite has been developed by Deltares, an independent institute for applied research on water with over 30 years of experience in modelling aquatic systems (http://www.deltares.nl/en). The Delft3D suite of models adheres to the International Association for Hydro-Environment Engineering and Research guidelines for documenting the validity of computational modelling software, closely replicating an array of analytical, laboratory, schematic and real-world data.

The configuration of the current and wave models is in line with recommendations of best practice for sediment dispersion modelling in Western Australia as outlined by WAMSI Dredging Science Node guidance (Sun *et al.*, 2016). Inclusion of mesoscale ocean currents is recommended, as these currents have a significant influence on the net drift of suspended material over the time scales of dredging operations (days to weeks) and are therefore important to predictions of sediment transport. The use of three-dimensional current modelling with a series of interconnected grids of progressively finer resolution is also recommended, as are coupling of the current and wave models and validation of current predictions against measured data.

2.2 Hydrodynamic Model (D-FLOW)

2.2.1 Model Description

To simulate the hydrodynamics within Mermaid Sound and the surrounding area, a three-dimensional model with accurate representations of the bathymetry, bottom roughness and spatially-varying wind stress was utilised for the region. The model framework was developed through the combination of a large-scale regional model with smaller refined regions, or sub-domains.

The D-FLOW model is ideally suited to represent the hydrodynamics of complex coastal waters, including regions where the tidal range creates large intertidal zones and where buoyancy processes are important. RPS has applied the model for numerous studies in the region.

D-FLOW is a multi-dimensional (2-D or 3-D) hydrodynamic (and transport) simulation program which calculates non-steady flow and transport phenomena that result from tidal, meteorological and baroclinic forcing on a rectilinear or a curvilinear, boundary-fitted grid. In three-dimensional simulations, the vertical grid can be defined following the sigma-coordinate approach, where the local water depth is divided into a series of layers with thickness at a set proportion of the depth.

D-FLOW allows for the establishment of a series of interconnected (two-way, dynamically-nested) curvilinear grids of varying resolution; a technique referred to as “domain decomposition”. This allows for the generation of a series of grids with progressively increasing spatial resolution, down to an appropriate scale for accurate resolution of the hydrodynamics associated with features such as dredged channels. The main advantage of domain decomposition over traditional one-way, or static, nesting systems is that the model domains interact seamlessly, allowing transport and feedback between the regions of different scales. The ability to dynamically couple multiple model domains offers a flexible framework for hydrodynamic model development. This modelling method was applied in this study.

Inputs to the model, as discussed in the following sections, included:

- Bathymetry of the study area, including shipping channels, islands, and adjacent features. The wetting and drying of the intertidal zones was simulated in applicable areas.
- Boundary elevation forcing data.
- Spatially-varying surface wind and pressure data.

2.2.2 Bathymetry and Domain Definition

The hydrodynamic model was established over the domain shown in Figure 2.1. Accurate bathymetry is a significant factor in development of a model framework required to resolve highly variable wave and current conditions. The bathymetry was developed using data provided by Woodside and supplemented with data from Geoscience Australia and the C-MAP electronic chart database where relevant and required.

The composite bathymetric data was interpolated onto the D-FLOW Cartesian grid. The resultant bathymetry is shown in Figure 2.2. The extent and shape of the model coastline will change as water levels rise and fall with tidal movements due to the inclusion of wetting and drying within the model system.

The vertical grid of the model comprised five layers of varying thickness, depending on location, throughout the domain. Five layers was found to be enough to resolve the circulation and provide suitable bed level currents, without overly compromising model performance. As the model was set up as a proportional sigma-grid in the vertical dimension, these layers therefore represented a terrain-following arrangement with a layer thickness of 20% of the total local water depth.

To offset the computational effort required for a large, multi-layered model domain, and to achieve adequate horizontal and temporal resolution, a multiple-grid (domain-decomposition) strategy was applied using three sub-domains of varying horizontal grid cell size (Figure 2.1 and Figure 2.2). Horizontal resolutions within each sub-domain were 250 m for the Mermaid Sound region from Enderby Island to Legendre Island (sub-grid 2), 500 m for the intermediate region (sub-grid 1) and 2 km for the outer domain (sub-grid 0).

Each sub-domain is an individual hydrodynamic model simulated in parallel with the others, with dynamic coupling at the shared boundaries between sub-domains. The outermost sub-domain captured large-scale oceanographic phenomena which progressively fed into the finer-resolution domains representing the area of interest. The resolution of the innermost sub-domain was specified after assessment of the requirement to adequately resolve the variation in current fields, and in turn the sediment dynamics.

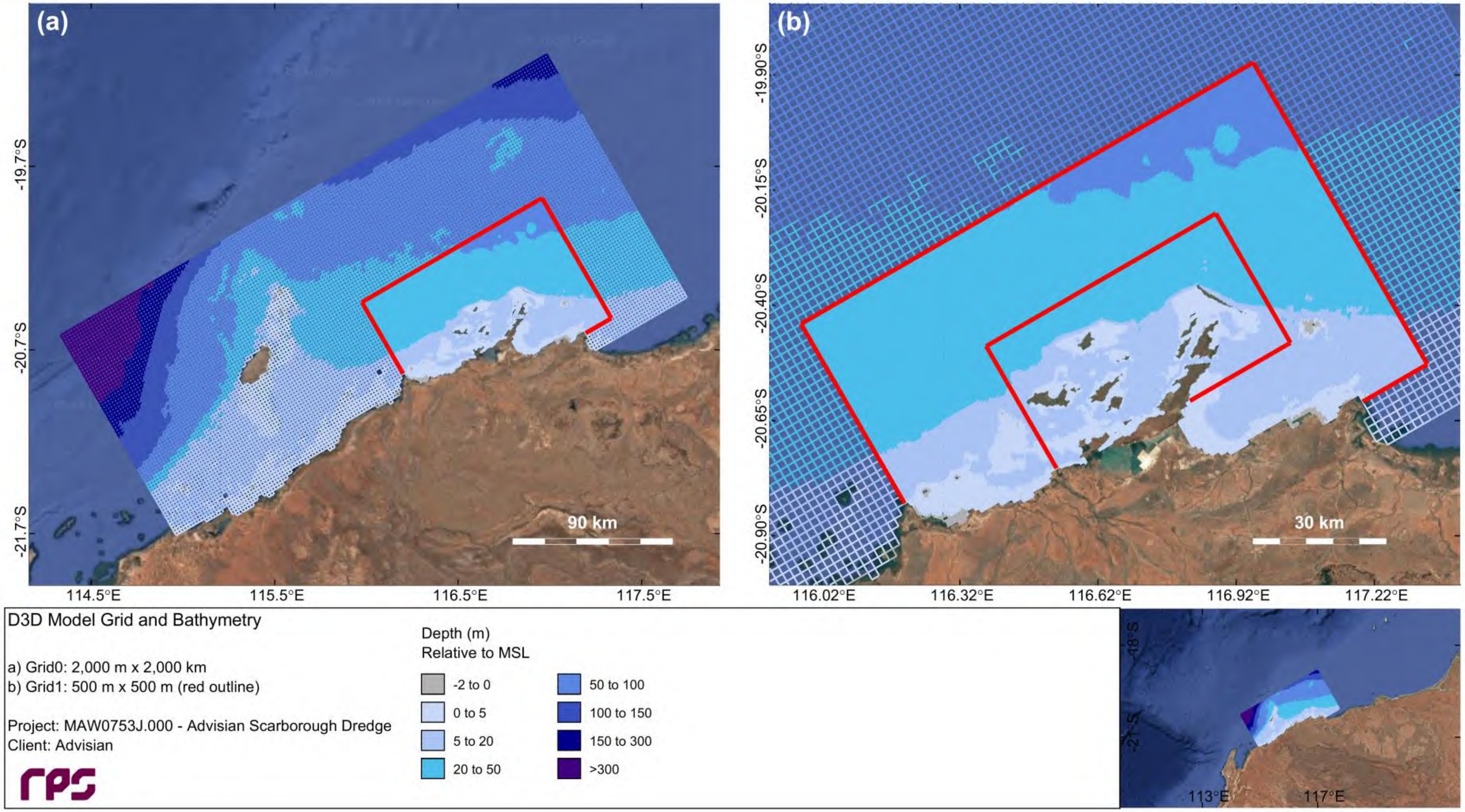


Figure 2.1 Model grid setup showing the domain-decomposition scheme applied, highlighting the two outermost grids.

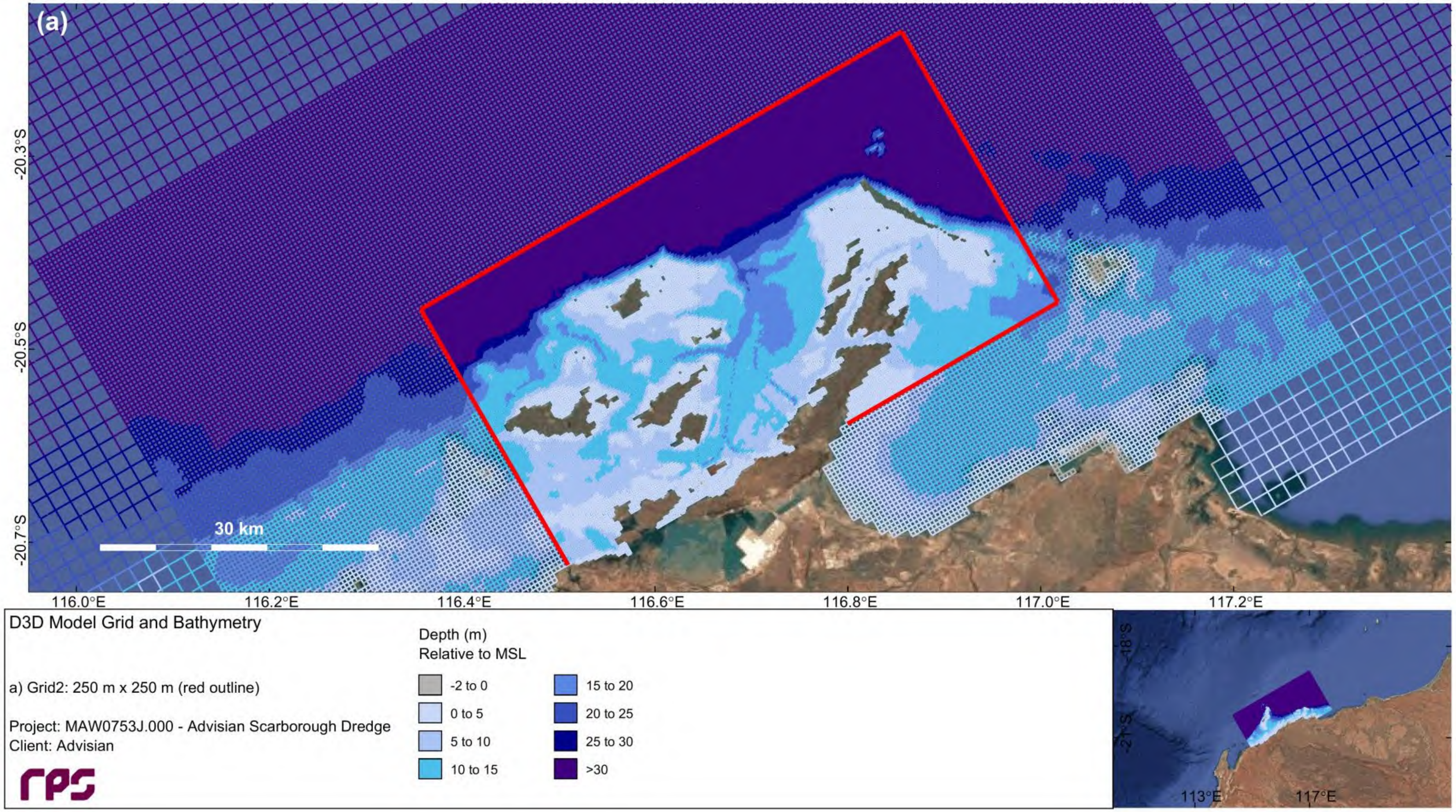


Figure 2.2 Model grid setup showing the domain-decomposition scheme applied, highlighting the innermost grid.

2.2.3 Boundary and Initial Conditions

2.2.3.1 Overview

As the hydrodynamics in the study area are controlled primarily by tidal flows and wind forcing, these processes were explicitly included in the developed model.

The model was forced on the open boundaries of the outer sub-domain with time series of water elevation obtained for the chosen simulation period. Spatially-varying wind speed and wind direction data was used to force the model across the entire domain.

2.2.3.2 Water Elevation

Water elevations at hourly intervals were obtained from the TPXO8.0 database, which is the most recent iteration of a global model of ocean tides derived from measurements of sea-surface topography by the TOPEX/Poseidon satellite-borne radar altimeters. Tides are provided as complex amplitudes of earth-relative sea-surface elevation for eight primary (M_2, S_2, N_2, K_2, K_1, O_1, P_1, Q_1), two long-period (M_f, M_m) and three non-linear (M_4, MS_4, MN_4) harmonic constituents at a spatial resolution of 0.25°.

The tidal sea level data was augmented with non-tidal sea level elevation data from the global Hybrid Coordinate Ocean Model (HYCOM; Bleck, 2002; Chassignet *et al.*, 2003; Halliwell, 2004), created by the USA's National Ocean Partnership Program (NOPP) as part of the Global Ocean Data Assimilation Experiment (GODAE). The HYCOM model is a three-dimensional model that assimilates observations of sea surface temperature, sea surface salinity and surface height, obtained by satellite instrumentation, along with atmospheric forcing conditions from atmospheric models to predict drift currents generated by such forces as wind shear, density, sea height variations and the rotation of the Earth.

The HYCOM model is configured to combine the three vertical coordinate types currently in use in ocean models: depth (z-levels), density (isopycnal layers), and terrain-following (σ-levels). HYCOM uses isopycnal layers in the open, stratified ocean, but uses the layered continuity equation to make a dynamically smooth transition to a terrain-following coordinate in shallow coastal regions, and to z-level coordinates in the mixed layer and/or unstratified seas. Thus, this hybrid coordinate system allows for the extension of the geographic range of applicability to shallow coastal seas and unstratified parts of the world ocean. It maintains the significant advantages of an isopycnal model in stratified regions while allowing more vertical resolution near the surface and in shallow coastal areas, hence providing a better representation of the upper ocean physics than non-hybrid models. The model has global coverage with a horizontal resolution of 1/12th of a degree (~7 km at mid-latitudes) and a temporal resolution of 24 hours.

2.2.3.3 Wind Forcing

Spatially-variable wind data was sourced from the Global Data Assimilation System (GDAS), which is used by the National Centers for Environmental Prediction (NCEP) Global Forecast System (GFS) model to place observations into a gridded model space for the purpose of starting, or initializing, weather forecasts with observed data. The GFS Forecasts model variant used has a horizontal resolution of 1/12th of a degree and a temporal resolution of 6 hours (NCEP, 2016).

2.2.4 Model Validation

2.2.4.1 Comparison of Modelled and Measured Water Elevation

Validation of the water level changes predicted by the D-FLOW hydrodynamic model configuration was provided through comparisons to independent predictions from the XTide tidal constituent database (Flater, 1998). Comparison of model tidal amplitudes with the XTide database showed strong agreement (Figure 2.3), with slight overprediction of tidal amplitudes at some stations. Time series comparisons for two tide stations situated at locations that are relevant to this study also showed good agreement (Figure 2.4).

In general, a consistent match is observed between water elevations calculated by the D-FLOW model and those predicted by XTide (Figure 2.4). Both the amplitude and phase of the semidiurnal tidal signal are clearly reproduced at each station, as is the timing of the spring-neap cycle. The D-FLOW model slightly overpredicts high tides and underpredicts low tides, which indicates there was a small difference between the datums used to compare these different data sets rather than actual amplitude differences.

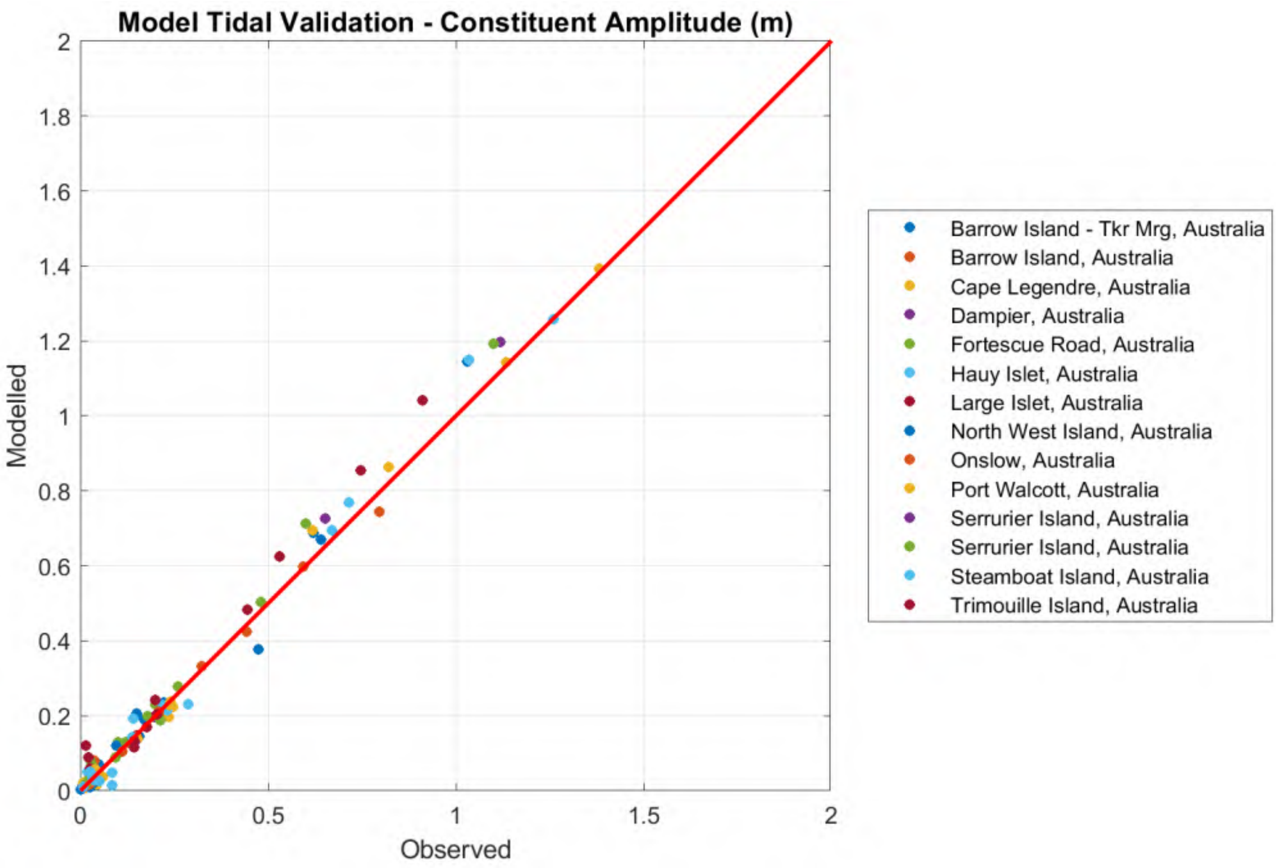


Figure 2.3 Comparison of tidal amplitudes from the D-FLOW hydrodynamic model (y-axis) with those from the XTide database (x-axis) at 14 stations located within the model domain.

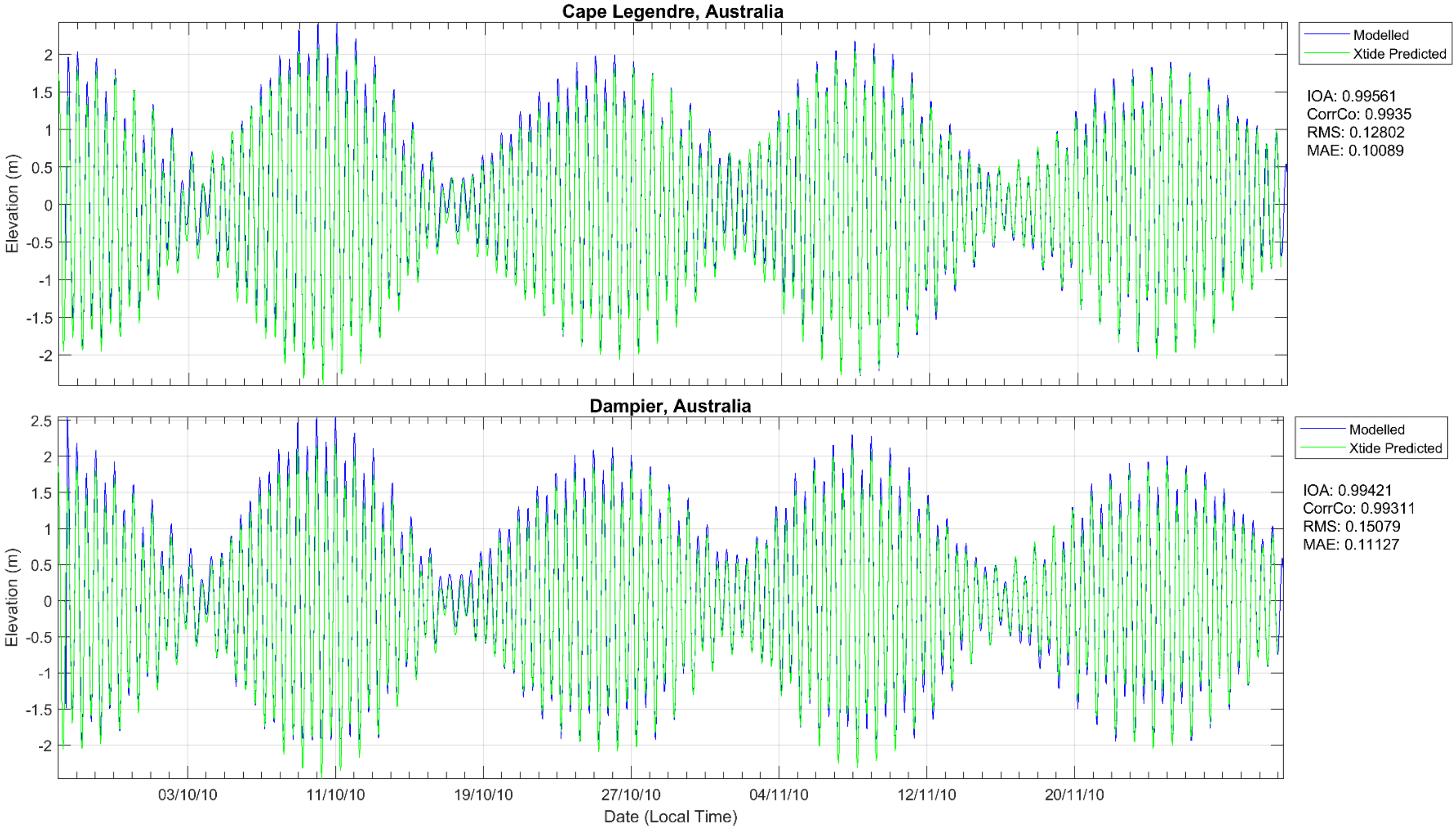


Figure 2.4 Comparisons of water elevations predicted by the D-FLOW hydrodynamic model (blue line) with those predicted by the XTide database (green line) over the validation period of October-November 2010 at two selected station locations.

2.2.4.2 Comparison of Modelled and Measured Currents

Validation of the model-predicted currents was conducted for a spring/neap tide period during October and November 2010 by comparing the model results to measured data from the Woodside LNG Channel AWAC that was located within Mermaid Sound (116.738° E, 20.561° S) in water depth of approximately 12 m. Comparisons of current speed and direction at a depth interval representative of the mid-water column are provided in Figure 2.5.

Overall, the comparison indicates that the model provides a good prediction of tidal currents at the comparison site. There was a minor mismatch in the phase of the tidal oscillations, with a slight lag apparent in the modelled data. However, this lag was not evident in the XTide water level comparisons (Figure 2.4).

The amplitudes of the modelled and measured current fluctuations were generally well-matched, but there were some spikes in the measured data that were not reproduced. These spikes in the measured data, assuming they were not instrument errors, may have been caused by local-scale events related to wind-driven currents. These events are difficult to reproduce in the model because the horizontal grid scale of the model in this region is 250 m. The GFS wind driving the model can be less accurate close to the coast when sea breeze effects are dominant. The inability of the model to reproduce some spikes observed in the measured data might be explained by inaccuracies in the NCEP wind data near to the Woodside LNG Channel AWAC location.

The vertical layer structure of the model is not considered to be significant in shallow areas – including the majority of Mermaid Sound – during periods of typical ambient wind conditions, but in deeper areas the layering allows differences in current characteristics between the wind-affected surface layers and the near-seabed layers to drive sediment dispersion.

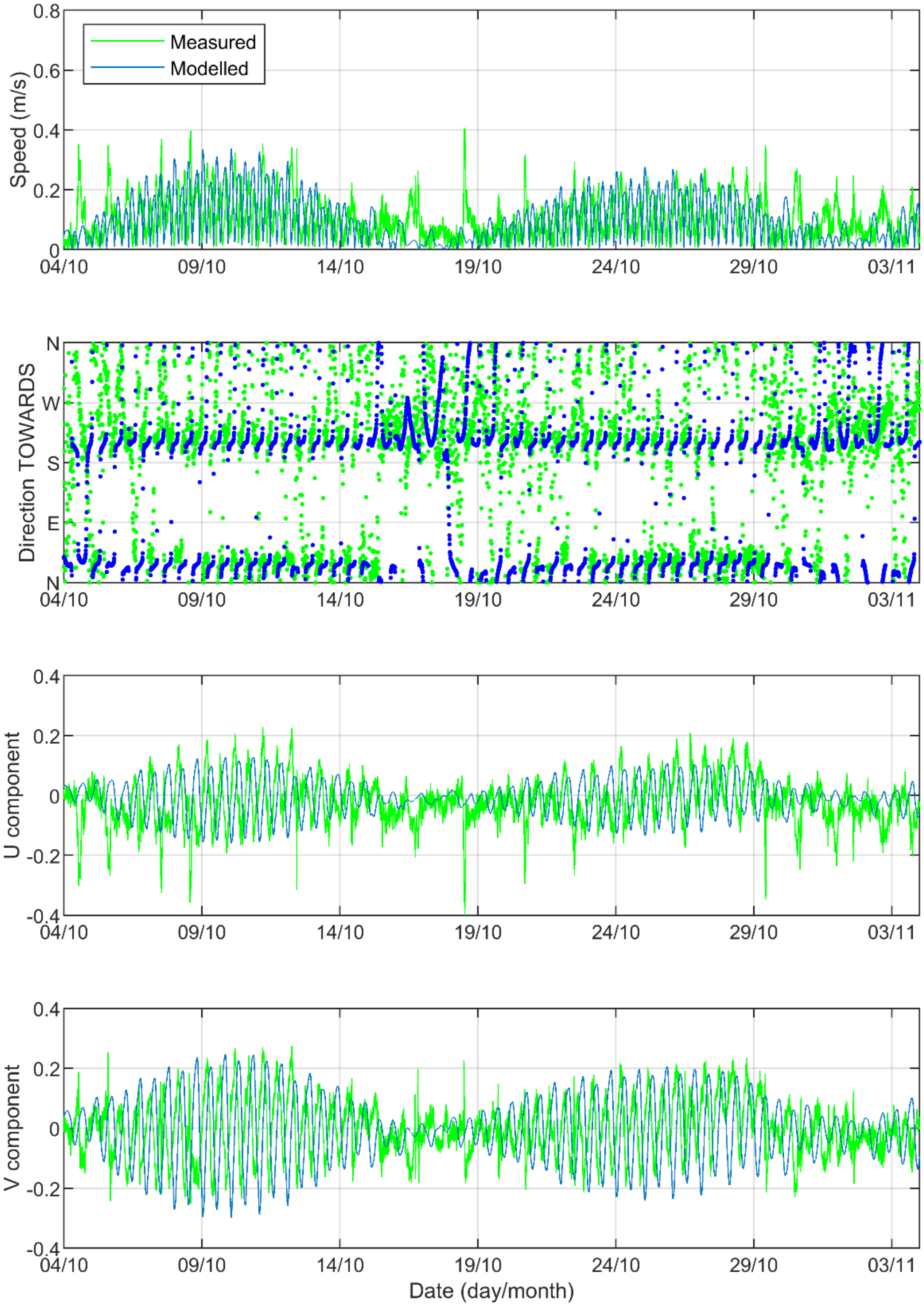


Figure 2.5 Comparisons of modelled (blue line) and measured (green line) currents for a mid-water column depth interval at the Woodside LNG Channel AWAC location during the 2010 validation period.

2.3 Wave Model (D-WAVE)

2.3.1 Model Description

Reliable forecasting for the fate of fine sediments in the study location, which is a wave-exposed coastal region, required the input of wave spectra information to calculate the shear-stress and orbital velocities imposed by waves which will affect the settlement and re-suspension of fine material that is initially suspended by dredging and related operations. D-WAVE is a variant of the well-known SWAN wave model that has been customised for compatibility with the Delft3D software suite.

The D-WAVE model is a spectral phase-averaging wave model originally developed by the Delft University of Technology. D-WAVE, a third-generation model based on the energy balance equation, is a numerical model for simulating realistic estimates of wave parameters in coastal areas for given wind, bottom and current conditions.

D-WAVE includes algorithms for the following wave propagation processes: propagation through geographic space; refraction and shoaling due to bottom and current variations; blocking and reflections by opposing currents; and transmission through or blockage by obstacles. The model also accounts for dissipation effects due to white-capping, bottom friction and wave breaking as well as non-linear wave-wave interactions. D-WAVE is fully spectral (in all directions and frequencies) and computes the evolution of wind waves in coastal regions with shallow water depths and ambient currents.

RPS has successfully applied D-WAVE in many studies in the region, including ambient condition modelling in Mermaid Sound and dredging fate projects in the wider Pilbara region.

2.3.2 Model Implementation

The D-WAVE model was developed to cover the same grid regions defined by the hydrodynamic model (Figure 2.1 and Figure 2.2). The bathymetry and wind data input to the wave model was the same as used for the hydrodynamic model. Time-varying water level information for each grid node in the wave model was provided by the output of the hydrodynamic model. The boundary data to represent swells imposed from a distance was sourced from the WAVEWATCH III 0.5° model, operated by the National Oceanic and Atmospheric Administration (NOAA) (NOAA, 2018).

The wave model was run in a coupled mode with the hydrodynamic model for the years of 2016 and 2017. The model results were independently validated by comparison to other modelled wave data for the Mermaid Sound region that is held internally by RPS. Given the purpose of the wave model is to provide bottom shear-stresses and orbital velocities for settlement and resuspension calculations across a large domain in the sediment dispersion model, rather than a more site-specific application such as the design of a structure, it is believed this is an acceptable level of validation.

3 SEDIMENT FATE MODELLING

3.1 General Approach

Estimates for the three-dimensional distribution of sediments suspended by dredging, disposal and backfill operations have been derived for the full duration of the pipeline dredging and backfill program using numerical modelling. The approach of modelling dredging operations in full and in three dimensions is in line with best practice for sediment dispersion modelling in Western Australia as outlined by WAMSI Dredging Science Node guidance (Sun *et al.*, 2016).

This modelling relied upon specification of sediment discharges over time for each of the expected sources of sediment suspension, and predicted the evolution of the combined sediment plumes via current transport, dispersion, sinking and sedimentation. The model allowed for the subsequent resuspension of settling sediments due to the erosive effects of currents and waves. Thus, the fate of sediments was assessed beyond their initial settling.

Forcing was provided using predictions of three-dimensional current fields and two-dimensional wave fields for the study area, which are described in Section 2.

3.2 Model Description

Modelling of the dispersion of suspended sediment resulting from the various dredging, disposal and backfill operations was undertaken using an advanced sediment fate model, Suspended Sediment FATE (SSFATE), operating within the RPS DREDGEMAP model framework. This model computes the advection, dispersion, differential sinking, settlement and resuspension of sediment particles. The model can be used to represent inputs from a wide range of suspension sources, producing predictions of sediment fate both over the short-term (minutes to days following a discharge source) and longer term (days to years following a discharge source).

SSFATE allows the three-dimensional predictions of SSC and seabed sedimentation to be assessed against allowable exposure thresholds. Sedimentation thresholds often relate to burial depths or rates, while SSC thresholds are usually more complicated, involving tiered exposure duration and intensities. As a result, assessing the project-generated sediment distributions against these thresholds in both three-dimensional space and time is a computationally intensive task. A variety of SSC threshold formulations have recently been applied in Western Australian coastal waters and at present there are no general guidelines.

SSFATE is a computer model originally developed jointly by the US Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC) and RPS to estimate SSC generated in the water column and deposition patterns generated due to dredging operations in a current-dominated environment, such as a river (Johnson *et al.*, 2000; Swanson *et al*., 2000, 2004). RPS has significantly enhanced the capability of SSFATE to allow the prediction of sediment fate in marine and coastal environments where wave forcing becomes important for reworking the distribution of sediments (Swanson *et al.*, 2007).

SSFATE is formulated to simulate far-field effects (~25 m or larger scale) in which the mean transport and turbulence associated with ambient currents are dominant over the initial turbulence generated at the discharge point. A five-class particle-based model predicts the transport and dispersion of the suspended material. The classes include the 0-130 µm range of sediment grain sizes that typically result in plumes. Heavier sediments tend to settle very rapidly, remain more stable over time and are not relevant over the longer durations (>1 hour) and larger spatial scales (>25 m) of interest here. Table 3.1 shows the standard material classes used in SSFATE for suspended sediment.

Table 3.1 Material size classes used in SSFATE.

Material Class Description	Particle Size Range (µm)
Clay	<7
Fine Silt	7-34
Coarse Silt	35-74
Fine Sand	75-130
Coarse Sand	>130

Particle advection is calculated using three-dimensional current fields, obtained from hydrodynamic modelling, thus the model can account for vertical changes in the currents within the water column. For example, as particles sink towards the seabed they will tend to be moved at slower speeds due to the slowing of currents by friction at the seabed. Particle diffusion is assumed to follow a random walk process using a Lagrangian approach of calculating transport, which uses a grid-less space to remove limitations of grid resolution, artefacts due to grid boundaries, and also maintain a high degree of mass conservation.

Following release into the model space, the sediment cloud evolves according to the following processes:

- Advection due to the three-dimensional current field.
- Diffusion by a random walk model with the mass diffusion rate specified, ideally, from measurements at the site. As particles represent an ensemble of real particles, each particle in the model has an associated Gaussian distribution governed by particle age and the mass diffusion properties of the surrounding water.
- Settlement or sinking of the sediment due to buoyancy forces. Settlement rates are determined from the particle class sizes and include allowance for flocculation and other concentration-dependent behaviour, following the model of Teeter (2000). The SSFATE model calculates the settling velocity for four of the five classes, with a settling velocity of 0.1 m/s assumed for coarse sand (Teeter, 2000; Swanson, 2007). The settling velocities are calculated from typical values of coefficients within SSFATE. The formulas used to calculate settling velocities, and the typical values of coefficients from the formulas, are presented below.

$$If\ C \geq \bar{C}_{ul}\ then$$

$$Ws_i = a$$

$$If\ C \leq \bar{C}_{ll}\ then$$

$$Ws_i = a\left(\frac{\bar{C}_{ll}}{\bar{\bar{C}}_{ul}}\right)^{n_i}$$

  Where:

  - C_{uli} and C_{lli} are the nominal upper and lower concentration limits, respectively, for enhanced settling of grain class *i*, and *C* is the total concentration for all grain size classes (except coarse sand).
  - a_i is a grain-size class average maximum floc settling velocity.
  - n_i is a grain-size dependent exponent.

Table 3.2 Typical values of coefficients for calculating settling velocities in SSFATE.

Sediment Grain Size Class	Size Range (µm)	C_{lli} (mg/L)	C_{uli} (mg/L)	a_i (m/s)	n_i
Clay	<7	50	1,000	0.0008	1.33
Fine Silt	7-34	150	3,000	0.0023	1.10
Coarse Silt	35-74	250	5,000	0.0038	0.90
Fine Sand	75-130	400	8,000	0.0106	0.80

- Potential deposition to the seabed determined using a model that couples the deposition across particle classes (Teeter, 2000). The likelihood and rate of deposition depends on the shear stress at the seabed. High shear inhibits deposition, and in some cases excludes it altogether with sediment remaining in suspension. The model allows for partial deposition of individual particles according to a practical deposition rate, thereby allowing the bulk sediment mass to be represented by fewer particles.
- Potential resuspension from the seabed, if previously deposited, at a rate governed by exceedance of a shear stress threshold at the seabed due to the combined action of waves and currents. Different thresholds are applied for resuspension depending upon the size of the particle and the duration of sedimentation, based on empirical studies that have demonstrated that newly-settled sediments will have higher water content and are more easily resuspended by lower shear stresses (Swanson *et al.*, 2007).

The resuspension flux calculation also accounts for armouring of fine particles within the interstitial spaces of larger particles. Thus, the model can indicate whether deposits will stabilise or continue to erode over time given the shear forces that occur at the site. Resuspended material is released back into the water column to be affected by the processes defined above.

SSFATE formulations and proof of performance have been documented in a series of USACE Dredging Operations and Environmental Research (DOER) Program technical notes (Johnson *et al.*, 2000; Swanson *et al.*, 2000), and published in the peer-reviewed literature (Andersen *et al.*, 2001; Swanson *et al.*, 2004; Swanson *et al.*, 2007). SSFATE has been applied and validated by RPS against observations of sedimentation and suspended sediments at multiple locations in Australia, notably Cockburn Sound for Fremantle Ports and Mermaid Sound for the LNG Foundation Project dredging program.

3.3 Model Limitations

There are inherent limitations to the accuracy of numerical models. The possible sources of uncertainty within the modelling conducted for the sediment fate assessment of the Scarborough development include:

- *The equations and algorithms applied in the model*. The formulations included in the model, as discussed in Section 3.2, were selected to achieve the best possible representation of the relevant processes and have been proven to be valid over a range of projects.
- *The accuracy of the physical (current and wave) inputs to the model*. Current and wave forcing inputs were provided from validated three-dimensional hydrodynamic and wave models created and customised for the study area. The accuracy of these models is suitable, as good correlations with field measurements and independent model predictions have been achieved, with the uncertainties minimised and quantifiable. The hydrodynamic and wave models are described in Section 2. It should be noted that the model inputs are a hindcast of past metocean conditions; the overall trends reflected in this data will be broadly reflected in future conditions, but conditions on any given day during the actual dredging operations may be quite different.
- *The accuracy of dredge methodology inputs to the model*. Specification of the proposed dredge and disposal methodologies was provided by Woodside after consultation with the dredging contractor engaged to perform the work (Boskalis). Any assumptions made to achieve a realistic representation of the dredging and disposal activities are outlined in Section 3.5 and were based on extensive past project experience.
- *The accuracy of the material properties input to the model*. Geotechnical information obtained during site investigations for the Scarborough development (Advisian, 2019a; Fugro, 2019) and during previous site investigations for the LNG Foundation Project (Coffey, 2007) was provided by Woodside and is discussed in Section 3.6. From this data, the properties of the *in situ* material to be dredged are reasonably well-known. However, it is not possible to determine how the material properties will be changed by the action of the dredges and the mixing of the material with seawater in the process of pumping it to the hopper. Therefore, assumptions were made in the model with regard to the material that is released into the water column from dredging and the material properties of the sediments that are to be placed at the spoil grounds.
- *The accuracy of the dredging and disposal sediment source terms input to the model*. The source definition in the model is flexible and can be applied to any sediment source by specifying the time-varying flux rate, particle size distribution (PSD) and vertical profile in the water column. This information will be specific to the equipment used and the material encountered at the site, and therefore can only be determined with confidence from a pilot study at the site or field measurements during dredging. In the absence of such data, conservative assumptions were made with regard to these parameters. The assumptions are outlined in Section 3.7 and were based on literature review, including the recent WAMSI Dredging Science Node reports, and extensive past project experience.

The major sources of uncertainty for the sediment fate modelling are the modelled dredging methodology and sediment source inputs to the model. The assumptions made were based on literature review and experience, and aimed to give a good representation of the sources of suspended sediment that will result from the proposed dredging, disposal and backfill activities. However, as there were uncertainties in the inputs to the model, the results should be considered as indicative of the expected ranges in magnitude and distribution of suspended sediments and sedimentation, rather than an exact prediction.

3.4 Model Domain and Bathymetry

The DREDGEMAP model domain established for the Scarborough dredging works extended approximately 89 km north-south by 125 km east-west (Figure 3.1). The model grid covers the section of the Western Australian coastline from Cape Preston in the west to Point Samson in the east. The offshore boundaries of the domain were imposed at a reasonable distance from the proposed dredging areas, to allow potential sediment drift patterns in offshore directions to be adequately captured.

This region lies within the model domain of the Delft3D hydrodynamic and wave models that provide the current and wave inputs to DREDGEMAP (see Section 2). A grid resolution of 100 m by 100 m was selected to ensure that existing features in the domain, including the many bays, islands and passages of the Dampier Archipelago, were adequately defined.

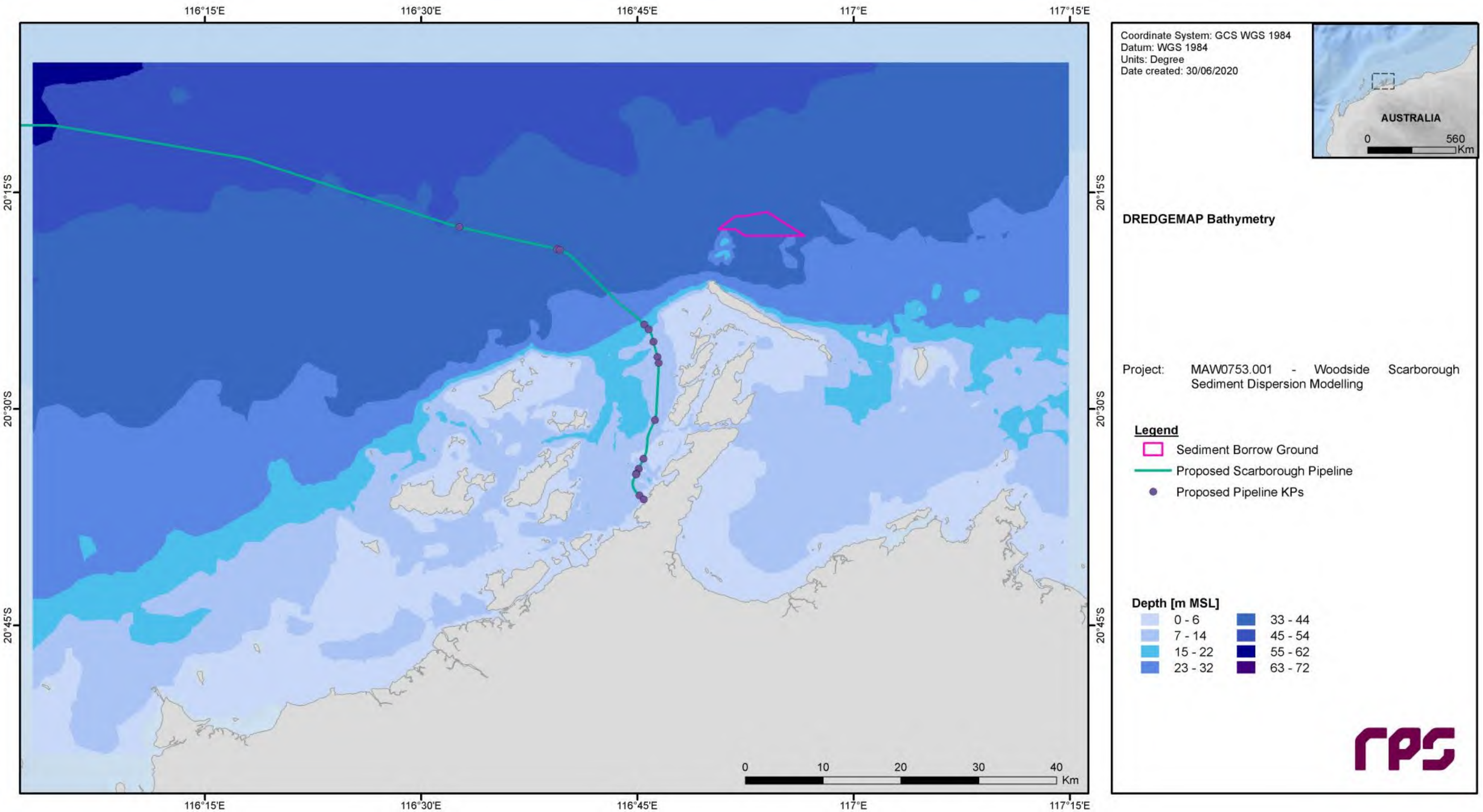


Figure 3.1 DREDGEMAP model domain and bathymetry (m MSL).

3.5 Dredging Project Description and Model Operational Assumptions

3.5.1 Overview

Information outlining the proposed dredging, disposal and backfill operations for the development of Scarborough has been drawn from input data provided by Woodside and its dredging contractor (Woodside, 2020), and subsequent meetings and email discussions. At the time of commencement of modelling, the collated information represented the best available data with regard to geotechnical properties of the project areas, the dredging and construction methodologies expected to be used within these areas, and the characteristics of vessels planned to be engaged for the work.

The operations modelled have been broken into two phases with four main activities:

- Phase 1 (Dredging):
  - Dredging of sediment along the pipeline route.
  - Disposal of dredged sediment at three nominated spoil grounds.
- Phase 2 (Backfilling):
  - Dredging of the borrow ground.
  - Backfill and stabilisation of the pipeline.

The pipeline route, spoil grounds and borrow ground will cover State and Commonwealth Waters (Figure 1.1).

The following sections outline the details of the operations for each of these activities and highlight any assumptions that were made.

3.5.2 Methods and Equipment

3.5.2.1 Pipeline Route Dredging

The material to be dredged from the pipeline route will consist mainly of marine sediments (approximately 1.80 Mm^3) and marine sediment/coarse material mix (approximately 0.07 Mm^3).

The dredging operations for the pipeline route have been divided into twelve sections as outlined in Table 3.3, with nine of these sections requiring dredging. The breakdown of the proposed dredging activities, including the locations of the pipeline KPs and spoil grounds, are shown in Figure 3.2. The dredging in each of the nine sections was assumed to be completed with either a backhoe dredge (BHD) or a trailing suction hopper dredge (TSHD). Typically, a TSHD will dredge unconsolidated sediments and a BHD will dredge sedimentary rock, and the quantities of each material type assumed in this case are detailed in Section 3.5.3. The assumed BHD bucket size was in the range of 20 m^3 (rock) to 30 m^3 (general purpose), while the TSHD hopper size was assumed to be 12,000 m^3. It has been specified that overflow of fines from the TSHD hopper will be permitted, with a ‘green valve’ incorporated into the overflow system, but that dewatering of the split hopper barges that accompany the BHD will not occur.

The estimated cycle times for dredging within each pipeline section where the BHD will operate are presented in Table 3.4, and those for each pipeline section where the TSHD will operate are presented in Table 3.5.

The potential for sediment mobilisation by TSHD propeller-wash effects has been considered along all relevant pipeline sections. This has been done using supplied data on vessel characteristics, and local depth and seabed composition. For the purposes of the modelling assessment, the relevant specifications were as follows:

- Vessel draft: 10.0 m loaded and 6.0 m empty.
- Number of propellers: 2 (ducted).
- Diameter of propellers: 4.0 m.
- Thrust power: 5,800 kW per propeller.

Table 3.3 Provisional outline of proposed pipeline dredging and disposal activities.

Pipeline Zone	Pipeline Location	Vessel	Task Description	Disposal Location
PRE1	KP0.072 – KP0.8	BHD & barges	Dredging of a 3.5 m deep trench. Dredging of pre-treated sediment if required.	AB
PRE2	KP0.8 – KP3.9	BHD & barges	Dredging of a 3.5-4.0 m deep trench.	AB
		TSHD		2B
PRE3	KP3.9 – KP4.6	TSHD	Clearing out of a pre-excavated trench across the NWS Shipping Channel.	2B
PRE4	KP4.6 – KP6.0	BHD & barges	Dredging of a 3.0 m deep trench.	AB
		TSHD		2B
PRE5	KP6.0 – KP11.2	N/A	No dredging.	N/A
PRE6	KP11.2 – KP18.5	TSHD	Dredging of a 2.0-3.0 m deep trench.	2B
PRE7	KP18.5 – KP19.3	N/A	No dredging.	N/A
PRE8	KP19.3 – KP21.3	TSHD	Dredging of a 2.5-3.0 m deep trench.	2B
PRE9A	KP21.3 – KP23.0	N/A	No dredging.	N/A
PRE9B	KP23.0 – KP23.8	TSHD	Dredging of an 800 m section of trench.	2B
PRE10A	KP23.8 – KP38.2	TSHD	Dredging of a 2.5-3.5 m trench along sections with unconsolidated sediment.	2B
				5A
PRE10B	KP38.2 – KP50.3	TSHD	Dredging of a 2.5-3.5 m trench along sections with unconsolidated sediment.	5A

Table 3.4 Estimated cycle times for each pipeline section where the BHD will be operating.

Pipeline Zone	Non-Dewatering Time (min)	Dewatering Time (min)	Disposal Time (min)	Sailing Time (min)	Total Cycle Time (min)
PRE1	354	N/A	15	90	459
PRE2	734	N/A	15	85	834
PRE4	734	N/A	15	75	824

Table 3.5 Estimated cycle times for each pipeline section where the TSHD will be operating.

Pipeline Zone	Non-Overflow Time (min)	Overflow Time (min)	Disposal Time (min)	Sailing Time (min)	Total Cycle Time (min)
PRE2	20	169	15	130	334
PRE3	20	169	15	125	329
PRE4	20	169	15	120	324
PRE6	20	169	15	70	274
PRE8	20	169	15	48	252
PRE9B	20	169	15	33	237
PRE10A	20	169	15	20	224
PRE10B	20	169	15	20	224

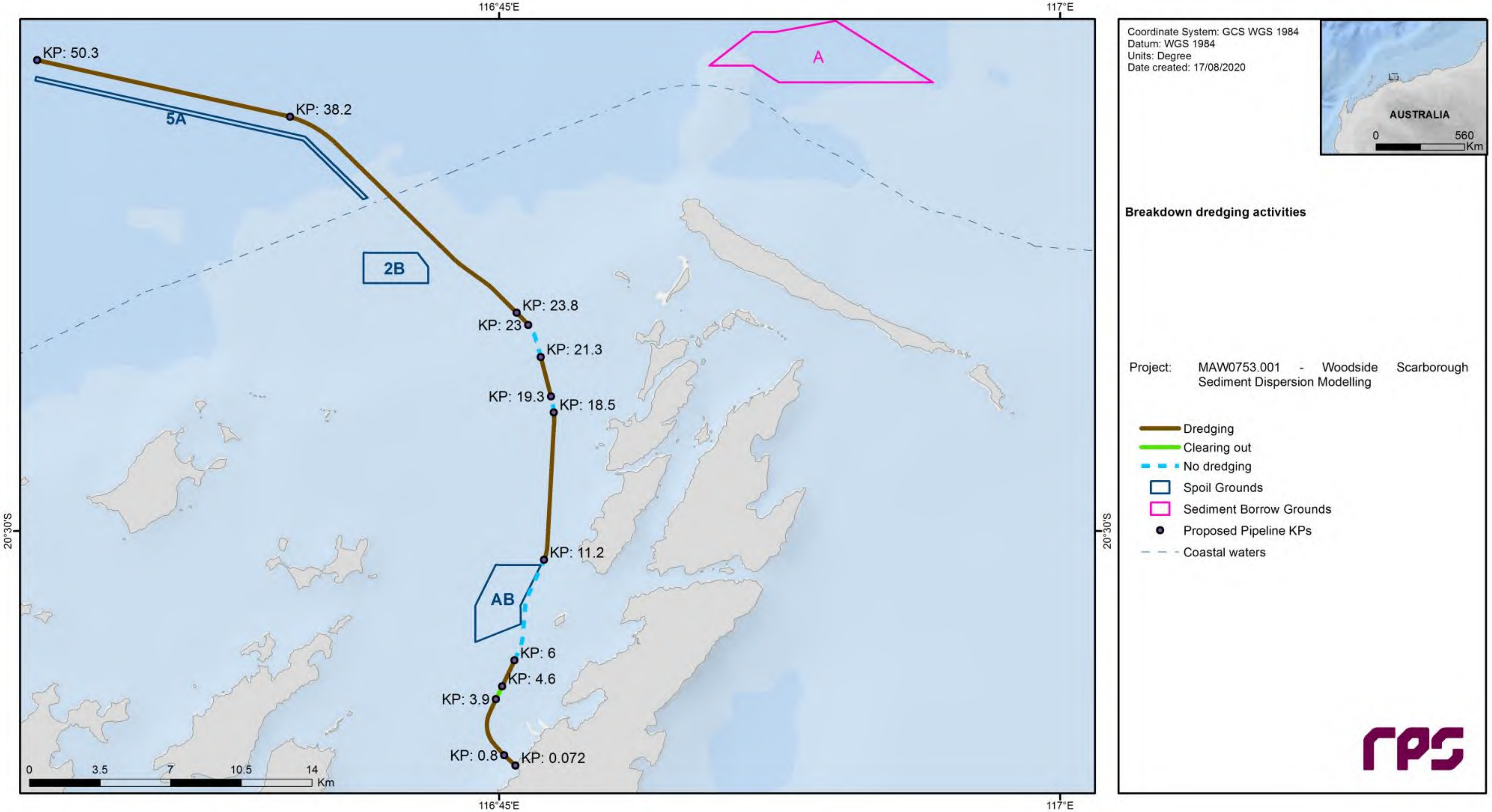


Figure 3.2 Breakdown of proposed dredging activities showing the pipeline KPs and locations of the existing spoil grounds (AB, 2B and 5A) that will be utilised during disposal activities.

3.5.2.2 Spoil Ground Disposal

As outlined in Table 3.3, it was assumed that all material dredged by the BHD will be placed into a waiting split hopper barge and transported to the offshore disposal areas (shown in Figure 3.2), while all material dredged by the TSHD will be transported directly to the offshore disposal areas.

It was assumed that the BHD will be accompanied by two split hopper barges, assumed to be approximately 3,800 m^3 in capacity, to be used for disposal of dredged material. Material discharges from the split hopper barges were assumed to occur between depths of 5.8 m and 1.5 m below mean sea level.

The TSHD hopper doors, from which discharge will occur, were assumed to be opened at a depth of 12.75 m below sea level. The modelled vessel draft will be reduced as spoil is discharged to a minimum depth of 8.75 m below sea level when empty.

The split hopper barges will be pushed or towed by a harbour tug. The potential for sediment mobilisation by tug propeller-wash effects has been considered along all relevant pipeline sections. This has been done using supplied data on vessel characteristics, and local depth and seabed composition. For the purposes of the modelling assessment, the relevant specifications were as follows:

- Vessel draft: 4.5 m (tug).
- Number of propellers: 2 (ducted).
- Diameter of propellers: 2.5 m.
- Thrust power: 1,850 kW per propeller.

The allocations of dredge spoil from each pipeline section to each spoil ground are shown in Table 3.6. It was assumed that the broad aim of the spoil disposal patterns will be to evenly distribute the total volume of allocated material across the entire spoil ground area by the conclusion of all activities, so the spacing of individual disposal operations (which are restricted to a comparatively small area within the spoil ground) was designed to achieve this.

Table 3.6 Anticipated spoil ground allocations of dredge volumes from each pipeline section.

Spoil Ground	Pipeline Zone	Spoil Volume (m^3)	Spoil Ground Area (m^2)	Theoretical Thickness (m)
AB	PRE1, 2 & 4	90,000	4,000,000	0.13
2B	PRE2, 3, 4, 6, 8, 9B & 10A	1,035,772	2,600,000	0.16
5A	PRE10A & 10B	741,087	3,200,000	0.29

3.5.2.3 Borrow Ground Dredging

Dredging of backfill material from the borrow ground locations will consist of the removal of approximately 1.98 Mm^3 of sandy sediments with a low proportion of fines.

It was assumed that dredging of borrow ground A (Figure 3.3) will be conducted using a TSHD. The TSHD hopper size was assumed to be 12,000 m^3 (filled at a rate of approximately 90 m^3/min). It has been specified that overflow of fines from the TSHD hopper will be permitted.

The estimated cycle times for TSHD dredging within borrow ground A and placement of material within each pipeline section are presented in Table 3.7.

The potential for sediment mobilisation by TSHD propeller-wash effects has been considered at the borrow ground. This has been done using supplied data on vessel characteristics, and local depth and seabed composition. For the purposes of the modelling assessment, the relevant specifications were as follows:

- Vessel draft: 10.0 m loaded and 6.0 m empty.
- Number of propellers: 2 (ducted).

- Diameter of propellers: 4.0 m.
- Thrust power: 5,800 kW per propeller.

Table 3.7 Estimated cycle times for each pipeline section where the TSHD will be placing material dredged from borrow ground A.

Pipeline Zone	Non-Overflow Time (min)	Overflow Time (min)	Placement Time (min)	Sailing Time (min)	Total Cycle Time (min)
POST2	20	94	107	225	446
POST4	20	119	107	204	450
POST6	20	119	107	145	391
POST8	20	119	107	123	369
POST9B	20	119	107	123	369
POST10A	20	119	107	133	379
POST10B	20	119	107	133	379

3.5.2.4 Pipeline Route Backfill

The backfill operations for the pipeline route have been divided into twelve sections as outlined in Table 3.8. The breakdown of the proposed backfill activities, including the locations of the pipeline KPs and the backfill material type to be placed along each pipeline section, are shown in Figure 3.3. It was assumed that rock backfill will be placed by a side-dump vessel and sand backfill will be placed by a TSHD.

The side-dump vessel was assumed to have a capacity of 4,500 tonnes with an average installation rate of approximately 2,250 tonnes/hr, with rock dumped from a fixed height at the sea surface. The TSHD hopper size was assumed to be 12,000 m^3 (emptied at a rate of approximately 90 m^3/min), with sand discharged through the suction pipe at an elevation of approximately 5 m above the pipeline.

The potential for sediment mobilisation by TSHD and side-dump vessel propeller-wash effects has been considered along the relevant pipeline sections. This has been done using supplied data on vessel characteristics, and local depth and seabed composition. For the purposes of the modelling assessment, the relevant specifications were as follows:

- Vessel draft:
  - 10.0 m loaded and 6.0 m empty (TSHD).
  - 4.8 m loaded (side-dump vessel).
- Number of propellers:
  - 2 (ducted; TSHD).
  - 2+2 (ducted; side-dump vessel).
- Diameter of propellers:
  - 4.0 m (TSHD).
  - 2.5 m (side-dump vessel).
- Thrust power:
  - 5,800 kW per propeller (TSHD).
  - 2 x 1,250 kW and 2 x 1,000 kW (side-dump vessel).

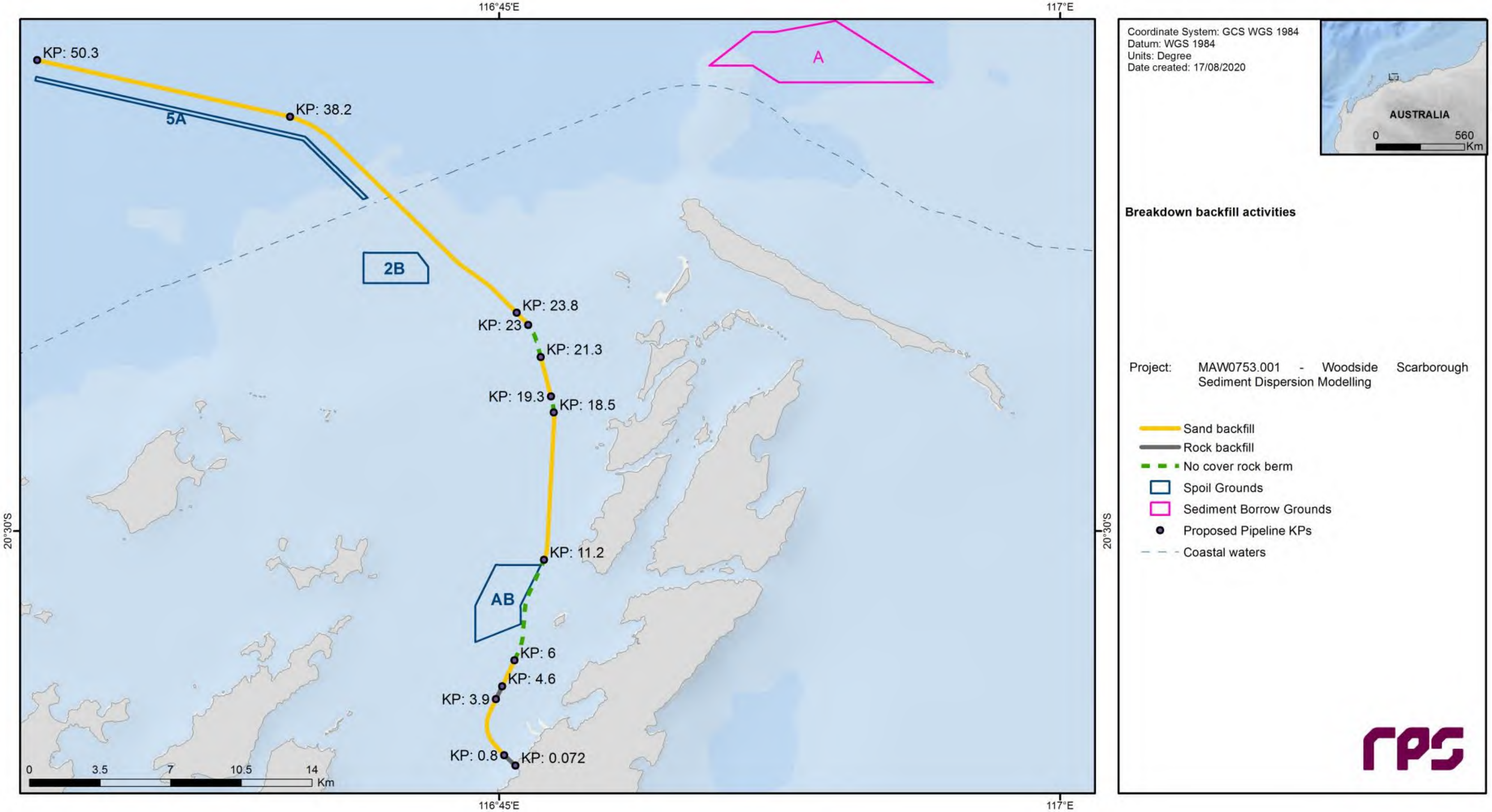


Figure 3.3 Breakdown of proposed backfill activities showing the pipeline KPs, the backfill material type to be placed along each pipeline section, and the location of borrow ground A where sand backfill material is to be sourced.

Table 3.8 Provisional outline of proposed pipeline backfill and stabilisation activities.

Pipeline Zone	Pipeline Location	Vessel	Task Description	Borrow Location
POST1	KP0.072 – KP0.8	Side-dump vessel	Rock backfill (1.2-2.0 m cover over top of pipe).	Rock from the Nickol Bay Quarry.
POST2	KP0.8 – KP3.9	TSHD	Sand backfill (≥3.0 m cover over top of pipe).	Sand from borrow ground A.
POST3	KP3.9 – KP4.6	Side-dump vessel	Rock backfill (2.0 m cover over top of pipe).	Rock from the Nickol Bay Quarry.
POST4	KP4.6 – KP6.0	TSHD	Sand backfill (1.7-2.5 m cover over top of pipe).	Sand from borrow ground A.
POST5	KP6.0 – KP11.2	Side-dump vessel	No cover rock berm (flush to top of pipe).	Rock from the Nickol Bay Quarry.
POST6	KP11.2 – KP18.5	TSHD	Sand backfill (0.8-1.7 m cover over top of pipe).	Sand from borrow ground A.
POST7	KP18.5 – KP19.3	Side-dump vessel	No cover rock berm (flush to top of pipe).	Rock from the Nickol Bay Quarry.
POST8	KP19.3 – KP21.3	TSHD	Sand backfill (1.2-1.7 m cover over top of pipe).	Sand from borrow ground A.
POST9A	KP21.3 – KP23.0	Side-dump vessel	No cover rock berm (flush to top of pipe).	Rock from the Nickol Bay Quarry.
POST9B	KP23.0 – KP23.8	TSHD	Sand backfill of an 800 m section of trench.	Sand from borrow ground A.
POST10A	KP23.8 – KP38.2	TSHD	Sand backfill (0.7-1.7 m cover over top of pipe).	Sand from borrow ground A.
POST10B	KP38.2 – KP50.3	TSHD	Sand backfill (0.7-1.7 m cover over top of pipe).	Sand from borrow ground A.

3.5.3 Quantities and Production Rates

For dredging of each section along the pipeline route, the proposed dredge depths, quantities for each material type, and production rates for each material type were specified for input to the modelling (Table 3.9). The stated quantities include allowances for overdredge and contingency; hence, they are conservative volume estimates. The table has two material categories, defined as “soft” (unconsolidated sediments) and “moderate” (calcareous sedimentary rock). It is understood that no “hard” material (andesite igneous rock) will be present due to its removal during capital dredging activities for the LNG Foundation Project.

For sand backfill of each relevant section along the pipeline route, which involves dredging of borrow ground A, the proposed quantities and production rates for each material type were specified for input to the modelling (Table 3.10). The sole material category within borrow ground A was assumed to be unconsolidated sediments (“soft” material).

For rock backfill sections where rock is to be placed, quantities for each material category were specified (Table 3.11).

It is understood that:

- The estimated material quantities (inclusive of overdredge and contingency) were based on the latest surveyed bathymetry and a geotechnical model incorporating existing geotechnical data.
- The estimated production rates were based on the material type and equipment that may be used for dredging.
- The estimated production rates were average values inclusive of expected downtime estimates. The average production rates were specified by the dredging contractor based on its extensive past project experience and are a combination of: (i) the bulk rate; (ii) a reduced rate when approaching design; and (iii) spot hunting when the design is reached within the majority of the dredge footprint.

Table 3.9 Modelled dredge depths, quantities of material type, and production rates by material type for dredging of each pipeline section.

Pipeline Zone	Dredge Depth (m CD)	Dredged Quantities (m^3)			Production Rates (m^3/week)	
	Target	Soft Material	Moderate Material	Total	Soft Material	Moderate Material
PRE1	+4.3 / -5.5	-	47,100	47,100	-	15-20,000
PRE2	-13.1 / -11.1	240,778	8,884	249,662	250,000	15-20,000
PRE3	-10.7 / -18.6	131,992	-	131,992	250,000	-
PRE4	-9.7 / -11.3	110,598	4,876	115,474	250,000	15-20,000
PRE6	-13.0 / -16.0	208,844	800	209,644	250,000	15-20,000
PRE8	-14.4 / -17.7	48,200	5,500	53,700	250,000	15-20,000
PRE9B	-14.4 / -17.7	18,200	-	18,200	250,000	-
PRE10A	-24.0 / -44.9	486,100	-	486,100	250,000	-
PRE10B	-24.0 / -44.9	554,987		554,987	250,000	-
	Totals	**1,799,699**	**67,160**	**1,866,859**	**-**	**-**

Table 3.10 Modelled quantities of material type and production rates by material type for dredging of sand backfill material for each pipeline section from borrow ground A.

Pipeline Zone	Dredged/Backfill Quantities (m^3)	Production Rates (m^3/week)
	Soft Material	Soft Material
POST2	272,537	300,000
POST4	131,223	300,000
POST6	299,069	300,000
POST8	78,200	300,000
POST9B	26,500	300,000
POST10A	599,575	300,000
POST10B	572,237	300,000
Totals	**1,979,341**	**-**

Table 3.11 Modelled quantities of material type for placement of rock backfill material within each pipeline section.

Pipeline Zone	Backfill Quantities (m^3)
	Rock Material
POST1	9,976
POST3	30,374
POST5	16,416
POST7	5,580
POST9A	10,980
Totals	**73,326**

3.5.4 Schedules

For dredging of each section along the pipeline route, the proposed duration and sequencing of operations has been specified for input to the modelling (Table 3.12 and Table 3.13). Table 3.12 has two material categories, as described in Section 3.5.3.

The modelled sequence of dredging has been specified to represent a worst-case scenario where the TSHD and BHD operate concurrently, as outlined in Table 3.13. The TSHD modelled sequence starts in zone PRE2, moving to zone PRE4, then zone PRE3 and then proceeds consecutively from zone PRE6 to zone PRE10B. The BHD modelled sequence starts in zone PRE2 following completion of the TSHD works in PRE2, then moves to zone PRE4 and then zone PRE1 last. Modelling of each section involves a series of dredging and related disposal activities. Allocations of spoil material from each pipeline section to each of the three spoil grounds are outlined in Table 3.3.

For backfill of each section along the pipeline route, the proposed duration and sequencing of operations has been specified for input to the modelling (Table 3.14). The table has two material categories, as described in Section 3.5.3.

The sequence of backfilling has been assumed to involve completing all sand backfill tasks (proceeding consecutively from zone POST2 to zone POST10B) and then completing all rock backfill tasks (proceeding consecutively from zone POST1 to zone POST9B). Modelling of each section involves a series of dredging and related backfill activities. For the pipeline sections where rock backfill will be placed, no associated borrow ground dredging will occur.

Table 3.12 Modelled durations of dredging and disposal operations by material type for each pipeline section.

Pipeline Zone	Duration of Operations (weeks)	
	Soft Material	Moderate Material
PRE1	-	2.69
PRE2	0.96	0.51
PRE3	0.53	-
PRE4	0.44	0.28
PRE6	0.84	0.05
PRE8	0.19	0.31
PRE9B	0.07	-
PRE10A	1.94	-
PRE10B	2.22	-
Totals	**7.19**	**3.84**

Table 3.13 Modelled sequencing of dredging and disposal operations assuming concurrent TSHD and BHD operation.

Week	TSHD			BHD			Comments
	Pipeline Zone	Pipeline Location	Duration (weeks)	Pipeline Zone	Pipeline Location	Duration (weeks)	
1	PRE2	KP0.8 – KP3.9	0.96	-	-	-	-
2	PRE4	KP4.6 – KP6.0	0.44	PRE2	KP0.8 – KP3.9	0.51	BHD dredging follows completion of TSHD works in zone PRE2.
	PRE3	KP3.9 – KP4.6	0.53	PRE4	KP4.6 – KP6.0	0.28	BHD dredging follows completion of TSHD works in zone PRE4.
3	PRE6	KP11.2 – KP18.5	0.89	PRE1	KP0.072 – KP0.8	2.69	Most complex section for BHD dredging, to be undertaken last.
4	PRE8	KP19.3 – KP21.3	0.50				
	PRE9B	KP23.0 – KP23.8	0.07				
4, 5 & 6	PRE10A	KP23.8 – KP38.2	1.94				
6 & 7	PRE10B	KP38.2 – KP50.3	2.22	-	-	-	-
Totals	**-**	**-**	**7.55**	**-**	**-**	**3.48**	**-**

Table 3.14 Modelled durations of dredging and backfill operations by material type for each pipeline section.

Pipeline Zone	Duration of Operations (weeks)		
	Sand Material	Rock Material	Total
POST1	-	0.40	0.40
POST2	1.82	-	1.82
POST3	-	1.20	1.20
POST4	0.87	-	0.87
POST5	-	0.70	0.70
POST6	1.99	-	1.99
POST7	-	0.20	0.20
POST8	0.52	-	0.52
POST9A	-	0.50	0.50
POST9B	0.18	-	0.18
POST10A	4.00	-	4.00
POST10B	3.81	-	3.81
Totals	**13.19**	**3.00**	**16.19**

3.5.5 Scenario Summary

The provisional schedule for the dredging works indicates a July 2021 start for dredging of the pipeline route followed by a December 2021 start for backfill and stabilisation works. Analysis of wind data in the region from 1993-2017 has shown that the period of 2016-2017 is likely to be representative of typical conditions. The dredge modelling simulations were conducted using hydrodynamic and wave data drawn from this period, with nominal start dates for model simulation purposes being chosen as 1st July 2016 (winter) and 1st January 2017 (summer).

A summary of the scenarios that were modelled is as follows:

- Scenario 1: dredging works to commence on 1st July 2016 (winter start):
  - TSHD dredging and disposal operations were programmed to occur between 1st July 2016 and 22nd August 2016.
  - BHD dredging and disposal operations were programmed to occur between 7th July 2016 and 4th August 2016.
  - A simulation run-on period was assumed to occur between 22nd August 2016 and 1st December 2016. Sediments suspended in the water column during previous operations were subject to settlement and progressively-reducing levels of resuspension during this time.
  - TSHD dredging and sand backfill operations were programmed to occur between 1st December 2016 and 3rd March 2017.
  - Side-dump vessel rock backfill operations were programmed to occur between 3rd March 2017 and 24th March 2017.
  - A further simulation run-on period was assumed to occur between 24th March 2017 and 23rd May 2017. Sediments suspended in the water column during previous operations were subject to settlement and progressively-reducing levels of resuspension during this time.
- Scenario 2: dredging works to commence on 1st January 2017 (summer start):
  - TSHD dredging and disposal operations were programmed to occur between 1st January 2017 and 22nd February 2017.
  - BHD dredging and disposal operations were programmed to occur between 7th January 2017 and 4th February 2017.
  - A simulation run-on period was assumed to occur between 22nd February 2017 and 1st June 2017. Sediments suspended in the water column during previous operations were subject to settlement and progressively-reducing levels of resuspension during this time.
  - TSHD dredging and sand backfill operations were programmed to occur between 1st June 2017 and 1st September 2017.
  - Side-dump vessel rock backfill operations were programmed to occur between 1st September 2017 and 22nd September 2017.
  - A further simulation run-on period was assumed to occur between 22nd September 2017 and 21st November 2017. Sediments suspended in the water column during previous operations were subject to settlement and progressively-reducing levels of resuspension during this time.

The outcomes of the summer-start and winter-start scenarios have been analysed and presented separately, for comparison.

3.6 Geotechnical Information

The dredged material from the pipeline route will consist mainly of marine sediments (approximately 1.80 Mm^3) and marine sediment/coarse material mix (approximately 0.07 Mm^3). The backfill material to be dredged from borrow ground A will consist of the removal of approximately 1.98 Mm^3 of sandy sediments with a low proportion of fines.

The critical geotechnical information required as input to the modelling is: (i) PSD data for the sediments to be dredged along the pipeline route; (ii) PSD data for the sediments to be dredged from borrow ground A; and (iii) PSD data for the quarry rock material.

The PSD data used in the modelling was specified by Woodside (2020) for each pipeline zone to be dredged (see Table 3.3) and for the sand backfill from borrow ground A. The specified PSD for each zone was determined based on an average of the PSD results of all samples taken within each zone during site investigations for the Scarborough development (Advisian, 2019a; Fugro, 2019). An example of a calculated average PSD plotted over the corresponding set of raw PSD sample data within zone PRE3 is shown in Figure 3.6. The geotechnical sampling points from which PSDs were acquired within each zone and within borrow ground A are summarised in Table 3.15, including reference to the relevant geotechnical investigation and the total number of PSD samples used to determine the average. The locations of the geotechnical sampling points from the Advisian (2019a) and Fugro (2019) site investigations are shown in Figure 3.4 and Figure 3.5, respectively.

It should be noted that the Advisian (2019a) sampling points were all surface sediment samples which typically contained higher fines content than samples taken below the surface. Therefore, to be conservative, where possible the Advisian (2019a) PSD sample data was selected for use in defining the PSDs for modelling.

The resultant PSDs for each pipeline section and borrow ground A have been redistributed to match the material size classes used in the DREDGEMAP model, as shown in Table 3.16 and Table 3.17.

For the rock backfill operations, in the absence of grading information it has been conservatively assumed that the fraction of material within the quarry rubble classified as “fines” in this context (diameters less than 100 mm) will be 5% of the total volume. From experience, this is a typical upper limit for the “fines” fraction of well-graded limestone rubble, with the breakdown of this figure into smaller size classes usually unknown. Although the most conservative approach would be to further assume that all of the “fines” material is potentially available for resuspension into the water column, the assumed PSD has been heavily slanted towards the least-mobile coarse sand (>130 µm) category to account for the typically minimal proportion of the finest material categories. The chosen PSD is shown in Table 3.18.

In addition to PSD information, data and assumptions relating to the dry bulk density of the material to be dredged from the pipeline route and borrow ground, and of the quarry rock material, was used as input to the modelling.

Dry bulk density information for the project area was available from a geotechnical study conducted by Fugro for the Scarborough development (Fugro, 2019) and from a previous geotechnical study conducted in the vicinity of the project area for the LNG Foundation Project (Coffey, 2007). The Fugro investigation presented ‘low-estimate’, ‘best-estimate’ and ‘high-estimate’ dry bulk density values along the trunkline and within the borrow ground. The high-estimate values were adopted as input to the modelling, as these values are most conservative in terms of sediment mass and also lie within the range of values presented in the earlier Coffey report. The dry bulk density values applied to each zone are outlined in Table 3.19. For the quarry rock material, a conservative dry bulk density value of 1,950 kg/m^3 was assumed based on learnings from the Pluto LNG Foundation Project, which utilised rock from the Nickol Bay quarry (located between Dampier and Karratha, Western Australia).

Table 3.15 Summary of geotechnical data used in the derivation of model PSDs for each pipeline zone and borrow ground A.

Pipeline Zone	Pipeline Location	Source Study	No. of PSD Samples	Location Figure
PRE1	KP0.072 – KP0.8	KP0.0 – KP3.6 (Advisian, 2019a)	35	Figure 3.4
PRE2	KP0.8 – KP3.9			
PRE3	KP3.9 – KP4.6	KP3.6 – KP4.6 (Advisian, 2019a)	8	Figure 3.4
PRE4	KP4.6 – KP6.0	KP4.6 – KP6.2 (Advisian, 2019a)	2	Figure 3.4
PRE6	KP11.2 – KP18.5	KP11.0 – KP15.0 (Advisian, 2019a)	21	Figure 3.4
PRE8	KP19.3 – KP21.3	KP18.0 – KP23.8 (Fugro, 2019)	3	Figure 3.5
PRE9B	KP23.0 – KP23.8	KP23.2 – KP23.8 (Fugro, 2019)	2	Figure 3.5
PRE10A	KP23.8 – KP38.2	KP23.8 – KP38.1 (Fugro, 2019)	10	Figure 3.5
PRE10B	KP38.2 – KP50.3	KP38.2 – KP50.0 (Fugro, 2019)	4	Figure 3.5
Borrow Ground A	N/A	Sand Search Area (Fugro, 2019)	5	Figure 3.5

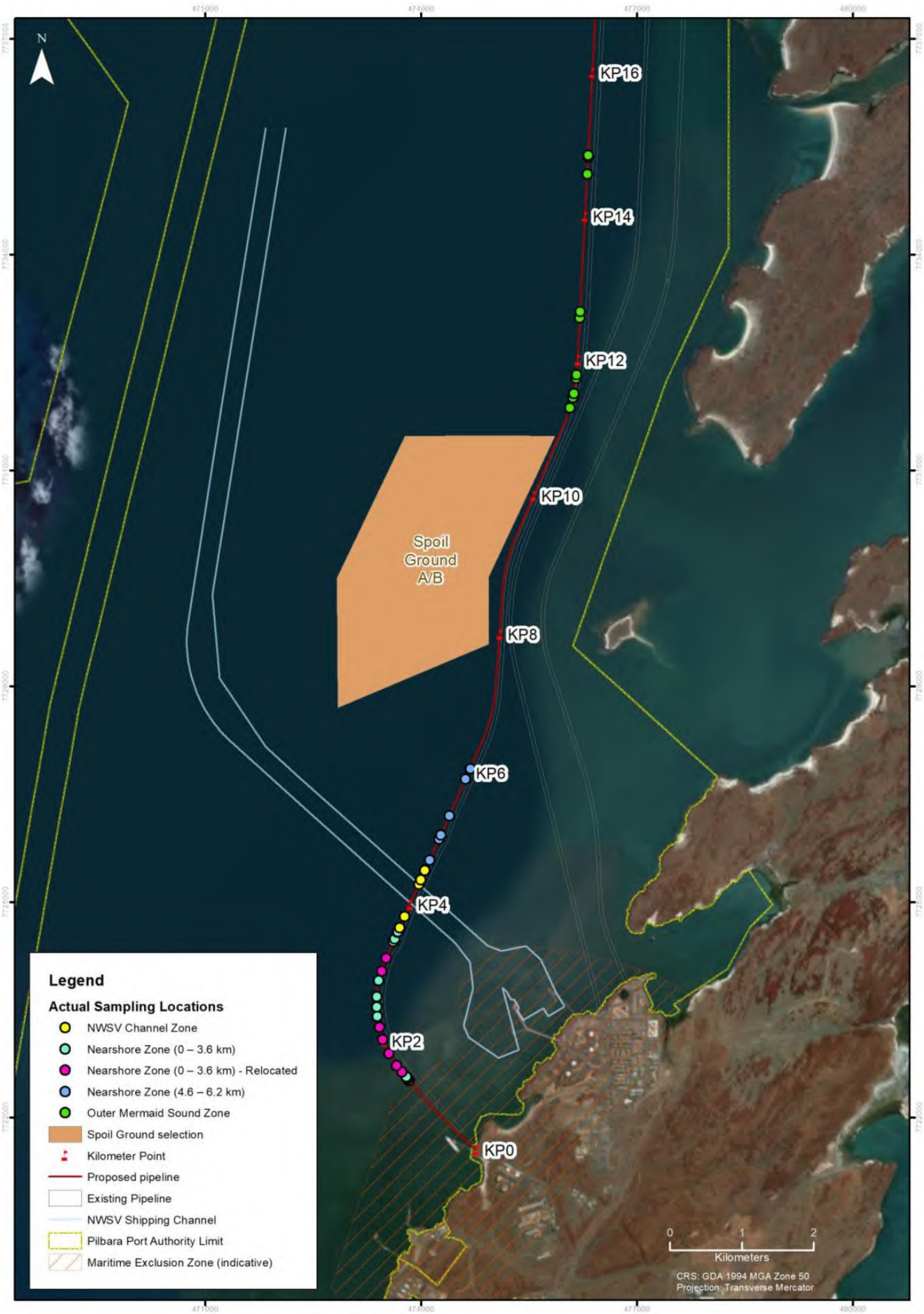


Figure 3.4 SAP implementation actual sampling locations, March 2019 (source: Advisian, 2019b).

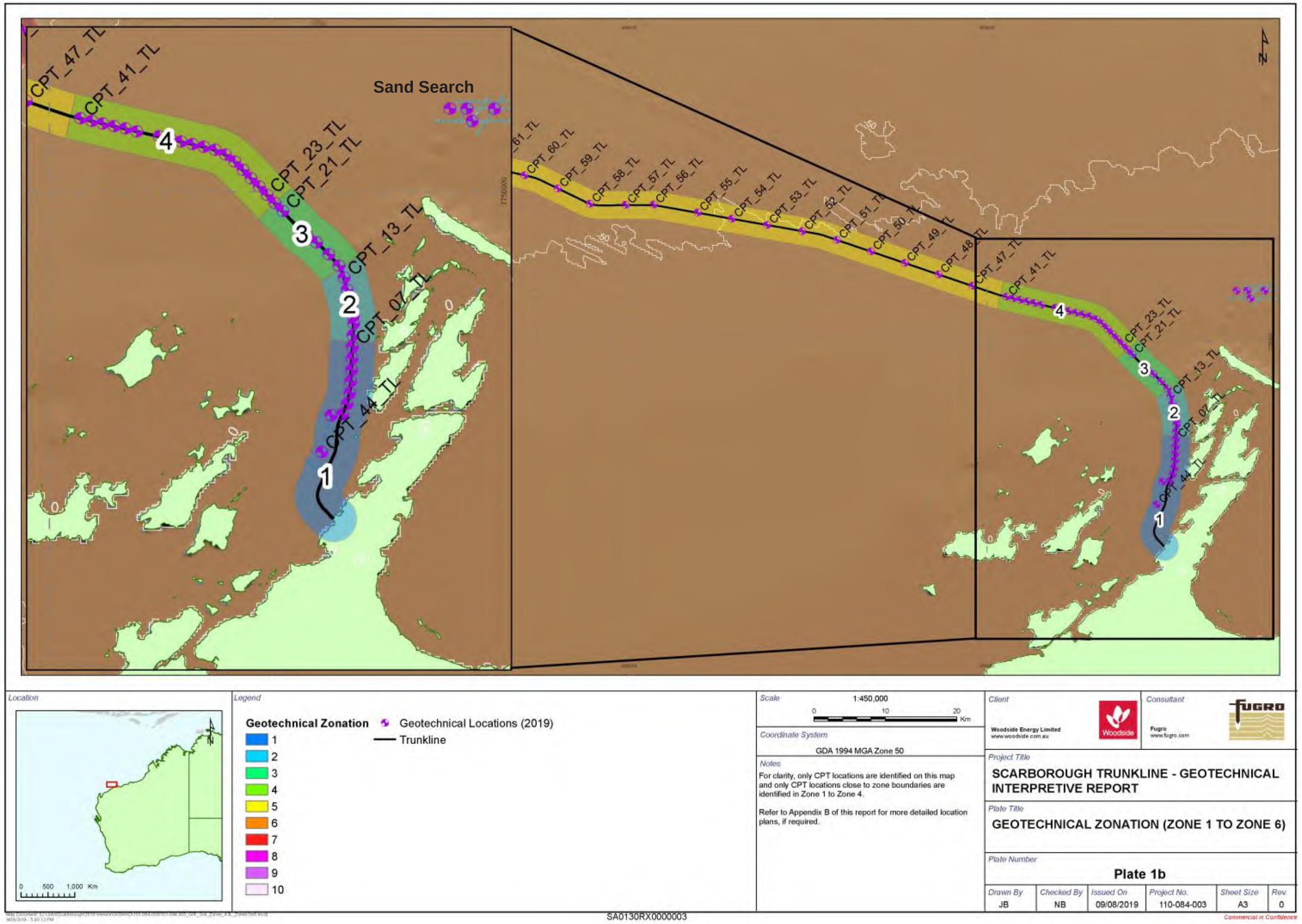
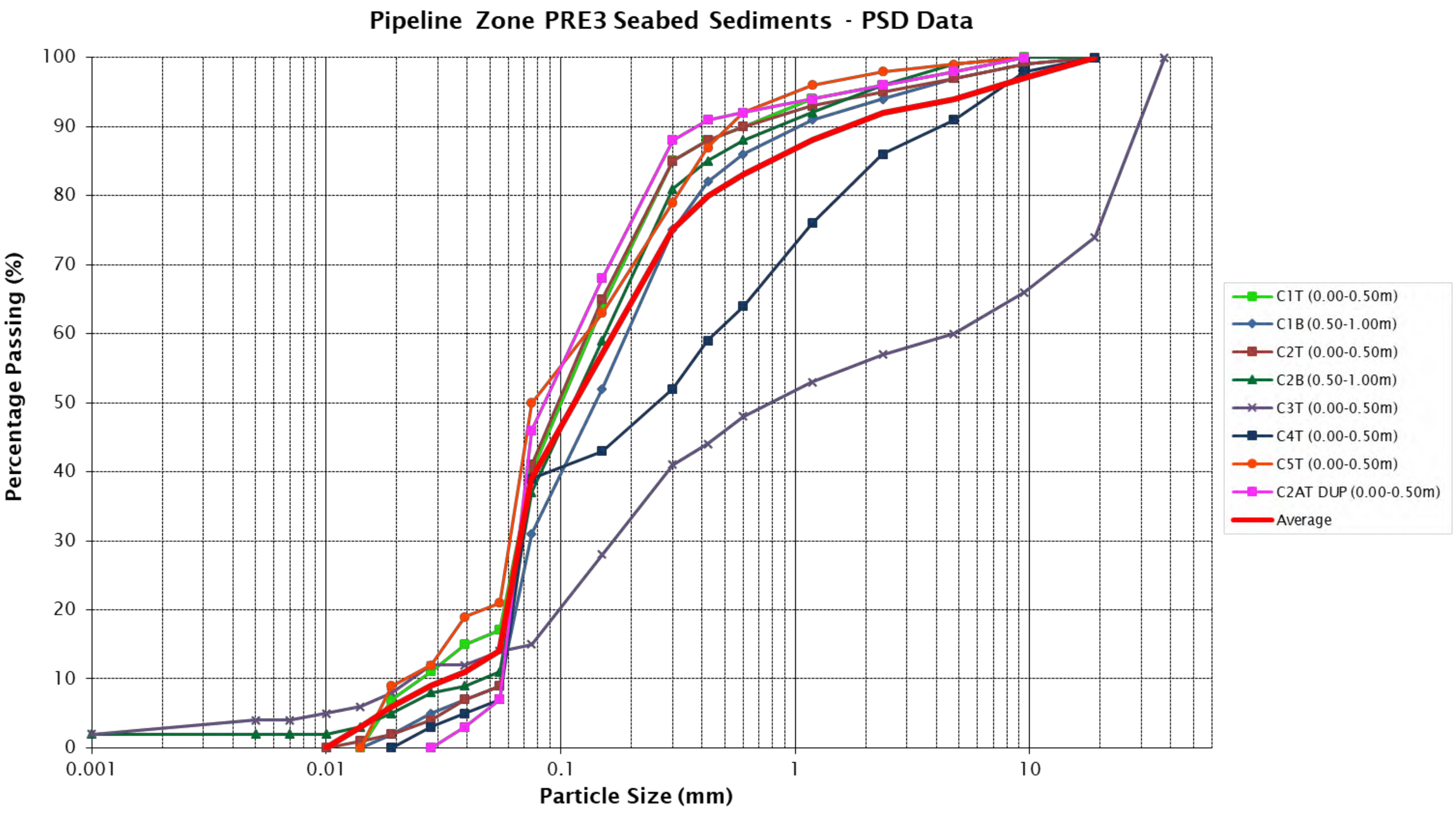


Figure 3.5 **Locations of geotechnical sample points along the trunkline and in the sand search area, extracted and modified from Fugro (2019). Note Zone 1 is from KP0-16.5, Zone 2 is from KP16.5-23.0, Zone 3 is from KP23.0-31.0 and Zone 4 is from KP31.0-51.0.**



CLAY	SILT	SAND FRACTION			GRAVEL FRACTION		
		FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE

Figure 3.6 Calculated average PSD (solid red line) overlain on raw PSD data for all samples from pipeline zone PRE3.

Table 3.16 *In situ* PSDs broken down into DREDGEMAP material classes for each pipeline section to be dredged, derived from available geotechnical information.

Sediment Grain Size Class	Size Range (µm)	Zone PRE1 (%)	Zone PRE2 (%)	Zone PRE3 (%)	Zone PRE4 (%)	Zone PRE6 (%)	Zone PRE8 (%)	Zone PRE9B (%)	Zone PRE10A (%)	Zone PRE10B (%)
Clay	<7	4.58	4.58	0.97	6.80	0.51	7.33	11.00	8.80	2.75
Fine Silt	7-34	8.51	8.51	8.89	7.63	11.52	6.33	9.50	5.40	2.00
Coarse Silt	35-74	18.31	18.31	28.37	11.94	25.94	16.33	21.00	10.80	7.75
Fine Sand	75-130	32.70	32.70	18.04	23.71	32.19	13.67	20.00	20.70	18.00
Coarse Sand	>130	35.90	35.90	43.73	49.92	29.84	56.34	38.50	54.30	69.50

Table 3.17 *In situ* PSDs broken down into DREDGEMAP material classes for the sand backfill material dredged from borrow ground A for each pipeline section, derived from available geotechnical information.

Sediment Grain Size Class	Size Range (µm)	Zone POST2 (%)	Zone POST4 (%)	Zone POST6 (%)	Zone POST8 (%)	Zone POST9B (%)	Zone POST10A (%)	Zone POST10B (%)
Clay	<7	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Fine Silt	7-34	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Coarse Silt	35-74	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Fine Sand	75-130	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Coarse Sand	>130	94.00	94.00	94.00	94.00	94.00	94.00	94.00

Table 3.18 *In situ* PSDs broken down into DREDGEMAP material classes for the rock backfill material of each pipeline section, assumed as typical values for well-graded limestone rubble.

Sediment Grain Size Class	Size Range (µm)	Zone POST1 (%)	Zone POST3 (%)	Zone POST5 (%)	Zone POST7 (%)	Zone POST9A (%)
Clay	<7	0.50	0.50	0.50	0.50	0.50
Fine Silt	7-34	0.50	0.50	0.50	0.50	0.50
Coarse Silt	35-74	0.50	0.50	0.50	0.50	0.50
Fine Sand	75-130	0.50	0.50	0.50	0.50	0.50
Coarse Sand	>130	98.00	98.00	98.00	98.00	98.00

Table 3.19 *In situ* dry bulk densities, based on the 'high estimate' values specified in Fugro (2019).

Zone	Dry Bulk Density (t/m^3)
PRE1	1.54
PRE2	1.54
PRE3	1.54
PRE4	1.54
PRE5	1.54
PRE6	1.54
PRE7	1.54
PRE8	1.54
PRE9A	1.54
PRE9B	1.54
PRE10A	1.54
PRE10B	1.54
Borrow Ground A	1.78

3.7 Model Sediment Sources

3.7.1 Overview

To accurately represent the pipeline dredging, disposal and backfill operations in DREDGEMAP, a range of information was defined for the proposed operations, including dredge, disposal and backfill methodology, production rates, sediment/rock types and quantities (see Section 3.5). It is evident that there will be seven different sources of suspended sediment plumes during dredging, disposal and backfill operations, which can be broadly defined as:

- Direct suspension of material from the BHD bucket, from grabbing and lifting unconsolidated sediments and sedimentary rock through the water column, accounting for periods of no-dewatering and dewatering from the split hopper barge.
- Disposal of sediment and rock excavated by the BHD from split hopper barges to the nominated spoil grounds.
- Direct suspension of material by the TSHD during dredging of unconsolidated sediments, accounting for no-overflow and overflow periods.
- Disposal of sediment dredged by the TSHD to the nominated spoil grounds.
- Indirect suspension of material due to the propeller-wash of the BHD barge tug and TSHD while dredging.
- Suspension of material during backfill activities, via TSHD, using sediments dredged from the borrow ground.
- Suspension of material during backfill activities, via side-dump vessel, using rock from onshore quarries.

Each of these sources of suspended sediment plumes will vary in strength and persistence depending on the nature of the operations. In the DREDGEMAP model, each source is defined by specifying the time-varying flux rate, PSD and vertical profile in the water column. The following sections outline how the information provided has been used to represent the dredging operations in the model and explain any assumptions that have been made to supplement the available information.

3.7.2 Representation of BHD Dredging

A BHD will be used to excavate all unconsolidated sediments and sedimentary rock material from zone PRE1, and all sedimentary rock material from zones PRE2 and PRE4 (following TSHD dredging of unconsolidated sediments in these zones) (Figure 3.7). The BHD will use a large excavator arm fitted with an open bucket of (nominally) 20-30 m^3 capacity. The excavator will lift material in the bucket and deliver it to one of two waiting split hopper barges – assumed for the purposes of modelling to be 3,800 m^3 in capacity – for transport to spoil ground AB for disposal.

Sources of sediment suspension from this type of operation include:

- Disturbance of the seabed sediments by the excavator bucket.
- Dewatering of the split hopper barge, resulting in the discharge of water and entrained sediments.

Only the first of these sources was considered in this modelling study, as it is understood that dewatering of split hopper barges is not planned to occur during BHD dredging operations for the Scarborough development.

Past observations have shown that material is suspended due to the initial grab at the seabed. Further suspension is generated as sediment spills from the bucket as it is lifted through the water column. Spillage of water and sediment also occurs as the bucket breaks free of the water surface and drains freely. Only sediments <130 μm in diameter are considered “lost” (i.e. suspended into the water column), because the coarser material spilled from the bucket while being lifted to the surface will fall immediately to the bottom where it will be re-dredged during subsequent grabs. As such, the distribution of material suspended by the bucket spillage is assumed to be distributed across the four smaller sediment size classes in the model.

For the dredging of the unconsolidated sediments, the PSD used in the model is based on PSDs from nearby boreholes (see Section 3.6), with the proportion >130 μm removed and the remaining distribution normalised to 100% by scaling up the proportions in the four remaining size classes (Table 3.20). The same PSD is used for the sedimentary rock component, assuming that due to the excavation action of the BHD the rock will break down into similar proportions of fines. Because the dredging action of the excavator involves no cutting or hydraulic pumping, this is a conservative assumption.

Table 3.21 shows the assumed vertical distribution of the suspended material during the BHD operations. The distribution is higher at the seabed and water surface, to represent the larger loss rate of material during the initial grab and as the bucket breaks free of the water column.

Table 3.20 Assumed PSDs of sediments initially suspended into the water column during BHD dredging operations along the pipeline route.

Sediment Grain Size Class	Size Range (μm)	PSD (%) for Sediment and Sedimentary Rock Removal – Zone PRE1	PSD (%) for Sedimentary Rock Removal – Zone PRE2	PSD (%) for Sedimentary Rock Removal – Zone PRE4
Clay	<7	7.15	7.15	13.58
Fine Silt	7-34	13.28	13.28	15.24
Coarse Silt	35-74	28.56	28.56	23.84
Fine Sand	75-130	51.01	51.01	47.34
Coarse Sand	>130	0.00	0.00	0.00

Table 3.21 Assumed vertical distribution of sediments initially suspended into the water column during BHD dredging operations along the pipeline route.

Elevation	Example Elevation (m ASB) – 10 m Water Depth	Vertical Distribution (%) of Sediments
Surface/water depth	10.0	23.0
0.80 x water depth	8.0	16.0
0.50 x water depth	5.0	14.0
0.30 x water depth	3.0	19.0
0.10 x water depth	1.0	28.0

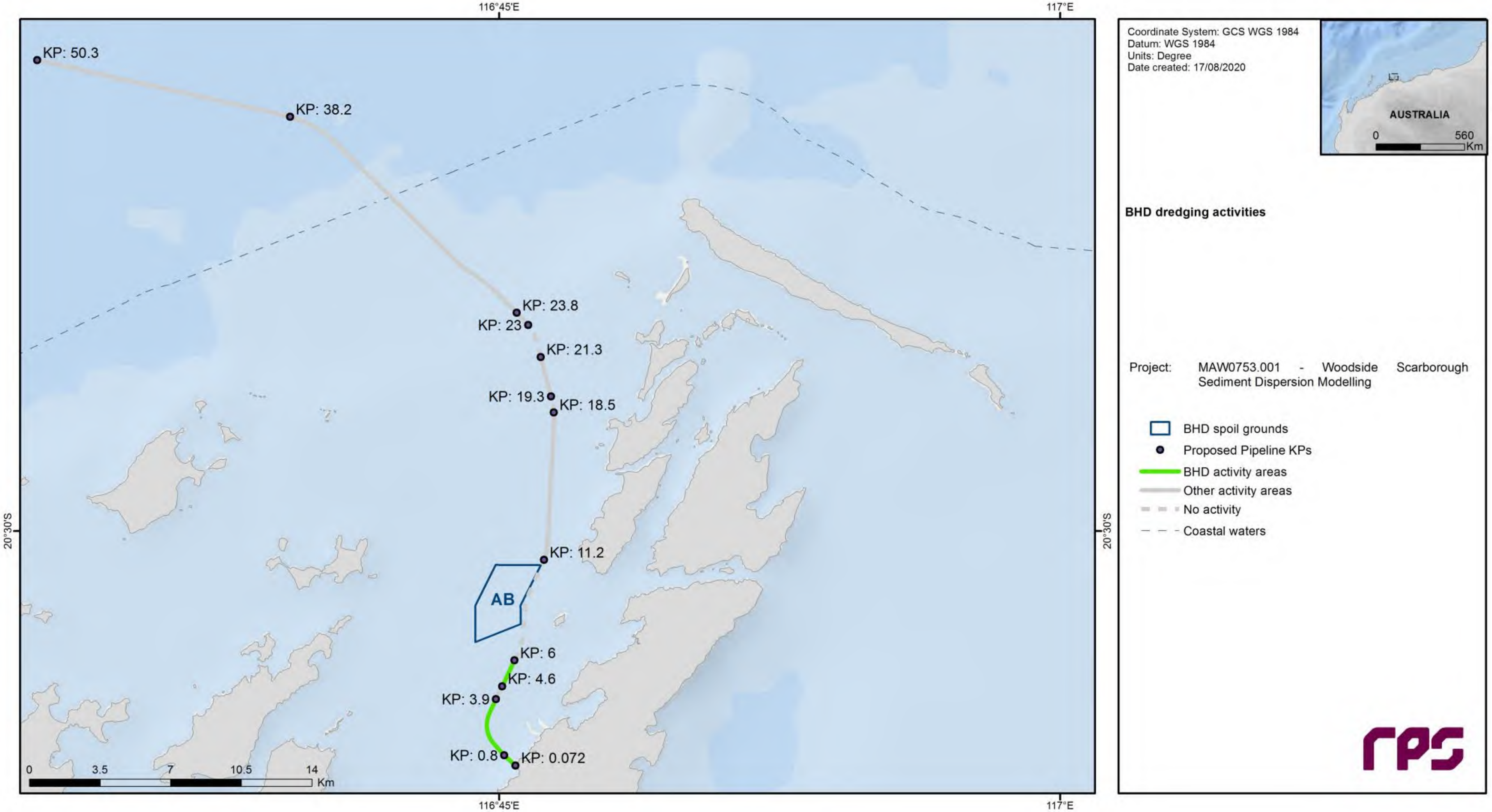


Figure 3.7 Overview of BHD dredging activity areas, showing the pipeline KPs and location of spoil ground AB that will be utilised during disposal activities.

Loss rates from similar operations are known to vary based on such factors as the size and type of bucket (i.e. open or closed), nature of the seabed material, presence of debris, current speed and depth of water, as well as the care of the operator (Hayes & Wu, 2001; Anchor Environmental, 2003). Reported rates compared by Anchor Environmental (2003) varied from 0.1% to 10%, with a mean of 2.1%. In the absence of measurements for the specific situation and equipment, the mean of 2.1% of production rate is assumed for all BHD operations.

3.7.3 Representation of Disposal of BHD-Dredged Material

All material dredged by the BHD will be placed into one of two waiting 3,800 m^3 split hopper barges and transported (by harbour tug) to spoil ground AB for disposal (Figure 3.7). This material will include all unconsolidated sediments and sedimentary rock material from zone PRE1, and all sedimentary rock material from zones PRE2 and PRE4.

For the disposal of the unconsolidated sediments dredged by BHD, the PSD used in the model is based on PSDs from nearby boreholes (see Section 3.6). The same PSD is used for the sedimentary rock component, assuming that due to the excavation action of the BHD the rock will break down into similar proportions of fines. Because the dredging action of the excavator involves no cutting or hydraulic pumping, this is a conservative assumption. This PSD is adjusted by removal of the component treated as suspended during dredging (see Section 3.7.2), but as this represents only 2.1% of the mass for the minor components, the modified PSD is not significantly different to the *in situ* PSD (Table 3.22).

Once at the AB spoil ground, the split hopper barge will open to release the sediments from the bottom of the hull at a depth of approximately 5.8 m below sea level. Previous observations of sediment dumping from hopper vessels (e.g. CSMW, 2005) have shown that there is an initial rapid descent of solids, with the heavy particles tending to entrain lighter particles, followed by a billowing of lighter components back into the water column after contact with the seabed (Figure 3.8). A proportion of the lighter components will also remain suspended and may be trapped by density layers, if present.

Because simulations in this study focused on the far-field fate of sediment particles due to transport and sinking after the initial dump phase, simulations were run with the initial vertical distribution specified to represent the post-collision phase for a case where a high proportion of the sediments are resuspended after collision with the seabed. To represent this, an assumed vertical distribution for the sediments (Table 3.23) has been specified following published information from previous hopper disposal operations (CSMW, 2005; NEPA, 2001). This vertical distribution, with the majority of the material input near the seabed and only 7% of the material released in the upper half of the water column, is in line with values quoted in the recent literature review by Mills & Kemps (2016), which found that sediment resuspension from individual dredged material disposal events was generally less than 10% of the disposed material load.

It is estimated that 95-99% of the bulk load deposits directly onto the seabed in a typical case, with the remainder released into the water column (CSMW, 2005, NEPA, 2001). It is difficult to find other definitive source values in the literature, but a value of 5% of each load agrees well with past experience and appears to be a conservative estimate based on the values quoted above. Accordingly, 5% of each hopper load was placed in suspension in the water column in the sediment fate model.

In addition to the proportion of material immediately suspended in the water column, disposal from the barge will result in the stockpiling of sediment as a mound on the seabed that will be subject to resuspension by tidal and wave forces. Because fine sediments in the deposited mass may be subject to ongoing resuspension and dispersion over time, it was necessary to specify the deposits as a further source of sediment potentially subject to resuspension.

The proportion of the newly deposited trenched material available for resuspension is characterised by a finite limit regulated by PSDs and the occurrence of natural sediment capping. As a result of the selective resuspension of the smaller-sized particles (silts and clays), the deposited mound surface layer gradually contains a greater proportion of larger particle sizes. These larger particles act as armouring against bottom shear stress, protecting and retaining the remaining fine particles in the mound. Therefore, in the model it was assumed that 5% of the deposited mass – representing the volume of the upper surface layer – would be subject to resuspension. It should be noted that the model maintains a mass balance estimate of the remaining sediment of each size class within each grid cell to derive an estimate of the median particle size in the surface-layer sediments. In turn, the potential for ongoing resuspension of fines is calculated. In this way, the model represents the increased armouring of sediments as the average particle size increases.

The disposal time for the barge material within each dredge cycle was assumed to be 15 minutes (Table 3.4). The disposal location within spoil ground AB was varied for each dredge cycle in a randomised manner, with the ultimate aim of ensuring an even distribution of dredged material within the spoil ground by the conclusion of all activities.

Table 3.22 Assumed PSDs of sediments initially suspended into the water column during split hopper barge disposal operations at spoil ground AB.

Sediment Grain Size Class	Size Range (μm)	PSD (%) for Sediment and Sedimentary Rock Disposal – Zone PRE1	PSD (%) for Sedimentary Rock Disposal – Zone PRE2	PSD (%) for Sedimentary Rock Disposal – Zone PRE4
Clay	<7	4.43	4.43	6.51
Fine Silt	7-34	8.23	8.23	7.31
Coarse Silt	35-74	17.71	17.71	11.44
Fine Sand	75-130	31.63	31.63	22.72
Coarse Sand	>130	38.00	38.00	52.02

Table 3.23 Assumed vertical distribution of sediments initially suspended into the water column during split hopper barge disposal operations at spoil ground AB.

Elevation	Example Elevation (m ASB) – 10 m Water Depth	Vertical Distribution (%) of Sediments
Surface/water depth	10.0	2.0
0.60 x water depth	6.0	5.0
0.40 x water depth	4.0	15.0
0.15 x water depth	1.5	35.0
0.10 x water depth	1.0	43.0

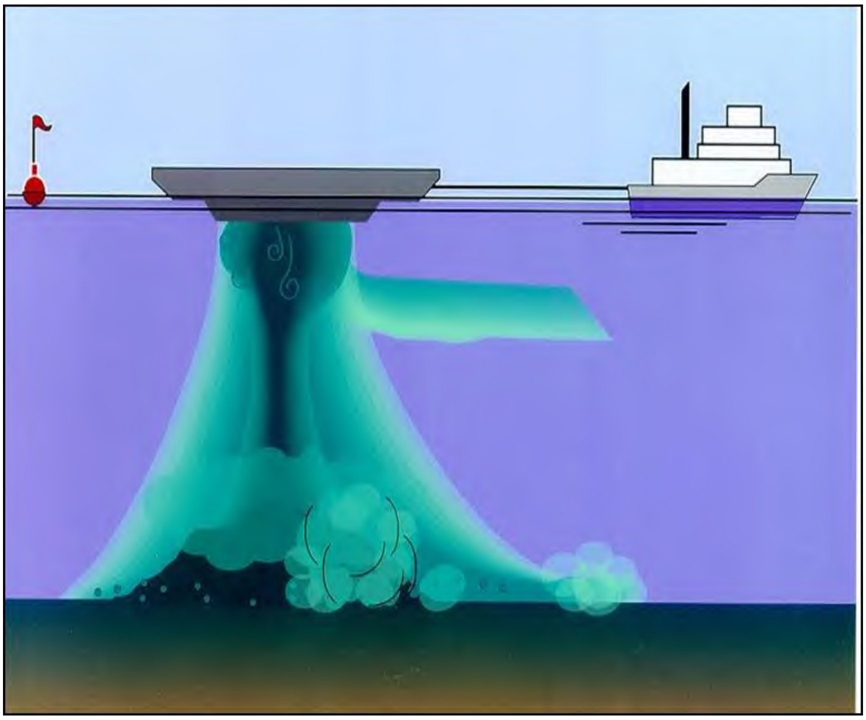


Figure 3.8 Conceptual diagram showing the general behaviour of sediments dumped from a split hopper barge and the vertical distribution of material set up by entrainment and billowing (source: ASA, 2004).

3.7.4 Representation of TSHD Dredging

A TSHD will be used to excavate all unconsolidated sediments from zones PRE2, PRE3, PRE4, PRE6, PRE8 and PRE9B with disposal at spoil ground 2B, and zones PRE10A and PRE10B with disposal at spoil ground 5A (Figure 3.9). The TSHD will also be used to dredge backfill material from borrow ground A, with disposal along the pipeline route. For the purposes of modelling, the capacity of the TSHD to be used for dredging of the pipeline route and borrow ground A was assumed to be 12,000 m^3.

TSHD vessels remove sediments by dragging a large drag-head over the seabed and drawing up the disturbed sediment by hydraulic suction. Sources of sediment suspension from this type of operation include:

- Hydraulic disturbance of the seabed sediments by the trailing arm.
- Propeller-wash generated as the vessel manoeuvres.
- Overflow of the on-board hoppers, resulting in the discharge of water and entrained sediments.

The characteristics of each of these sources vary greatly due to a wide range of factors (USACE, 2008) making the generalisation of source terms difficult. It appears however, that the overflow source term is dominant, being typically an order of magnitude greater than the drag-head and propeller-wash terms.

For the dredging of the unconsolidated sediments during periods with no overflow, the PSDs used in the model are based on PSDs from nearby boreholes (see Section 3.6). The PSDs applied to dredging along the pipeline route and within the borrow ground are shown in Table 3.24 and Table 3.26, respectively. During overflow periods, an increase in the rate of release of fine sediments, and hence initial turbidity, is observed (Anchor Environmental, 2003). The overflow water contains a high proportion of fines because the coarse material settles rapidly in the hopper while the fine material remains in suspension. After the hopper begins overflowing, PSDs heavily weighted towards finer particles have been assumed based on previous field measurements of hopper barge dewatering at Geraldton Port (OPR, 2010), with the proportion >75 µm removed and the remaining distribution normalised to 100% by scaling up the proportions in the three remaining size classes. The PSDs applied to dredging along the pipeline route and within the borrow ground are shown in Table 3.25 and Table 3.27, respectively.

Table 3.28 shows the assumed vertical distribution of the suspended material during the TSHD operations while the hopper is not overflowing. The distribution is concentrated near the seabed and decreases in intensity towards the surface, to represent the disturbance of seabed material by the drag-head and propeller-wash effects (HR Wallingford, 2003). After the hopper begins overflowing, a uniform distribution of sediments throughout the water column, between the hull depth and the seabed, has been assumed to represent a continuous stream of material being discharged from the hopper through an overflow system incorporating a ‘green valve’ (Table 3.29). This is consistent with measured ADCP profiles presented by Hitchcock & Bell (2004), which show a reasonably even distribution of sediment through the water column during hopper overflow.

It should be noted that the installation of a green valve within an overflow system is designed to reduce the proportion of air entrained into the overflow mixture, which in turns will result in a lessened phenomenon of discharged material mixing and billowing upwards to the water surface. To account for this process in the modelling, the vertical distribution applied during hopper overflow (Table 3.29) is not uniform throughout the entire water column, but only from the hull depth to the seabed.

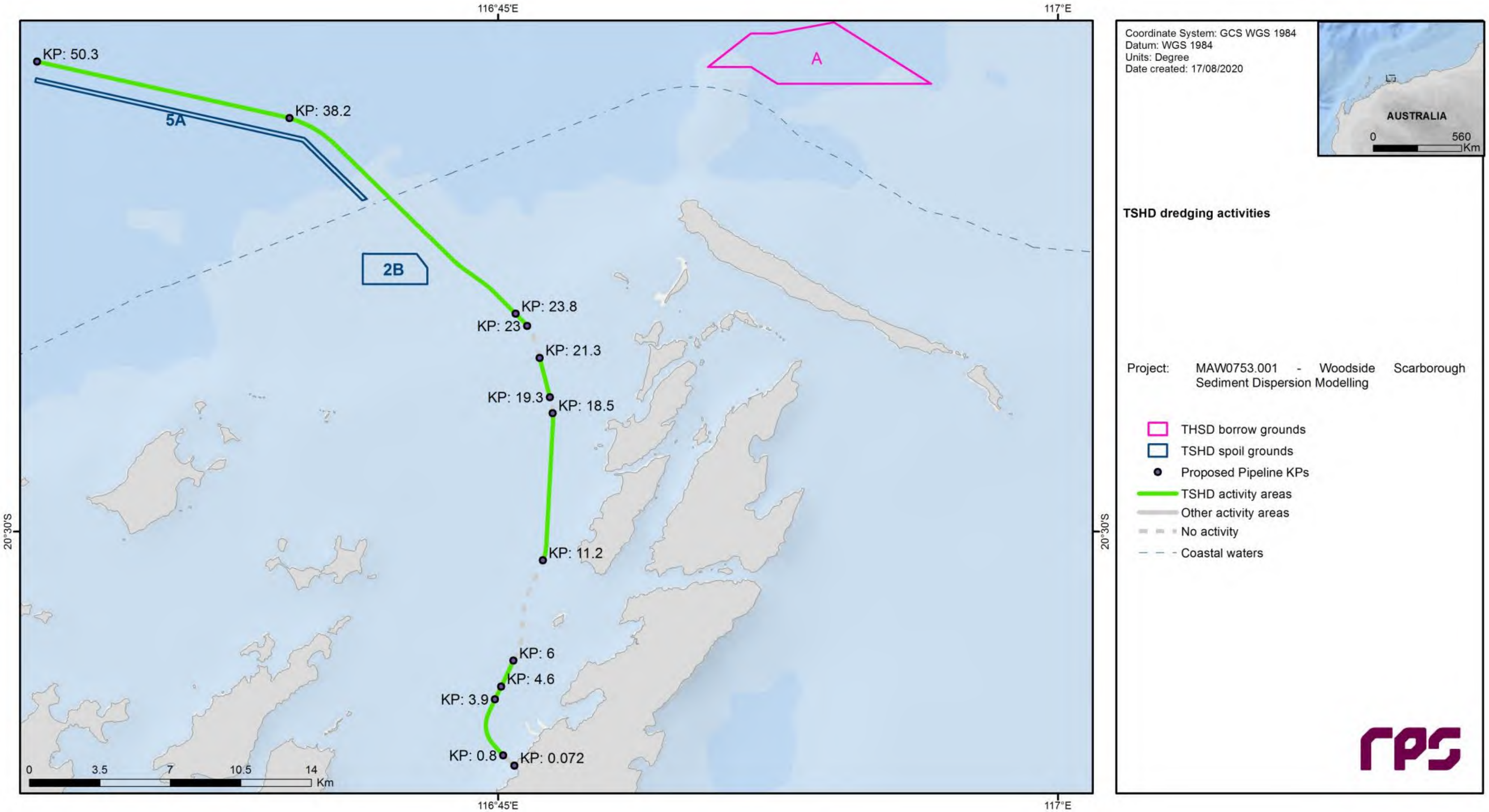


Figure 3.9 Overview of TSHD dredging activity areas, showing the pipeline KPs, locations of spoil grounds 2B and 5A that will be utilised during disposal activities, and location of borrow ground A where sand backfill material is to be sourced.

Table 3.24 Assumed PSDs of sediments initially suspended into the water column during TSHD dredging operations along the pipeline route while the hopper is not overflowing.

Sediment Grain Size Class	Size Range (µm)	PSD (%) for Sediment Removal							
		Zone PRE2	Zone PRE3	Zone PRE4	Zone PRE6	Zone PRE8	Zone PRE9B	Zone PRE10A	Zone PRE10B
Clay	<7	4.58	0.97	6.80	0.51	7.33	11.00	8.80	2.75
Fine Silt	7-34	8.51	8.89	7.63	11.52	6.33	9.50	5.40	2.00
Coarse Silt	35-74	18.31	28.37	11.94	25.94	16.33	21.00	10.80	7.75
Fine Sand	75-130	32.70	18.04	23.71	32.19	13.67	20.00	20.70	18.00
Coarse Sand	>130	35.90	43.73	49.92	29.84	56.34	38.50	54.30	69.50

Table 3.25 Assumed PSDs of sediments initially suspended into the water column during TSHD dredging operations along the pipeline route while the hopper is overflowing.

Sediment Grain Size Class	Size Range (µm)	PSD (%) for Sediment Removal							
		Zone PRE2	Zone PRE3	Zone PRE4	Zone PRE6	Zone PRE8	Zone PRE9B	Zone PRE10A	Zone PRE10B
Clay	<7	42.31	34.94	47.30	34.63	45.84	43.18	50.05	50.88
Fine Silt	7-34	27.03	25.57	27.51	28.27	25.23	25.30	25.65	25.63
Coarse Silt	35-74	30.66	39.49	25.19	37.11	28.93	31.53	24.30	23.50
Fine Sand	75-130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse Sand	>130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3.26 Assumed PSDs of sediments initially suspended into the water column during TSHD dredging operations at borrow ground A while the hopper is not overflowing.

Sediment Grain Size Class	Size Range (µm)	PSD (%) for Sediment Removal – Borrow Ground A
Clay	<7	1.13
Fine Silt	7-34	1.13
Coarse Silt	35-74	1.13
Fine Sand	75-130	3.00
Coarse Sand	>130	94.00

Table 3.27 Assumed PSDs of sediments initially suspended into the water column during TSHD dredging operations at borrow ground A while the hopper is overflowing.

Sediment Grain Size Class	Size Range (µm)	PSD (%) for Sediment Removal – Borrow Ground A
Clay	<7	54.48
Fine Silt	7-34	27.32
Coarse Silt	35-74	18.59
Fine Sand	75-130	0.0
Coarse Sand	>130	0.0

Table 3.28 Assumed vertical distribution of sediments initially suspended into the water column during TSHD dredging operations along the pipeline route and at borrow ground A while the hopper is not overflowing.

Elevation	Example Elevation (m ASB) – 30 m Water Depth	Vertical Distribution (%) of Sediments
10.0 m (ASB)	10.0	5.0
7.0 m (ASB)	7.0	15.0
3.0 m (ASB)	3.0	20.0
2.0 m (ASB)	2.0	40.0
1.0 m (ASB)	1.0	20.0

Table 3.29 Assumed vertical distribution of sediments initially suspended into the water column during TSHD dredging operations along the pipeline route and at borrow ground A while the hopper is overflowing.

Elevation	Example Elevation (m ASB) – 30 m Water Depth and 10 m Hull Depth	Vertical Distribution (%) of Sediments
Hopper hull elevation	20.0	20.0
0.75 x hull elevation	15.0	20.0
0.50 x hull elevation	10.0	20.0
0.25 x hull elevation	5.0	20.0
0.50 m (ASB)	0.5	20.0

The resuspension of sediment when the TSHD hopper is not overflowing was estimated by combining the drag-head and propeller-wash terms. The propeller-wash component typically dominates the drag-head component, but both sources were assessed. Propeller-wash generation was estimated by applying a model of the bed-induced shear stress from the TSHD vessel over the range of under-keel clearances expected during the dredging operations.

Field measurements of drag-head-induced sediment suspension was reported by Coastline Surveys Ltd (CSL, 1999). The inferred production rate was less than 1 kg/s and it was concluded that, generally, drag-head production is small in comparison to the quantity of sediment released via overflow. Given the above, a loss rate of 0.6% of the gross production rate, representing a combined sediment flux due to losses from the drag-head and propeller-wash, was assumed when the TSHD is not overflowing. This rate is within the range of values (less than 1%) summarised in a review of contemporary practice conducted as part of the WAMSI Dredging Science Node by Kemps & Masini (2017).

The resuspension of sediment from hopper overflow is the most complex source term associated with a TSHD. The discharged water-sediment mixture forms a negatively-buoyant jet (dynamic plume) that descends towards the seabed. Due to mixing and entrainment as the plume descends, not all of the sediment in the dynamic plume directly descends to the seabed, forming a passive plume in the water column below the TSHD. Based on evidence from numerous field measurements, Spearman *et al.* (2011) state that the dynamic plume retains the bulk of the overflow sediment, with a small proportion (in the range of 5-15%) contained in the passive plume. The proportion of sediment contained in the passive plume is a function of the air content in the overflow mixture, with the use of a green valve shown to significantly reduce the proportion of the overflow sediment that forms the passive plume (Spearman *et al.*, 2011).

The overflow source term was calculated for each discrete dredge zone based on a method outlined in Becker *et al.* (2015) and recommended in Kemps & Masini (2017). This method was applied as it allows the proportion of fines in the material being dredged in each zone to be considered in determination of the source terms. This is important for this project given the significant variations in the fines proportion between dredge zones. Additionally, this method allows for the use of a green valve in the overflow system to be accounted for in the source term estimates.

The Becker *et al.* (2015) method considers the following parameters:

- The total flux of fines entering the hopper during dredging.

- The proportion of the dredged fines flux that settles (and is trapped) in the hopper.
- The proportion of the dredged fines flux that exits the hopper in the overflow water.
- The relative proportions of the overflow fines flux that contribute to the dynamic and passive plumes.

In calculating these parameters, the method takes into account:

- The PSDs and dry bulk densities of the material to be dredged.
- The production/pumping rates of the TSHD.
- The rate at which material settles/traps in the hopper.
- The overflow-to-loading ratio based on the dredge cycle times.

Becker *et al.* (2015) state that a reasonable estimate of the proportion of overflow fines that becomes the passive plume will fall in the range of 0-20%. This broadly agrees with the range of 5-15% found in Spearman *et al.* (2011). Values of this order of magnitude are confirmed by field measurements taken during operation of a sand dredger (8,225 m^3 capacity) in Hong Kong, which suggested 15% of the overflow fines flux contributed to the passive plume (Whiteside *et al.*, 1995).

It should be noted that in the Hong Kong study a green valve was not employed to moderate the overflow. There is limited experimental data available on the degree to which a green valve will reduce the proportion of the overflow fines flux that becomes a passive plume. DHI (2010) state that an appropriate estimate for the proportion of fines remaining in the passive plume when a green valve is in use is around 7% of the total overflow fines flux, with this assessment informed by monitoring activities undertaken in the vicinity of marine construction vessels in Singapore.

The proposed use of a green valve during the Scarborough development is accounted for in this modelling study by assuming that 10% of the overflow fines flux will become a passive plume. This represents a moderate value in the context of the ranges stated above. Calculation of the overflow source rates using a proportional value of 10% are presented in Table 3.30 for each dredge zone, expressed as a proportion of the dredging production rate.

Table 3.30 Calculated source rates of sediments initially suspended into the water column during TSHD hopper overflow, using the methodology outlined in Becker *et al.* (2015).

Zone	Source Rate (% Production Rate)
PRE1	2.77
PRE2	2.77
PRE3	3.96
PRE4	2.73
PRE6	3.74
PRE8	3.21
PRE9B	4.44
PRE10A	2.17
PRE10B	1.08
Borrow Ground A	0.30

The overflow source rate values calculated using the Becker *et al.* (2015) method range from 0.30% to 3.96% of the gross production rate, which compares well with the range of published measurements from TSHD operations (0.1-5.0%; Hayes & Wu, 2001) and is within the range of values used in modelling studies (0.3-9.8%) outlined in a review of contemporary practice by Kemps & Masini (2017). The lower overflow source rate values (<1.5% of total production) were calculated for the dredge areas containing material that had lower fines content, such as borrow ground A and zone PRE10B (see Section 3.6). Overflow source rate values quoted in literature for areas with low fines content range from 0.3 to 2.1% of total production, giving confidence in the calculated values. For the trenching areas where the fines content is higher (zones PRE1 through PRE9; Section 3.6), the calculated overflow source rate values are in the mid-range of the literature values.

To further contextualise the overflow source rate values calculated using the Becker *et al.* (2015) method, the corresponding TSS concentrations in the hopper overflow have been calculated and compared to values found in literature. Passive plume concentrations calculated without accounting for a green valve are in the range 2,300-4,700 mg/L for the areas with lower fines content (borrow ground A and zone PRE10), and in the range 9,000-14,000 mg/L for the remaining trenching areas. When a green valve is considered, the calculated concentrations are reduced to 1,900-3,800 mg/L for the areas with lower fines content and 7,500-11,500 mg/L for the remaining areas.

Field measurements taken of the TSS concentrations within overflowing waters are typically in the 5,000-6,000 mg/L range, and are generally less than 10,000 mg/L adjacent to the hopper (Hitchcock & Bell, 2004). These values correlate well with data drawn from other Western Australian projects that cannot be cited here for reasons of confidentiality. From comparisons, it is clear that the calculated values above fall into a range that past experience suggests is realistic.

3.7.5 Representation of Disposal of TSHD-Dredged Material

All material dredged by the TSHD along the pipeline route will be transported to spoil ground 2B or 5A (as appropriate) for disposal (Figure 3.9). This material will include all unconsolidated sediments from zones PRE2, PRE3, PRE4, PRE6, PRE8, PRE9B, PRE10A and PRE10B.

For the disposal of the unconsolidated sediments dredged by TSHD, the PSDs used in the model are based on PSDs from nearby boreholes (see Section 3.6). These PSDs are adjusted by removal of the component treated as suspended during dredging along the pipeline route (see Section 3.7.4), but as this represents only between 0.6% and 5.0% (averaged value depending on the relative contributions of overflow and non-overflow periods to the overall mass flux) of the mass for the minor components, the modified PSDs are not significantly different to the *in situ* PSDs (Table 3.31).

Once at the appropriate spoil ground, the hopper will open to release the sediments from the bottom of the hull at a depth of approximately 12.75 m below sea level. Previous observations of sediment dumping from hopper vessels (e.g. CSMW, 2005) have shown that there is an initial rapid descent of solids, with the heavy particles tending to entrain lighter particles, followed by a billowing of lighter components back into the water column after contact with the seabed (Figure 3.10). A proportion of the lighter components will also remain suspended and may be trapped by density layers, if present.

Because simulations in this study focused on the far-field fate of sediment particles due to transport and sinking after the initial dump phase, simulations were run with the initial vertical distribution specified to represent the post-collision phase for a case where a high proportion of the sediments are resuspended after collision with the seabed. To represent this, an assumed vertical distribution for the sediments (Table 3.32) has been specified following published information from previous hopper disposal operations (CSMW, 2005; NEPA, 2001). This vertical distribution, with the majority of the material input near the seabed and only 15% of the material released at hull depth or above, is in line with values quoted in the recent literature review by Mills & Kemps (2016), which found that sediment resuspension from individual dredged material disposal events was generally less than 10% of the disposed material load.

It is estimated that 95-99% of the bulk load deposits directly onto the seabed in a typical case, with the remainder released into the water column (CSMW, 2005, NEPA, 2001). It is difficult to find other definitive source values in the literature, but a value of 5% of each load agrees well with past experience and appears to be a conservative estimate based on the values quoted above. Accordingly, 5% of each hopper load was placed in suspension in the water column in the sediment fate model.

In addition to the proportion of material immediately suspended in the water column, disposal from the hopper will result in the stockpiling of sediment as a mound on the seabed that will be subject to resuspension by tidal and wave forces. Because fine sediments in the deposited mass may be subject to ongoing resuspension and dispersion over time, it was necessary to specify the deposits as a further source of sediment potentially subject to resuspension.

The proportion of the newly deposited trenched material available for resuspension is characterised by a finite limit regulated by PSDs and the occurrence of natural sediment capping. As a result of the selective resuspension of the smaller-sized particles (silts and clays), the deposited mound surface layer gradually contains a greater proportion of larger particle sizes. These larger particles act as armouring against bottom shear stress, protecting and retaining the remaining fine particles in the mound. Therefore, in the model it was assumed that 5% of the deposited mass – representing the volume of the upper surface layer – would be subject to resuspension. It should be noted that the model maintains a mass balance estimate of the remaining sediment of each size class within each grid cell to derive an estimate of the median particle size in the surface-layer sediments. In turn, the potential for ongoing resuspension of fines is calculated. In this way, the model represents the increased armouring of sediments as the average particle size increases.

The disposal time for the hopper material within each dredge cycle was assumed to be 15 minutes (Table 3.5). The disposal location within the relevant spoil ground was varied for each dredge cycle in a randomised manner, with the ultimate aim of ensuring an even distribution of dredged material within each spoil ground by the conclusion of all activities (Table 3.6).

Table 3.31 Assumed PSDs of sediments initially suspended into the water column during TSHD hopper disposal operations at spoil grounds AB, 2B and 5A.

Sediment Grain Size Class	Size Range (µm)	PSD (%) for Sediment Disposal							
		Zone PRE2	Zone PRE3	Zone PRE4	Zone PRE6	Zone PRE8	Zone PRE9B	Zone PRE10A	Zone PRE10B
Clay	<7	3.15	0.00	5.22	0.00	5.58	8.82	7.42	1.89
Fine Silt	7-34	7.60	7.10	6.71	9.30	5.37	8.22	4.69	1.57
Coarse Silt	35-74	17.28	26.57	11.10	24.33	15.23	19.41	10.13	7.35
Fine Sand	75-130	32.70	18.04	23.71	32.19	13.67	20.00	20.70	18.00
Coarse Sand	>130	39.27	48.29	53.25	34.18	60.15	43.54	57.07	71.18

Table 3.32 Assumed vertical distribution of sediments initially suspended into the water column during TSHD hopper disposal operations at spoil grounds AB, 2B and 5A.

Elevation	Example Elevation (m ASB) – 20 m Water Depth and 12.75 m Hull Depth	Vertical Distribution (%) of Sediments
Surface/water depth	20.0	5.0
Hopper hull elevation	7.5	10.0
0.75 x hull elevation	5.6	20.0
0.50 x hull elevation	3.8	30.0
0.25 x hull elevation	1.9	35.0

3.7.6 Representation of BHD Barge Tug/TSHD Propeller-Wash

Modelling of sediment suspended by propeller-induced motion at the seabed was conducted to estimate likely sediment concentrations generated by the TSHD and harbour tug propellers while manoeuvring during dredging operations. A specialised numerical model developed by RPS, named PROPMAP, was used to estimate a time- and space-varying rate of sediment flux from the seabed due to the thrust imposed by each vessel's propellers at the seabed level behind the moving vessel. The model uses characteristics of the vessel of interest to estimate the three-dimensional thrust-field generated by the propellers. This thrust-field is then combined with the grain size and degree of cohesion of the seabed sediments, and the varying under-keel clearance along the typical vessel paths, to calculate variations in the suspended sediment flux from the seabed in time and space.

The following details were used as input to PROPMAP to calculate variable rates of sediment flux from the seabed due to propeller-wash effects:

- Vessel tracks and speeds.
- Vessel draft, engine power and propeller size.
- Bathymetry along the vessel tracks.
- Grain size distributions of the sediment, defining the proportions of clay and silt along the vessel tracks.

The calculation steps applied by PROPMAP at discrete intervals along each vessel path were as follows:

- Based on the vessel's engine power and propeller size, determine the propeller-induced velocity profile.
- Based on the vessel's draft and the local bathymetry, determine the intersection of the thrust-field with the seabed and find the thrust imposed on it.
- Based on the velocity of water flow at the seabed, calculate the shear stress acting on it.
- Based on the calculated shear stress, and the sediment grain size and cohesiveness, calculate a theoretical erosion flux (mass per unit time) for seabed sediment.

Propeller-induced velocity profiles were calculated using empirical expressions from Blaauw & van de Kaa (1978). Thrust at the seabed will depend upon the level of the bed, which will intersect as a plane (Figure 3.10). For an under-keel clearance of 1 m, a velocity field exceeding 5 m/s would intersect the bed in this example, while at a clearance of 4 m the bed velocity would be reduced to <2 m/s. The influence of this thrust will vary with the sediment grain size. Consequently, outcomes will be sensitive to the magnitude of the thrust, the under-keel clearance and the PSD of the bed.

Sediment erosion flux was estimated from the derived velocity field using the empirical formulations of van Rijn (1989). The sediment flux component attributable to propeller-wash was found to be depth-limited for areas where the under-keel clearance was less than 3 m, assuming a fully-loaded vessel (maximum draft). Simulations over deeper areas, including the areas where vessels would transit to the spoil grounds, indicated that flux would be minimal (compared to other sources) and representative of short-lived suspension of the surface-layer sediments followed by rapid settlement. This settlement time was estimated to be shorter than the simulation output time step. Propeller-wash was found to be more significant in the shallow areas and would be greater over sediments previously suspended by dredging.

These findings were used to inform the definition of the sediment flux rates during TSHD dredging operations (see Section 3.7.4).

In summary, propeller-wash effects were considered: (i) along each pipeline section during dredging; and (ii) between each pipeline section and the spoil grounds during dredging. During backfilling, the typical depths at borrow ground A and the waters between it and the pipeline mean propeller-wash effects are less relevant and therefore were not considered.

In the absence of definitive information relating to the seabed composition of the areas traversed by the barge tug or TSHD between the pipeline and the spoil grounds, for simplicity the seabed composition was assumed to be described by the PSD of the area from which the vessel began its journey.

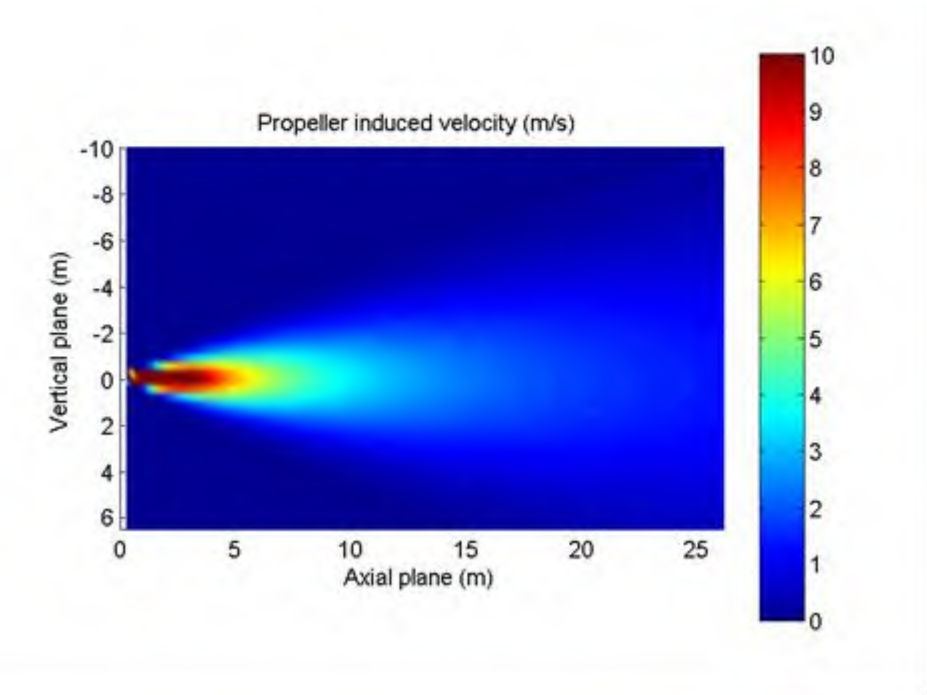


Figure 3.10 Two-dimensional view of a propeller-induced velocity profile.

3.7.7 Representation of TSHD Backfill

All material dredged by the TSHD within borrow ground A will be transported to sections POST2, POST4, POST6, POST8, POST9B, POST10A and POST10B of the pipeline route for placement (Figure 3.3).

For the backfill of the pipeline using unconsolidated sediments dredged by TSHD, the PSD used in the model is based on PSDs from nearby boreholes (see Section 3.6). This PSD is adjusted by removal of the component treated as suspended during dredging within the borrow ground (see Section 3.7.4), but as this represents only between 0.6% and 0.9% (averaged value depending on the relative contributions of overflow and non-overflow periods to the overall mass flux) of the mass for the minor components, the modified PSDs are not significantly different to the *in situ* PSDs (Table 3.33). It has been assumed, conservatively, that all sediment dredged from the borrow ground is available for use as backfill material.

Once at the appropriate location, the TSHD suction pipe will discharge material at a minimum elevation of 3 m above the pipeline (Figure 3.12). This gap will vary, and for modelling purposes the elevation above the pipeline has been assumed to be a constant 5 m. Sediment release from the suction pipe will occur as a jet of slurry that will have an initial rapid descent of solids followed by a billowing of lighter components back into the water column after contact with the seabed/pipeline (Swanson *et al.*, 2004). The plume that results from disposal of a jet of slurry from a pipe is typically concentrated near the seabed, with most of the material within 3 m of the bottom, and lower concentrations extend up towards the surface (Figure 3.11). Table 3.34 shows the assumed vertical distribution of the suspended material for the TSHD backfill source.

It is estimated that 95-99% of the bulk load deposits directly onto the seabed in a typical case, with the remainder released into the water column (CSMW, 2005, NEPA, 2001). It is difficult to find other definitive source values in the literature, and no site-specific sampling has been conducted for TSHD backfill placement operations, but a value of 5% of each load agrees well with past experience and appears to be a conservative estimate based on the values quoted above. Accordingly, 5% of each hopper load was placed in suspension in the water column in the sediment fate model.

The placement time for the hopper material within each dredge cycle was assumed to be 107 minutes (Table 3.7).

Table 3.33 Assumed PSD of sediments initially suspended into the water column during TSHD backfill operations using material dredged at borrow ground A.

Sediment Grain Size Class	Size Range (µm)	PSD (%) for Sediment Backfill – Borrow Ground A
Clay	<7	0.64
Fine Silt	7-34	0.88
Coarse Silt	35-74	0.96
Fine Sand	75-130	3.00
Coarse Sand	>130	94.90

Table 3.34 Assumed vertical distribution of sediments initially suspended into the water column during TSHD backfill operations using material dredged at borrow ground A.

Elevation	Example Elevation (m ASB) – 20 m Water Depth and 5 m Pipe Elevation	Vertical Distribution (%) of Sediments
Surface/water depth	20.0	5.0
Suction pipe elevation	5.0	10.0
0.75 x pipe elevation	3.8	15.0
0.50 x pipe elevation	2.5	20.0
0.25 x pipe elevation	1.3	50.0

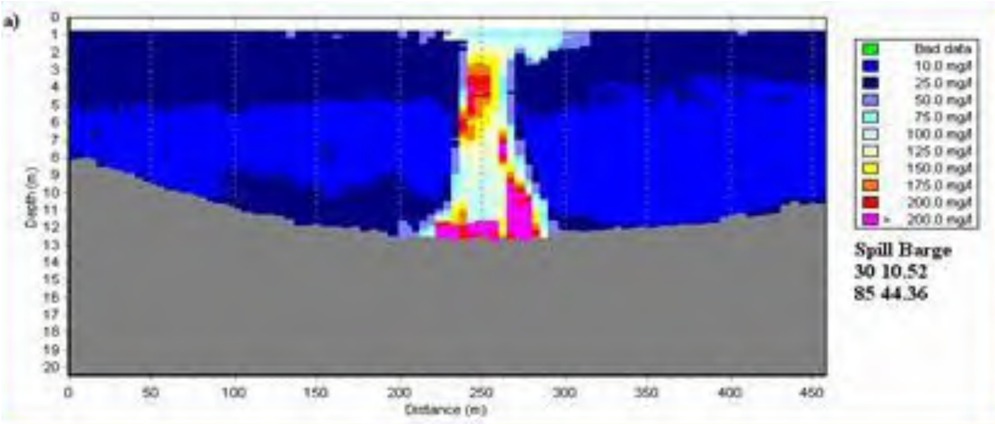


Figure 3.11 Example of a vertical cross-section through a typical open-water discharge plume from a spreader barge pipe (source: Swanson *et al.*, 2004).

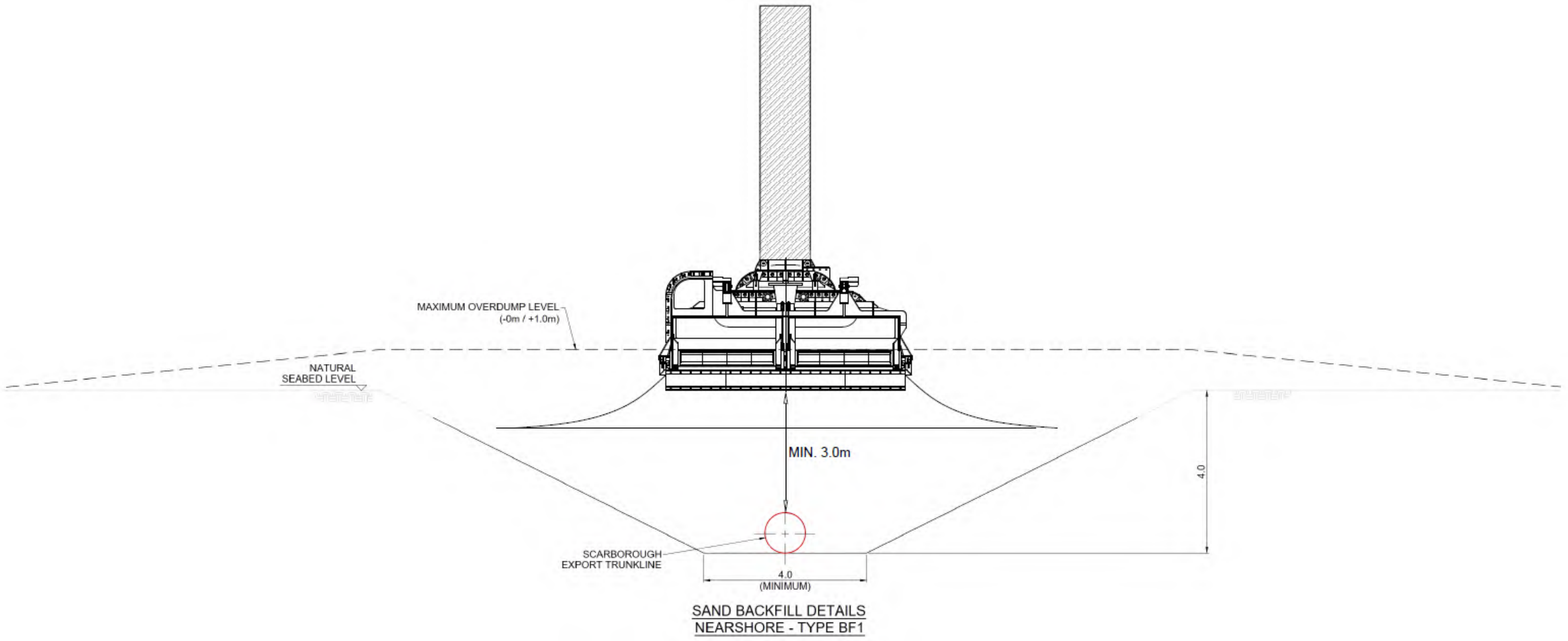


Figure 3.12: Schematic diagram showing how the TSHD draghead will be used to discharge sand backfill material along the pipeline (source: Boskalis, 2020).

3.7.8 Representation of Side-Dump Vessel Backfill

Rock material from an onshore quarry source will be transported by a side-dump vessel to sections POST1, POST3, POST5, POST7 and POST9A of the pipeline route for placement (Figure 3.3).

Based on previous project experience, quarry rock used for breakwater core construction or pipeline armouring typically contains around 5% material with diameters less than 100 mm. Therefore, a conservative loss rate of 5% of the total volume of dumped rock material was applied in the modelling. Based on material testing at the quarry from previous projects, the volume of quarried core/rock material less than 130 µm in size is typically even lower, in the order of 2%. Table 3.35 (equivalent to Table 3.18) presents the PSD that was applied in the modelling of the rock backfill source. The composition of the material is dominated by coarse sand and larger particles, with the 2% of finer material assumed to be evenly spread over the four smaller material classes. Although coarse sand material will be initially suspended in the water column, it will not be available for resuspension once it settles.

Because the rock backfill material will be dumped from the deck of the vessel, it will move through the whole water column as it falls to the seabed. Therefore, a uniform vertical distribution of suspended material in the water column has been assumed (Table 3.36).

The placement time for the rock material within each cycle was assumed to be 120 minutes. Other than an increased placement time, the operational cycle is assumed to be equivalent to that for TSHD backfill operations outlined in Table 3.7.

Table 3.35 Assumed PSDs of sediments initially suspended into the water column during side-dump vessel backfill operations using material from an onshore quarry.

Sediment Grain Size Class	Size Range (µm)	PSD (%) for Rock Backfill
Clay	<7	0.5
Fine Silt	7-34	0.5
Coarse Silt	35-74	0.5
Fine Sand	75-130	0.5
Coarse Sand	>130	98.0

Table 3.36 Assumed vertical distribution of sediments initially suspended into the water column during side-dump vessel backfill operations using material from an onshore quarry.

Elevation	Example Elevation (m ASB) – 10 m Water Depth	Vertical Distribution (%) of Sediments
Surface/water depth	10.0	20.0
0.8 x water depth	8.0	20.0
0.6 x water depth	6.0	20.0
0.4 x water depth	4.0	20.0
0.2 x water depth	2.0	20.0

3.7.9 Summary of Source Rates

For each source of suspended sediment plumes during dredging, disposal and backfill operations, as described in the preceding sections, Table 3.37 and Table 3.38 summarises the associated loss rates and approximate volumes of suspended sediment expected. The volumes assigned to the respective non-overflow and overflow periods for TSHD dredging, and non-dewatering period for BHD dredging, are based on the modelled cycle times detailed in Table 3.4, Table 3.5 and Table 3.7.

A total of approximately 259,085 m^3 of sediment is expected to be initially suspended in the water column over the course of the modelled program. This volume represents approximately 6.6% of the in situ dredged (and quarry) volume. If all deposited material assumed to be available for potential resuspension following spoil ground disposal operations is actually resuspended, a total of 349,951 m^3 of sediment will be suspended in the water column over the program duration; this will represent approximately 8.9% of the in situ dredged (and quarry) volume.

Table 3.37 Summary of sediment sources applied in the model.

Phase	Operation	Source Rate (% Production Rate)	Dredged Volume (m^3)	Suspended Volume (m^3)
Pipeline dredging	BHD excavator bucket	2.10	60,860	1,278
	BHD excavator bucket + dewatering from barge	N/A		
	Disposal from hopper barge	5 (water column) 5 (seabed; *potential*)		2,979 *2,979*
	TSHD drag-head + propeller-wash	0.60	1,805,999	48,256
	TSHD drag-head + propeller-wash + overflow	Specified per zone (see Table 3.38)		
	Disposal from TSHD	5 (water column) 5 (seabed; *potential*)		87,887 *87,887*
Pipeline backfilling	TSHD drag-head + propeller-wash	0.60	1,979,341	16,896
	TSHD drag-head + propeller-wash + overflow	Specified for borrow ground A (see Table 3.38)		
	Placement from TSHD	5.00		98,122
	Placement from side-dump vessel	5.00	73,326	3,666
		Totals	**3,919,526**	**259,085** ***349,951***

Table 3.38 Sediment source rates applied in the model for the TSHD while overflowing.

Zone	Source Rate (% Production Rate)
PRE1	3.37
PRE2	3.37
PRE3	4.56
PRE4	3.33
PRE6	4.34
PRE8	3.81
PRE9B	5.04
PRE10A	2.77
PRE10B	1.68
Borrow Ground A	0.90

4 ENVIRONMENTAL THRESHOLD ANALYSIS

4.1 Overview

Predictions of SSC for each scenario were assessed against a series of water quality thresholds to categorise the modelled outcomes into management zones of influence and impact, defined with regard to environmental sensitivities in the study region. These thresholds, and the technical justification which followed guidance from the WAMSI Dredging Science Node, were supplied to RPS by Advisian (MScience, 2019). Thresholds were selected for benthic habitats on the basis of past and present mapping of communities in the project area.

Thresholds for three management zones – a Zone of Influence (ZoI), a Zone of Moderate Impact (ZoMI) and a Zone of High Impact (ZoHI) – were defined. The criteria associated with each management zone also varied across three ecological zones, which were broadly defined based on past studies of these areas (MScience, 2019). The ecological zones are named as follows, with reference to the pipeline chainages shown in Figure 1.1, and with the spatial extents agreed for this study shown in Figure 4.1:

- Offshore: the pipeline area beyond KP25, and generally all areas north of a boundary line containing Rosemary Island, Legendre Island and Delambre Island.
- Zone B: the pipeline area between KP8 and KP25, adjacent coral and macroalgae habitats within Mermaid Sound, and generally all coral, macroalgae and mixed community habitats between Dolphin Island and Bezout Island.
- Zone A: the pipeline area between the shoreline and KP8, adjacent macroalgae and mangrove habitats within Mermaid Sound, and generally all mangrove, marsh and seagrass habitats between Nickol Bay and Point Samson.

Thresholds for coral habitats within Zone B were developed with the aid of data collected during a previous dredging campaign at Barrow Island, which is considered a similar habitat. Water quality within Zone A is more turbid, and coral communities are comprised of more sediment-tolerant or resilient species. Offshore habitats are not likely to contain corals.

In developing the thresholds, it was assumed that benthic communities around Spoil Ground 2B and Borrow Ground A (see Figure 1.1) will be sparse and made up largely of sponges and filter feeders without corals.

4.2 Baseline Water Quality

Water quality data collected during the LNG Foundation Project over the period of 2007 to 2010 (MScience, 2010) demonstrated that turbidity at sites within the Zone A and Zone B management areas was raised by 0.7 NTU and 0.3 NTU, respectively, as a result of dredging activities. Subtraction of these dredge-induced values across the 2007-2010 data set yielded a set of baseline turbidity measurements.

Table 4.1 presents the mean and 80th-percentile SSC values calculated from the background turbidity measurements in each zone. For the purposes of threshold assessment, it has been assumed that the summer season comprises the period of November to March and the winter season contains the months of April to October.

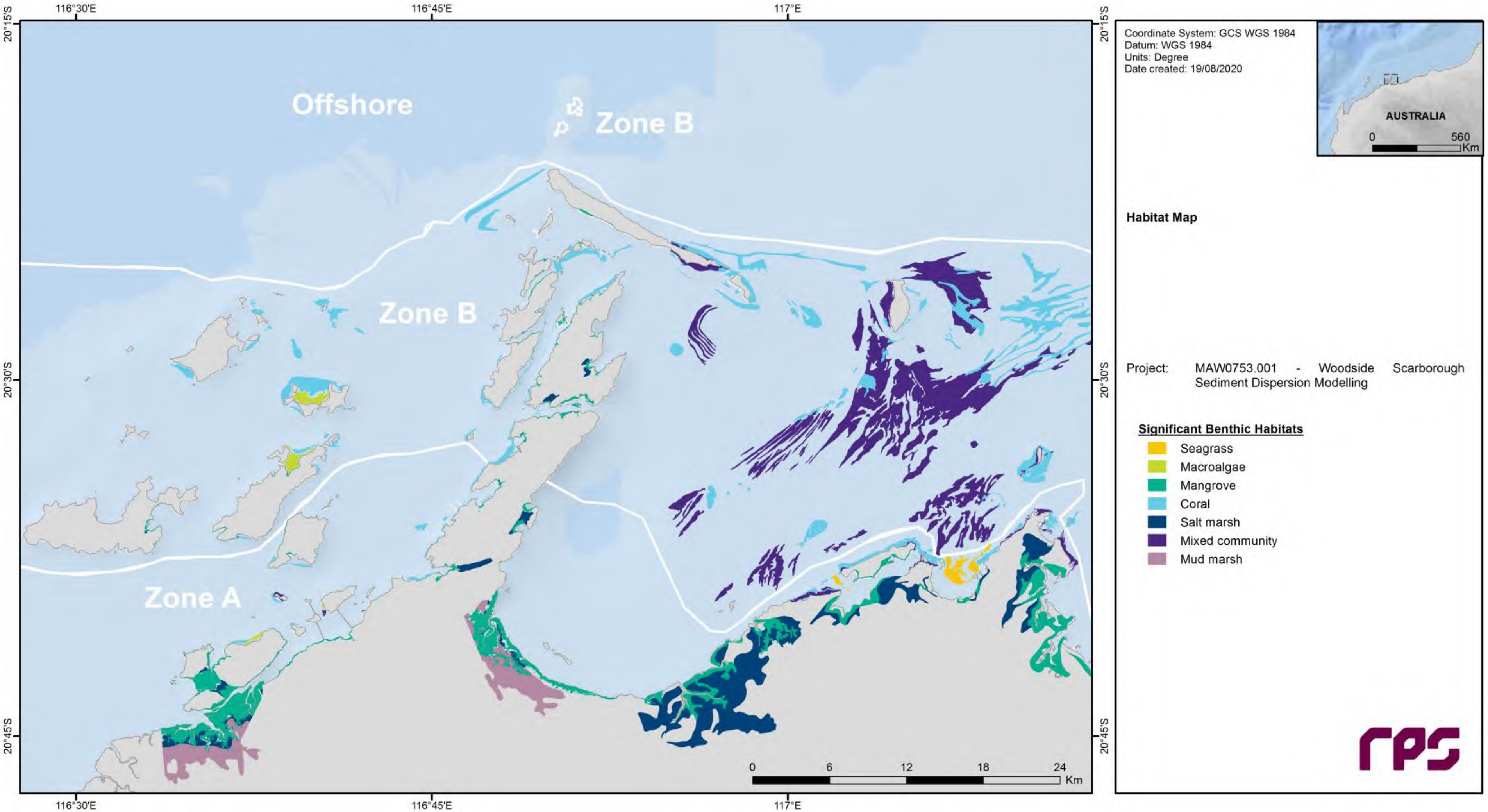


Figure 4.1 Delineation of the proposed ecological zones (Zone A, Zone B and Offshore) in the context of known habitat areas and types. Thresholds used to define the management zones will vary in magnitude between the ecological zones.

Table 4.1 Baseline mean and 80th percentile SSC values calculated from measurements undertaken during the LNG Foundation Project (2007-2010), categorised into summer and winter seasons for each of the three ecological zones.

Ecological Zone	Season	Mean SSC (mg/L)	80th Percentile SSC (mg/L)
A	Summer	4.1	5.0
	Winter	1.8	2.3
B	Summer	2.5	2.7
	Winter	1.2	1.6
Offshore	Summer	1.8	1.8
	Winter	0.6	0.9

4.3 Zone of Influence (ZoI)

The ZoI is defined as "*a zone where impacts to water quality will be detectable but below a level causing detectable impacts to biota*" (MScience, 2019). This is generally considered equivalent to the area around dredging activities where a plume may be visible to the naked eye.

The ZoI threshold will be exceeded at any point within the model domain where dredging is forecast to increase the depth-averaged concentration of SSC (specifically the contribution attributable to dredging activities) by a level greater than the seasonal 80th percentile baseline SSC over a 24-hour average period.

Table 4.2 presents the threshold SSC values used to define the extents of the ZoI. A background SSC value appropriate for each ecological zone and month of the year was added to the dredge-induced SSC predictions from the sediment fate model prior to evaluation of the thresholds.

Potential exceedances of the threshold were evaluated over the duration of each dredge scenario by:

- Creating a three-dimensional time series of dredge-excess SSC values in each model grid cell (with each scenario spanning a period of more than ten months, the data sets comprised more than 7,500 time steps).
- Adding appropriate background SSC values to each cell.
- Calculating a rolling 24-hour average of the total (dredge plus background) SSC values in each cell, with this time-window progressing through the data set at hourly increments (the temporal resolution of the data set).
- Calculating the 95th percentile value of each cell.
- Assessing the 95th percentile data against the threshold SSC values.

Typically, averaging discrete data points over an arbitrary time period will serve to reduce the influence of transient spikes in concentration, thereby reducing the possibility of spurious exceedances. More rarely, a transient concentration spike of sufficient magnitude to skew the rolling average to an above-threshold state may result in exceedances being recorded for a longer period than will be the case in reality. Generally, applying a time-average to a data set for the purposes of threshold analysis will result in a smaller zone of effect than if instantaneous data is evaluated. This methodology also has a strong connection to critical exposure times for benthic habitats or species of concern in the project area.

Table 4.2 Background, dredge-excess and threshold SSC values used as the criteria to define the ZoI outer boundary within each ecological zone.

Ecological Zone	Season	Time-Averaged Period (hours)	Background SSC (mg/L) [a]	Dredge-Excess SSC (mg/L) [b]	Threshold SSC (mg/L) [c]
A	Summer	24	4.1	5.0	9.1
	Winter	24	1.8	2.3	4.1
B	Summer	24	2.5	2.7	5.2
	Winter	24	1.2	1.6	2.8
Offshore	Summer	24	1.8	1.8	3.6
	Winter	24	0.6	0.9	1.5

[a] Background values are equivalent to 'Mean SSC' values in Table 4.1.

[b] Dredge-excess values are equivalent to '80th Percentile SSC' values in Table 4.1.

[c] Threshold values are the sum of background and dredge-excess values.

4.4 Zone of Moderate Impact (ZoMI)

The ZoMI is defined as "*a zone where impacts are sub-lethal or lethal but recoverable (in terms of the community) within a five-year period*" (MScience, 2019).

The ZoMI threshold will be exceeded at any point within the model domain where dredging is forecast to increase the depth-averaged concentration of SSC to a level sufficient to trigger impacts to EC_{10} (10% Effect Concentration or 10% Inhibition) or to cause bleaching through loss of light or sedimentation.

Thresholds chosen to indicate a transition between the ZoI and ZoMI areas are largely based on the 'possible mortality' thresholds of Fisher *et al.* (2019). These thresholds are based on analysis of water quality and coral monitoring data collected during a previous dredging project at Barrow Island, where coral communities exist in clear, near-oceanic conditions. Distinctions must be made between the thresholds most appropriate for each ecological zone.

Within the offshore zone, only thresholds of relevance to sponges and filter feeders are appropriate because corals, seagrasses and macroalgae are not known to form significant communities. A threshold relating to an LC_{10} (10% Lethal Concentration) effect on filter feeder-sponge habitats over a 28-day exposure period was selected (Pineda *et al.*, 2017).

For Zone B, coral communities experience similar conditions to those monitored at Barrow Island and the moderate-impact thresholds of Fisher *et al.* (2019) for coral/mixed benthos communities were deemed to be appropriate (MScience, 2019).

For Zone A, coral communities experience more turbid conditions and are more tolerant of elevated SSC levels and lowered light levels than their neighbours in Zone B due to adaptation and a different mix of species. To account for this greater tolerance, the moderate-impact thresholds in Zone A were defined as those of Zone B multiplied by a factor of 1.5, which is believed to be a conservative multiplier (MScience, 2019). Within both Zones A and B, spongers and filter feeders will occur among the corals, and the mixed community is best evaluated using coral-focused thresholds.

The taxa-specific thresholds and appropriate time-averaging periods (related to exposure times from experimental data) used to define the extents of the ZoMI are detailed in Table 4.3. A background SSC value appropriate for each ecological zone and month of the year was added to the dredge-induced SSC predictions from the sediment fate model prior to evaluation of the thresholds.

Potential exceedances of the thresholds were evaluated over the duration of each dredge scenario by calculating rolling 3-day, 7-day, 10-day, 14-day and 28-day averages (as appropriate in each ecological zone) of SSC values in each model grid cell and checking for breaches as this time-window progressed through the data set at hourly increments (the temporal resolution of the data set). If any time-average SSC value exceeds the corresponding threshold value at any time, even if only on one occasion, the model grid cell is included in the appropriate ZoMI area.

Table 4.3 Threshold SSC values used as the criteria to define the ZoMI outer boundary within each ecological zone.

Ecological Zone	Time-Averaged Period (days)	Threshold SSC (mg/L)
A	3	29.1
	7	22.5
	10	19.6
	14	17.6
B	3	19.4
	7	14.7
	10	13.1
	14	11.7
Offshore	28	22.5

4.5 Zone of High Impact (ZoHI)

Thresholds chosen to indicate a transition between the ZoMI and ZoHI areas are largely based on the 'probable mortality' thresholds of Fisher *et al.* (2019).

Within the offshore zone, a threshold relating to an LC_{50} (50% Lethal Concentration) effect on filter feeder-sponge habitats over a 28-day exposure period was selected (Pineda *et al.*, 2017).

For Zone B, the high-impact thresholds of Fisher *et al.* (2019) for coral/mixed benthos communities were deemed to be appropriate (MScience, 2019).

For Zone A, the high-impact thresholds were defined as those of Zone B multiplied by a factor of 1.5, which is believed to be a conservative multiplier (MScience, 2019).

The taxa-specific thresholds and appropriate time-averaging periods (related to exposure times from experimental data) used to define the extents of the ZoHI are detailed in Table 4.4. A background SSC value appropriate for each ecological zone and month of the year was added to the dredge-induced SSC predictions from the sediment fate model prior to evaluation of the thresholds.

Potential exceedances of the thresholds were evaluated over the duration of each dredge scenario by calculating rolling 3-day, 7-day, 10-day, 14-day and 28-day averages (as appropriate in each ecological zone) of SSC values in each model grid cell and checking for breaches as this time-window progressed through the data set at hourly increments (the temporal resolution of the data set). If any time-average SSC value exceeds the corresponding threshold value at any time, even if only on one occasion, the model grid cell is included in the appropriate ZoHI area.

Table 4.4 Threshold SSC values used as the criteria to define the ZoHI outer boundary within each ecological zone.

Ecological Zone	Time-Averaged Period (days)	Threshold SSC (mg/L)
A	3	53.6
	7	36.8
	10	31.4
	14	27.0
B	3	35.7
	7	24.5
	10	20.9
	14	18.0
Offshore	28	47.0

5 RESULTS OF SEDIMENT FATE MODELLING

5.1 Spatial Distributions of SSC

5.1.1 Summary

Simulations indicated that there may be significant spatial patchiness in the distribution of SSC at any point in time during the dredging, disposal and backfill operations because of variability in the number of sediment suspension sources, variability in the flux from each of these sources, and the varying dynamics of the transport, settlement and resuspension processes affecting the sediments.

The most pronounced differences in the predicted concentrations at any point in time are found in the vertical distributions, with a distinct increase in concentration towards the seabed. Most material will initially be suspended low in the water column, and material suspended higher in the water column will sink as it moves away from the source. Frequent resuspension of material will also mostly affect the lower reaches. Thus, the spatial area affected above a given concentration is typically greater in the near-seabed layer than in the near-surface layer. It should be noted, however, that there are instances throughout the simulations where elevated concentrations will occur in the near-surface layers – during TSHD overflow operations or during strong resuspension events affecting sediments that have migrated to shallow areas – but these will typically not be sustained for extended periods of time.

Although many of the activities related to dredging and backfilling of the pipeline will take place within Mermaid Sound, which is dominated by tidal currents year-round and is relatively sheltered from the variations in large-scale circulation observed beyond approximately KP30, reasonably distinct seasonal trends are evident in the modelling outcomes of each scenario.

The results observed on any given day will not always be representative of the given season’s prevailing transport patterns, and plume concentrations and distributions are forecast to vary markedly. To explore this variability, statistical distributions for each scenario are examined. Percentile distributions will summarise the outcomes over the entire scenario and do not represent an instantaneous plume footprint at any point in time.

Forecasts of median depth-averaged SSC values (values exceeded 50% of the time) do not exceed 0.1 mg/L in either scenario. At the 95th percentile, forecasts of depth-averaged SSC values 5 mg/L or greater are found in nearshore areas between Intercourse Island and King Bay for project works commencing in summer (Scenario 2; Figure 5.4), and also near Angel Island and Conzinc Island for project works commencing in winter (Scenario 1; Figure 5.2).

When examined over the course of an entire scenario, the sediment distributions reveal areas that broadly straddle the dredging and disposal zones where recurrent elevations of near-seabed SSC are expected as a consequence of dredging operations. The forecast in each scenario is that the greatest concentrations will typically be found in the inshore waters of Mermaid Sound along the pipeline between the KP5 and KP25 points. This zone contains a significant volume of the overall in situ volume to be dredged, and there are many shallow locales where strong tidal flows both inhibit settlement of fine suspended sediments and stimulate significant levels of resuspension of sediments deposited after initial release in the water column. Dredging of backfill material from the offshore borrow ground causes an additional plume signature north of Legendre Island, with recurrent elevations of near-seabed SSC and subsequent resuspension of this material as it is transported towards Nickol Bay by tidal movements.

Concentrations of suspended sediment in the key activity areas will represent the combined influence of new discharges and resuspension of fine sediments from earlier discharges. Temporal variations in intensity of the dredging operations, including overlap of multiple operations in time or downtime periods, will also influence turbidity peaks and troughs. At progressively more distant areas, the importance of resuspension as a contributor to the distribution of SSC values in general, and near-seabed concentrations in particular, becomes a greater factor. The areas forecast to receive elevated concentrations are substantially larger than would be affected by plumes only from the initial sources. The plume extents tend to expand over periods of several weeks in the direction of net drift, indicating the progressive transport of fine sediments through continuous patterns of settlement and resuspension.

With the duration of each scenario (more than ten months) spanning almost the entire range of seasonal conditions, the direction of net drift will shift from summertime trends (generally longshore in a north-easterly direction) to wintertime trends (generally longshore in a south-westerly direction), or vice versa, depending on commencement times (winter for Scenario 1 and summer for Scenario 2). A progressive shift in the available source of resuspendable fine sediments is also indicated. Periodic high wave-energy events will be a major contributor to estimates of high SSC in the near-seabed layer, particularly in shallow exposed areas. While these processes are forecast to extend the influence of dredging activities over a wider area, the longshore dispersal of finer sediments is indicated to be an important mechanism for limiting the trapping and build-up of fine sediments in the local region around the key activity areas. The build-up of resuspendable fine sediments in areas remote from dredging activities indicates that the supply of fines to these areas will be greater than their removal due to ongoing resuspension and longshore transport, for as long as sediment input from dredging activities continues.

5.1.2 Pipeline Dredging Activities

For pipeline dredging activities during winter conditions (Scenario 1), sediment plumes at low concentrations are forecast to drift generally towards the south-west. The plumes tend to follow the bathymetric contours between East Intercourse Island and East Lewis Island, and also between West Lewis Island and Rosemary Island.

In contrast, the net drift direction forecast for sediment plumes from pipeline dredging activities during summer conditions (Scenario 2) is towards the north-east, with the plumes following the bathymetric contours as they turn around Legendre Island towards Delambre Island. This drift is imposed by the prevailing south-westerly winds over the summer season. In general, the majority of the dispersing suspended material is forecast to migrate offshore rather than through Flying Foam Passage and Searipple Passage, which is attributable to the local bathymetric features. Much of the dredging occurs in water depths greater than that found within each passage, but strong tidal currents will drive significant sediment concentrations in and out of the passages on a regular basis.

Sections A.1 (Figures A.1 to A.5) and A.2 (Figures A.12 to A.16) in Appendix A contain, for Scenarios 1 and 2 respectively, sequential images of instantaneous SSC values at monthly intervals from pipeline dredging commencement until residual suspended sediments have settled throughout the model domain (prior to commencement of pipeline backfill activities). In both scenarios, the patterns of initial sediment plume generation and longer-term plume migration from inshore-to-offshore dredging and disposal operations are evident. These figures capture transient plumes in areas that may not be represented in the percentile figures in Section 5.1.4, such as the elevated levels of SSC in the vicinity of spoil ground 2B (Figures A.2 and A.13) and to the north of West Lewis Island (Figure A.14).

5.1.3 Pipeline Backfill Activities

The bulk of the sediment suspended by dredging is forecast to remain in Commonwealth waters and be dispersed in the offshore area between the borrow ground and Legendre Island in both scenarios. It should be noted that sediment plumes in this area are more dilute than those expected in Mermaid Sound due to the effects of depth-averaging over greater water depths in offshore areas.

The migration patterns of sediment plumes entering State waters are controlled by seasonal conditions. Strong tidal flows between Hauy Island and Delambre Island will aid movement of sediment towards the shallow waters of Nickol Bay, with this effect being greater during summer (Scenario 1, following pipeline dredging activities in winter) due to predominant net drift towards the east imposed by prevailing south-westerly winds. In contrast, the net drift direction forecast during winter conditions (Scenario 2) is towards the south-west, mostly following the bathymetric contours to the north of Rosemary Island. The sediment plume from operations in this area is forecast to migrate to the offshore pipeline and spoil ground areas, most noticeably in Scenario 2 when borrow ground dredging occurs in winter (following pipeline dredging activities in summer) but at lower concentrations than will have already occurred during pipeline dredging activities.

Sections A.1 (Figures A.6 to A.11) and A.2 (Figures A.17 to A.22) in Appendix A contain, for Scenarios 1 and 2 respectively, sequential images of instantaneous SSC values at monthly intervals from pipeline backfill commencement until residual suspended sediments have settled throughout the model domain. In both scenarios, the generation and migration patterns of sediment plumes from borrow-ground dredging operations are evident, with near-negligible plume contributions from placement of backfill material along the pipeline route.

5.1.4 Spatial Outcomes

5.1.4.1 Scenario 1: Dredging Operations Commencing during Winter, with Backfill Material Sourced from Borrow Ground A

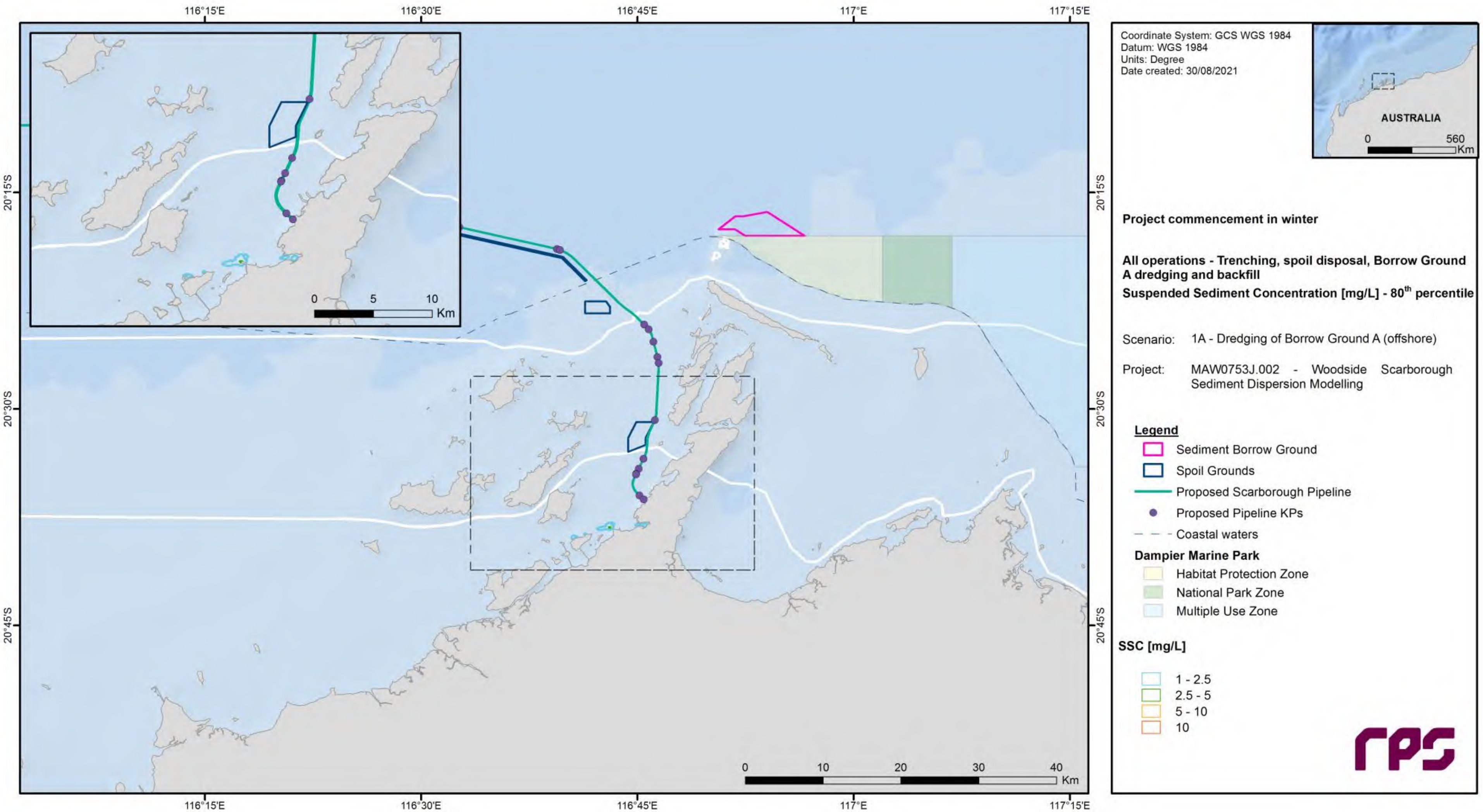


Figure 5.1 Predicted 80th percentile dredge-excess SSC throughout the entire scenario duration (1st July 2016 to 23rd May 2017).

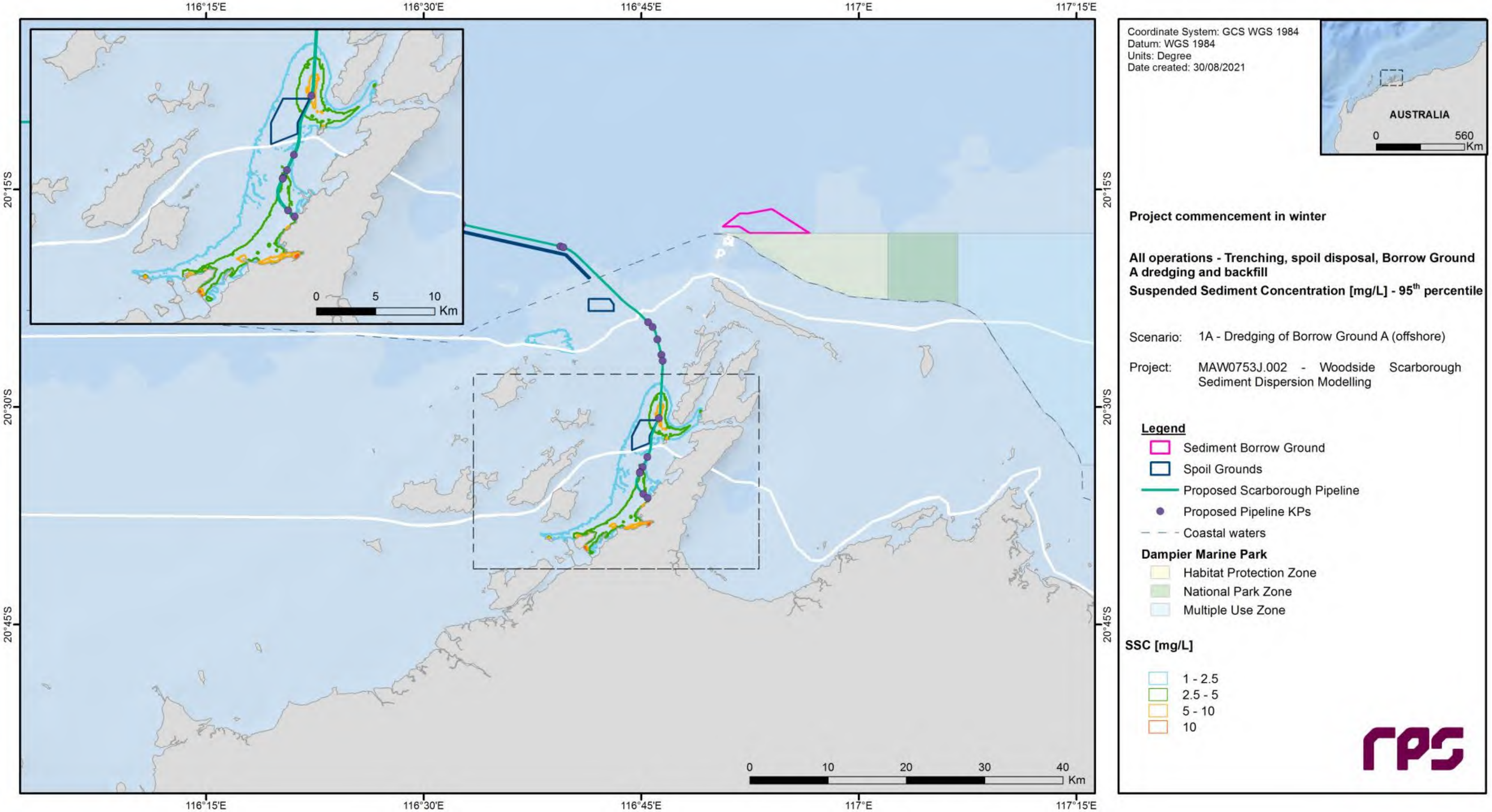


Figure 5.2 Predicted 95th percentile dredge-excess SSC throughout the entire scenario duration (1st July 2016 to 23rd May 2017).

5.1.4.2 Scenario 2: Dredging Operations Commencing during Summer, with Backfill Material Sourced from Borrow Ground A

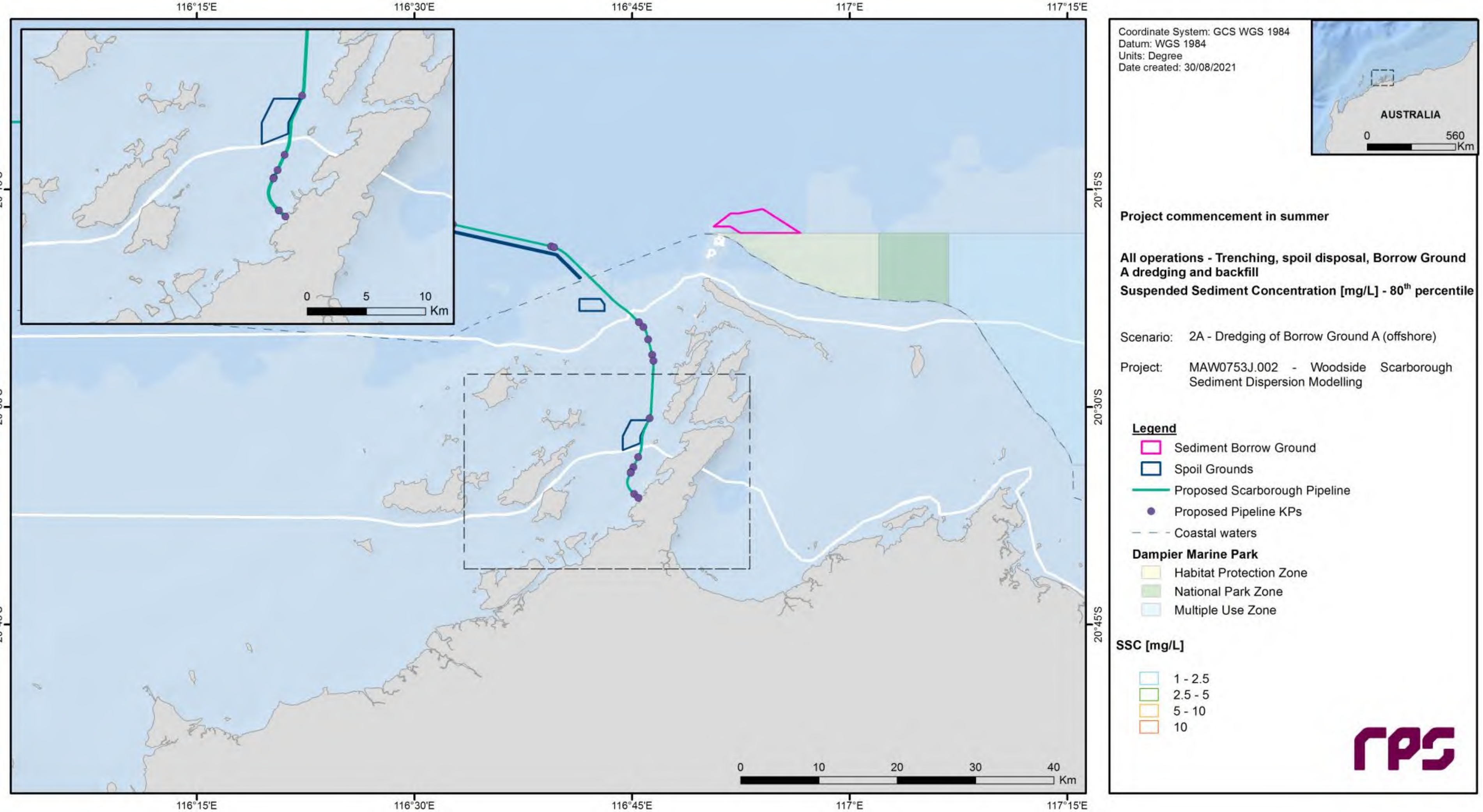


Figure 5.3 Predicted 80th percentile dredge-excess SSC throughout the entire scenario duration (1st January 2017 to 21st November 2017).

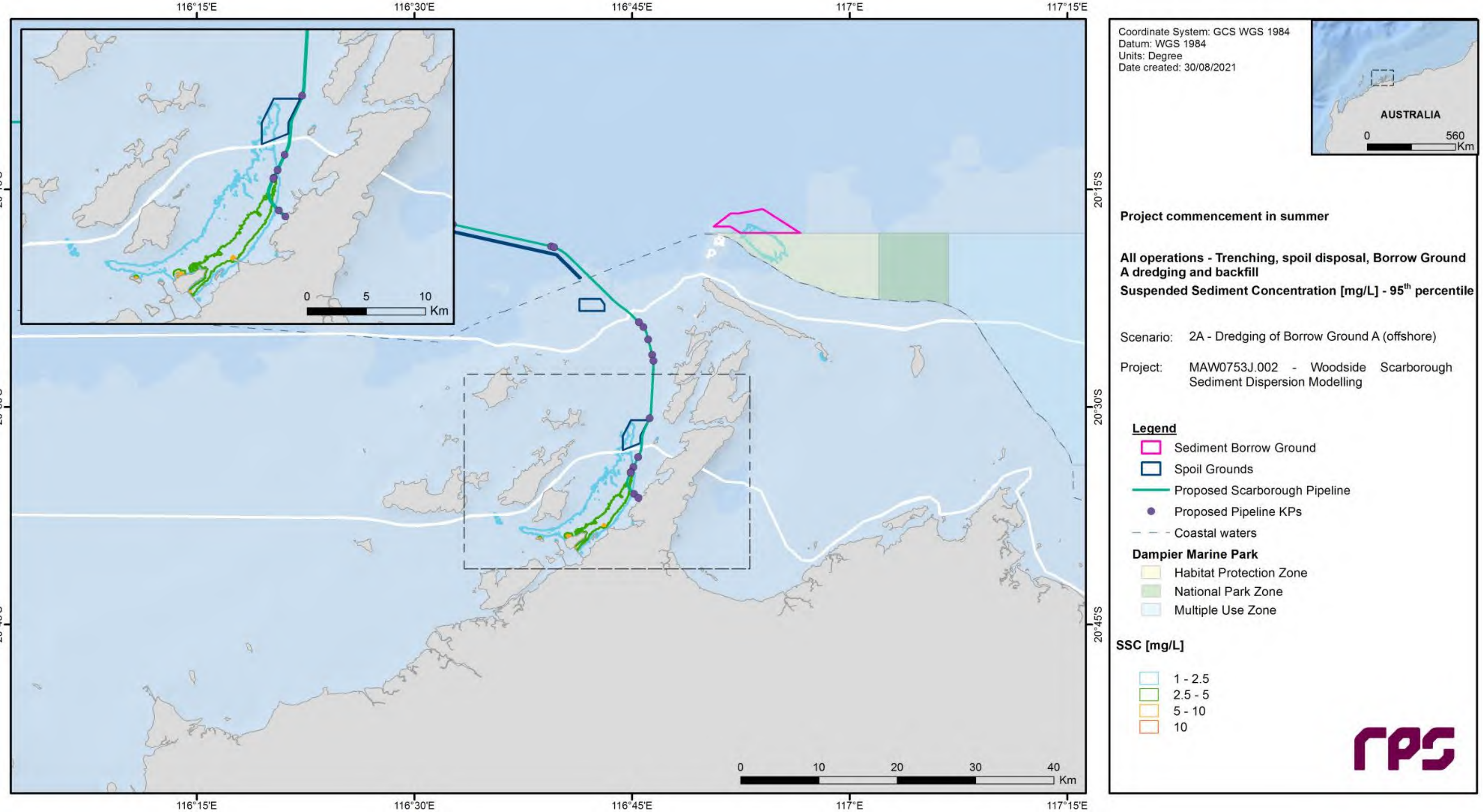


Figure 5.4 Predicted 95th percentile dredge-excess SSC throughout the entire scenario duration (1st January 2017 to 21st November 2017).

5.2 Predictions of Management Zone Extents

5.2.1 Summary

Figures showing the calculated extents of the defined management zones – ZoI, ZoMI and ZoHI – over the entire program of dredging, disposal and backfill operations are listed in Table 5.1 for each scenario.

Presentation of the ZoI areas is done on the basis of 95th percentile threshold exceedances for the 24-hour rolling average data.

It should be noted that the indicated management zone extents in each case represent a cumulative measure of exceedances of the relevant thresholds over a more than ten-month period, following the threshold criteria described in Section 4. They do not represent an instantaneous plume footprint at any point in time.

The indicated areas of threshold exceedances are largely a reflection of the areas of sediment confluence due to the proximity to key activity areas, where there is a sustained input of suspended sediments over periods of several months, and the influence of local metocean conditions acting to inhibit rates of settling and increase rates of resuspension.

The north-south ZoI extents in ecological Zones A and B are broadly similar in both scenarios, stretching from Angel Island to East Intercourse Island, with a larger overall footprint area in Scenario 1 (where pipeline dredging operations will occur during winter) relative to Scenario 2 (where these operations will occur during summer). In the Offshore ecological zone, a significantly larger ZoI is forecast along the pipeline in the vicinity of spoil grounds 2B and 5A for Scenario 1 than for Scenario 2. Both of these findings are largely a consequence of the lower thresholds applicable during the winter period, and consequently the lower levels of dredge-excess SSC required to cause exceedances. In a similar manner, the larger ZoI predicted at the offshore borrow ground for Scenario 2 (where, following project commencement in summer, pipeline backfill operations will occur during winter) than for Scenario 1 (where these operations will occur during summer) is attributable to the lower winter thresholds.

The ZoMI threshold exceedances in isolated pockets of King Bay and around the Intercourse Islands may be attributable to the combined effects of model bathymetry and hydrodynamics, representing sediments that are transported into the shallowest-possible grid cells and then “trapped” upon reversal of the tide. While it is clear that there is a potential for dredged sediments to be found in the indicated areas, the persistently high concentrations at the water-land boundaries may be overstated – particularly in light of the long durations required to trigger the ZoMI thresholds.

No ZoHI threshold exceedances are predicted to occur in either scenario.

Table 5.1 Index of the ZoI, ZoMI and ZoHI figures for each scenario.

Management Zone	Scenario 1	Scenario 2
Zone of Influence (95th percentile): 24-hour rolling average of total SSC	Figure 5.5	Figure 5.14
Zone of Moderate Impact: 3-day (Zones A and B) and 28-day (Offshore) rolling average of total SSC	Figure 5.6	Figure 5.15
Zone of Moderate Impact: 7-day (Zones A and B) and 28-day (Offshore) rolling average of total SSC	Figure 5.7	Figure 5.16
Zone of Moderate Impact: 10-day (Zones A and B) and 28-day (Offshore) rolling average of total SSC	Figure 5.8	Figure 5.17
Zone of Moderate Impact: 14-day (Zones A and B) and 28-day (Offshore) rolling average of total SSC	Figure 5.9	Figure 5.18
Zone of High Impact: 3-day (Zones A and B) and 28-day (Offshore) rolling average of total SSC	Figure 5.10	Figure 5.19
Zone of High Impact: 7-day (Zones A and B) and 28-day (Offshore) rolling average of total SSC	Figure 5.11	Figure 5.20
Zone of High Impact: 10-day (Zones A and B) and 28-day (Offshore) rolling average of total SSC	Figure 5.12	Figure 5.21
Zone of High Impact: 14-day (Zones A and B) and 28-day (Offshore) rolling average of total SSC	Figure 5.13	Figure 5.22

5.2.2 Spatial Outcomes

5.2.2.1 Scenario 1: Dredging Operations Commencing during Winter, with Backfill Material Sourced from Borrow Ground A

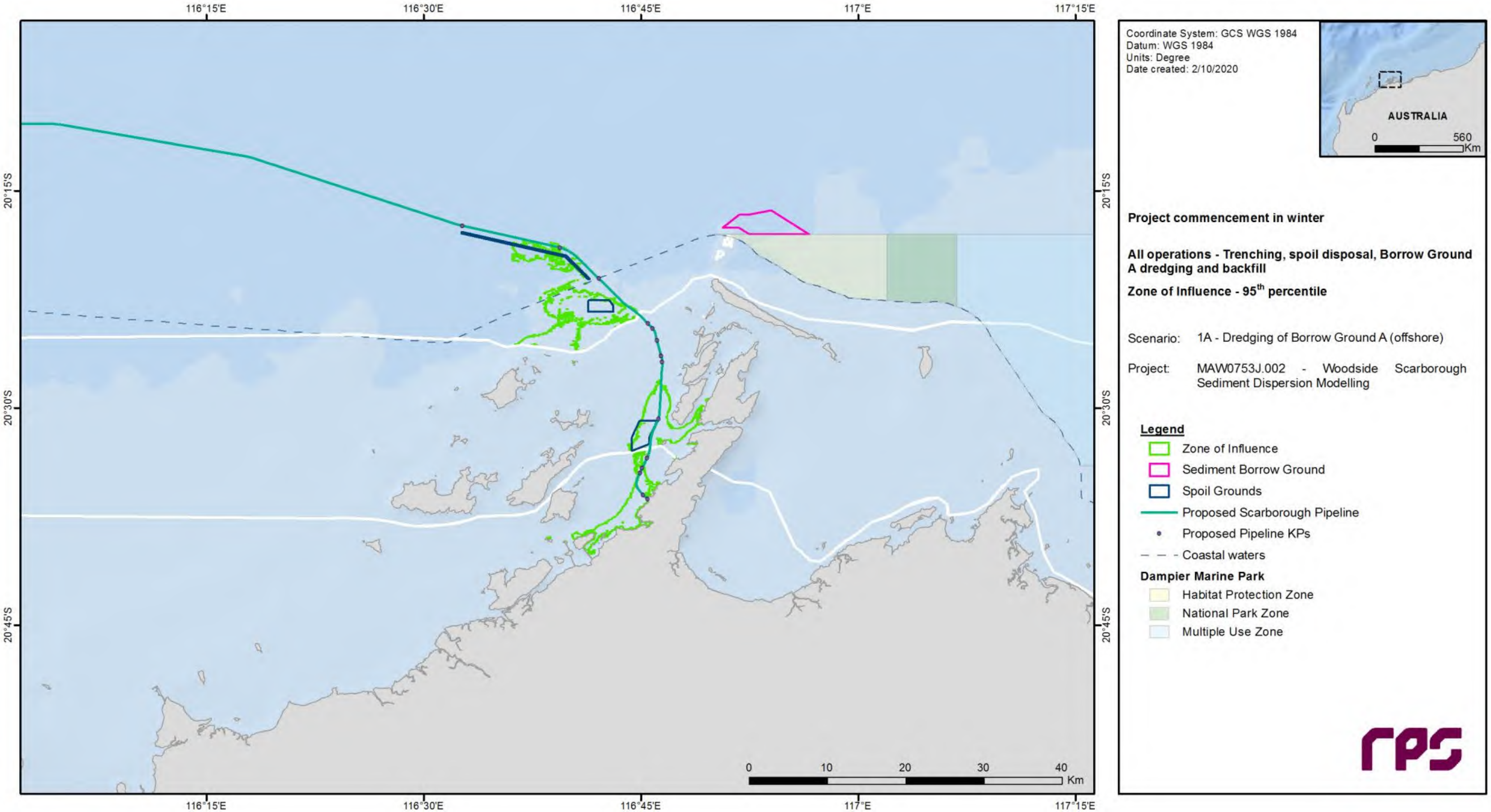


Figure 5.5 Predicted 95th percentile Zone of Influence following application of the appropriate spatial thresholds in Table 4.2 to a 24-hour rolling average of total (dredge and background) SSC throughout the entire scenario duration (1st July 2016 to 23rd May 2017).

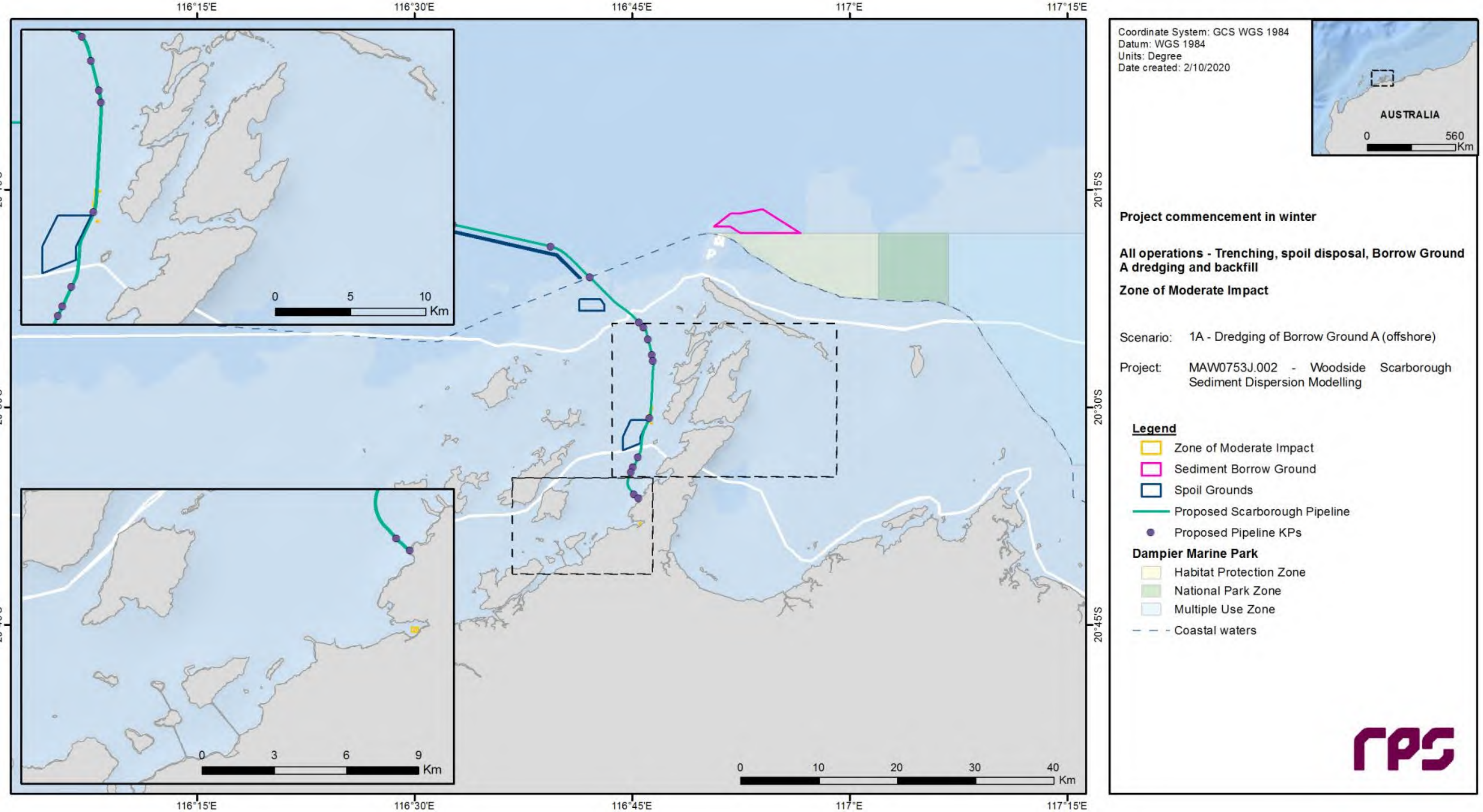


Figure 5.6 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 3-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st July 2016 to 23rd May 2017).

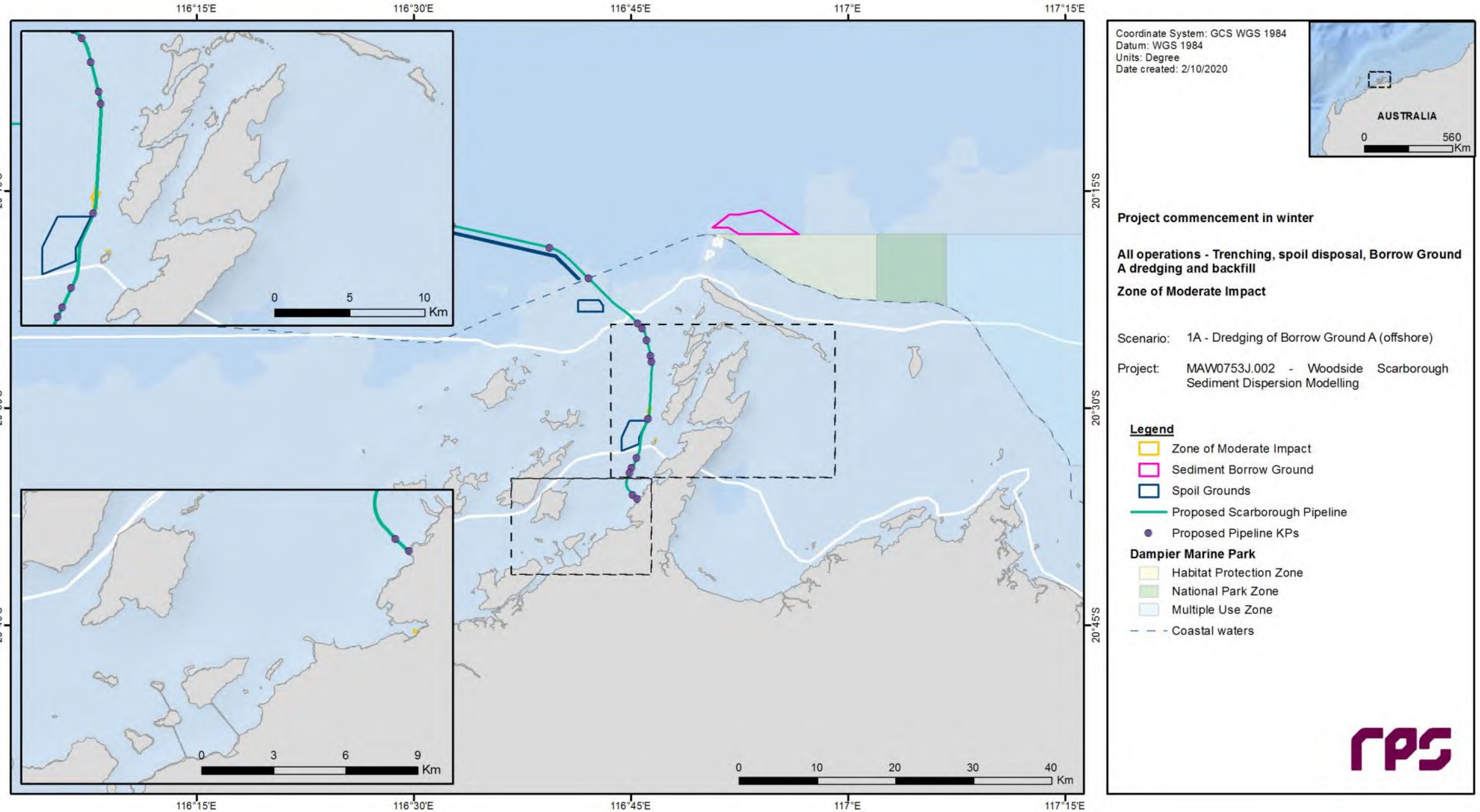


Figure 5.7 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 7-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st July 2016 to 23rd May 2017).

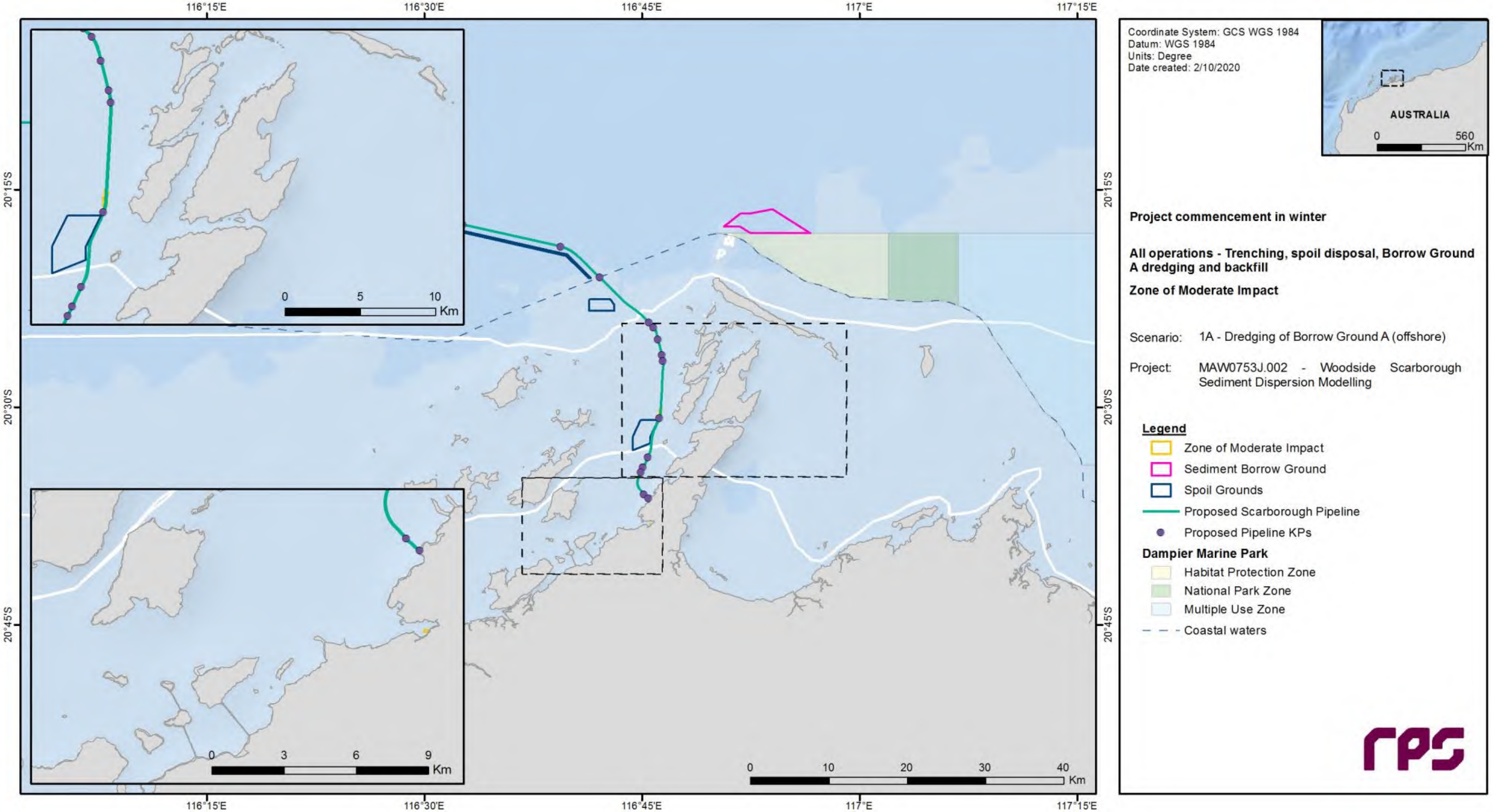


Figure 5.8 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 10-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st July 2016 to 23rd May 2017).

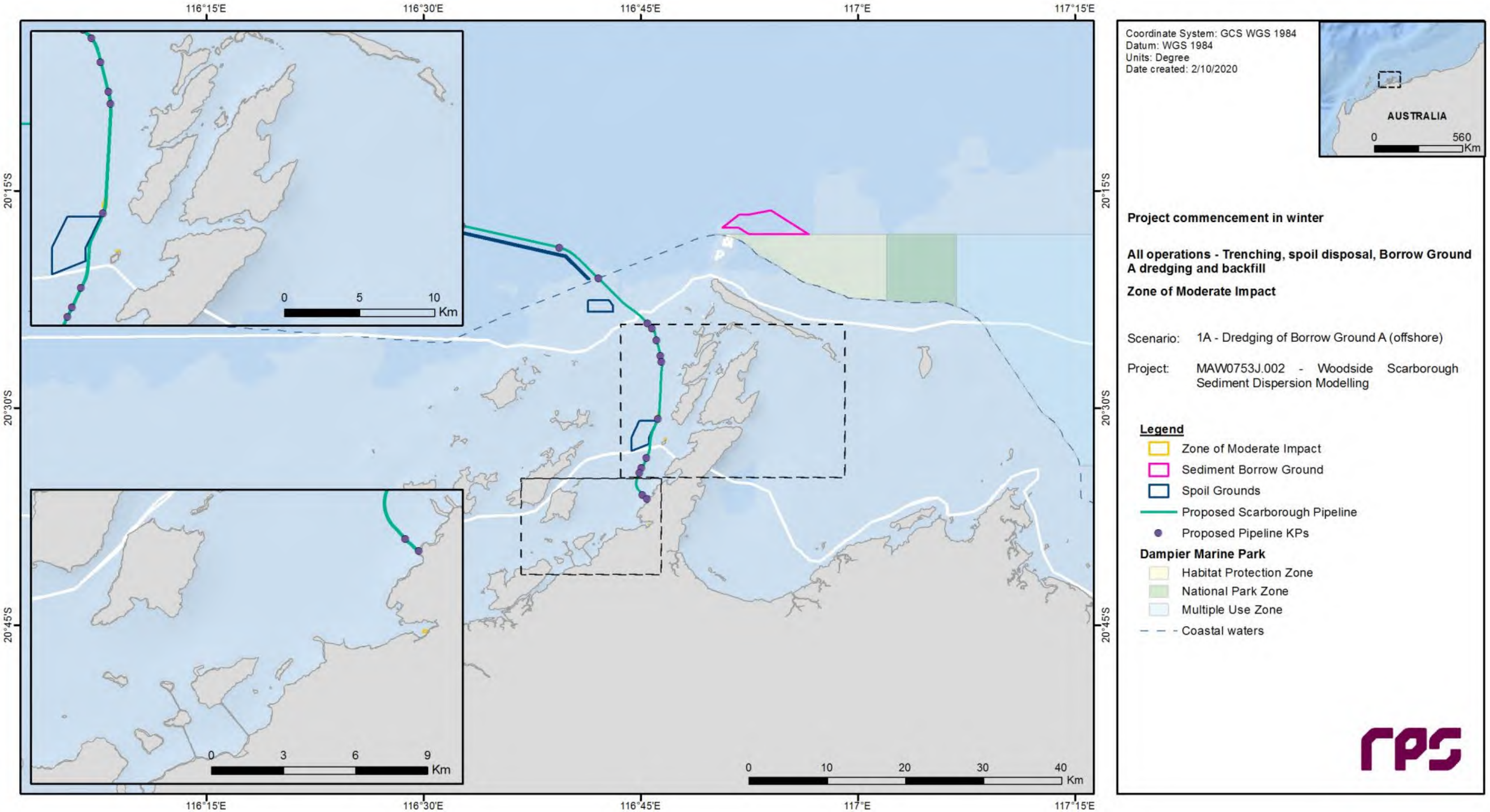


Figure 5.9 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 14-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st July 2016 to 23rd May 2017).

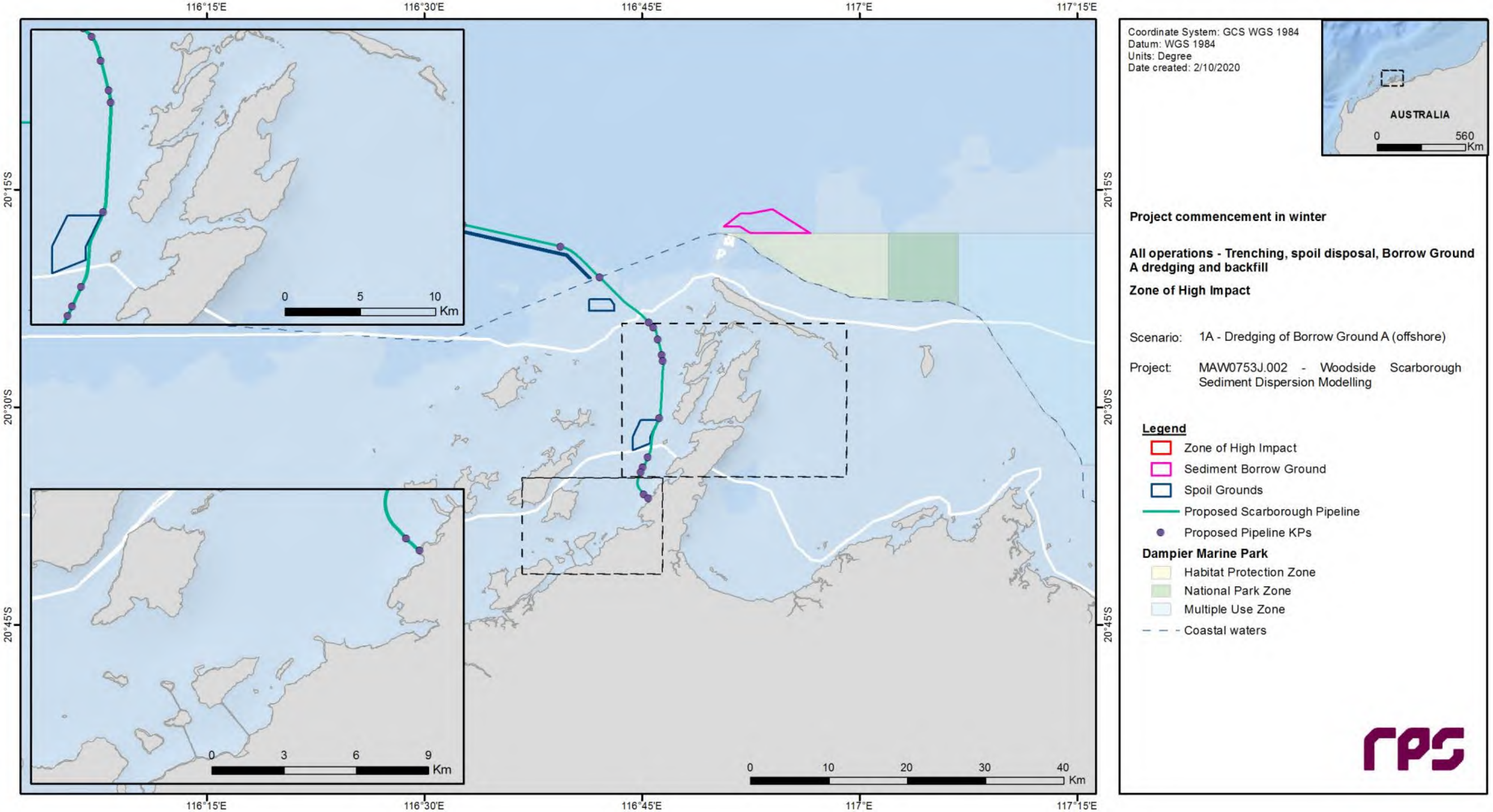


Figure 5.10 Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 3-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st July 2016 to 23rd May 2017).

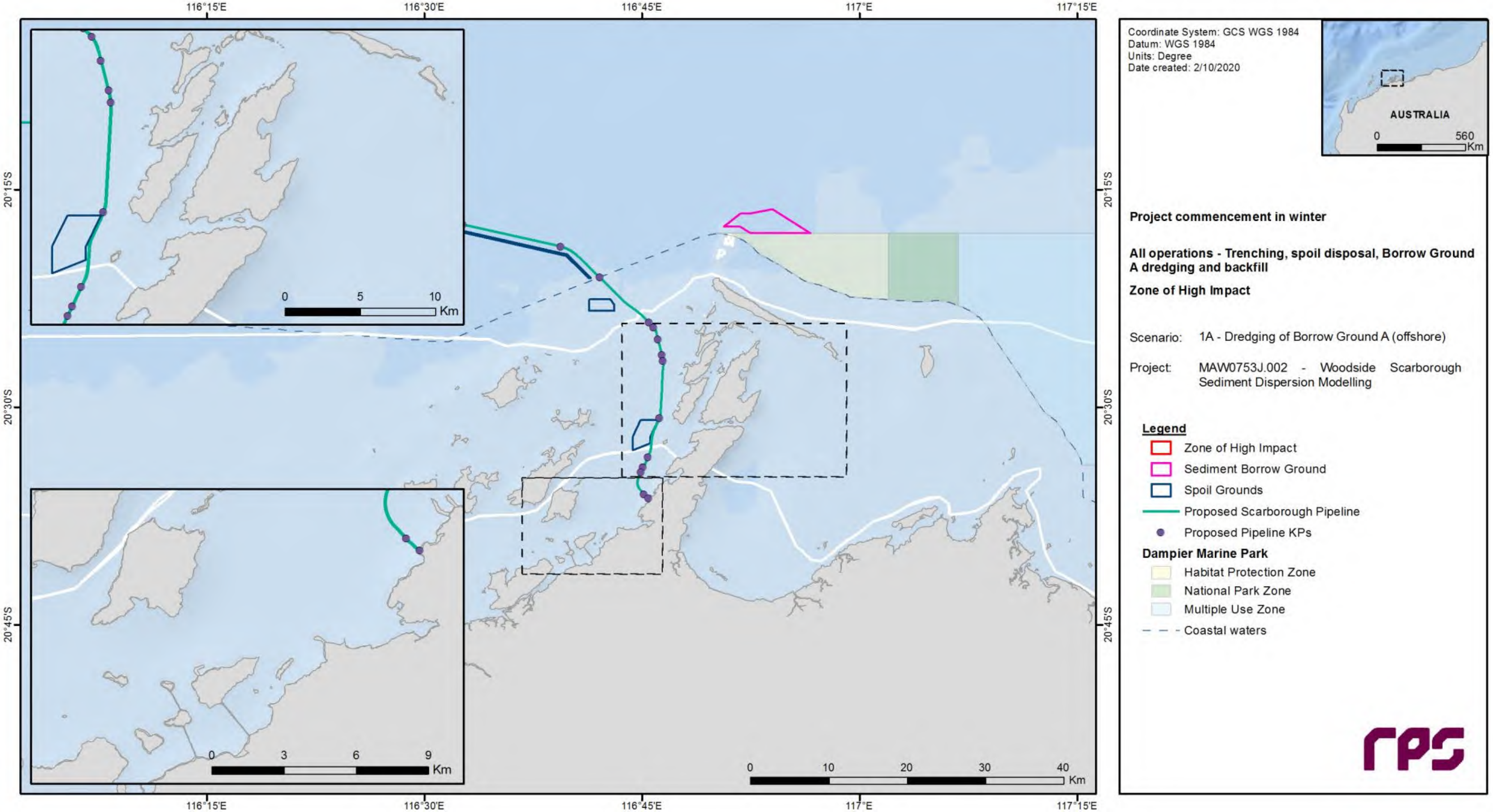


Figure 5.11 Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 7-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st July 2016 to 23rd May 2017).

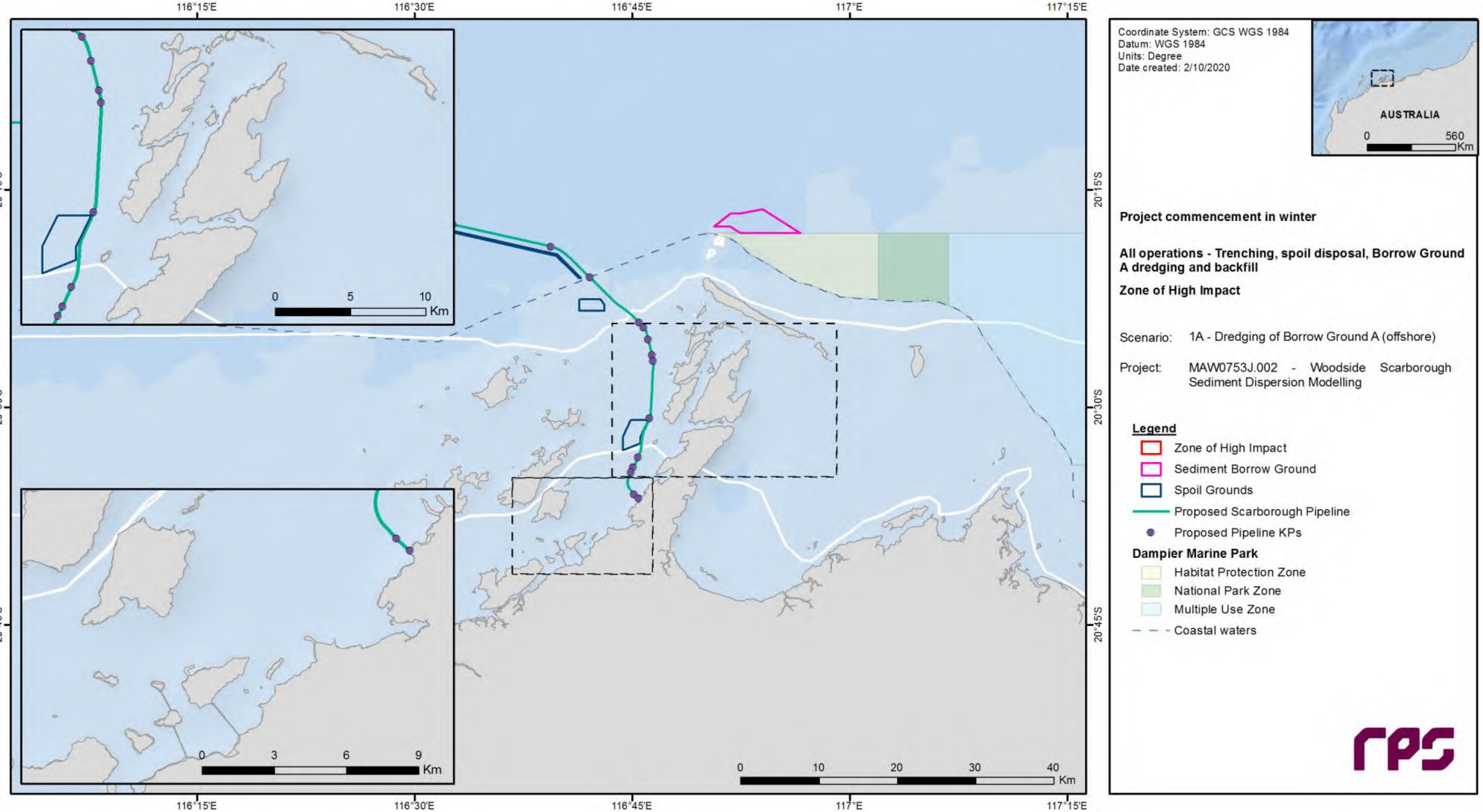


Figure 5.12 Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 10-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st July 2016 to 23rd May 2017).

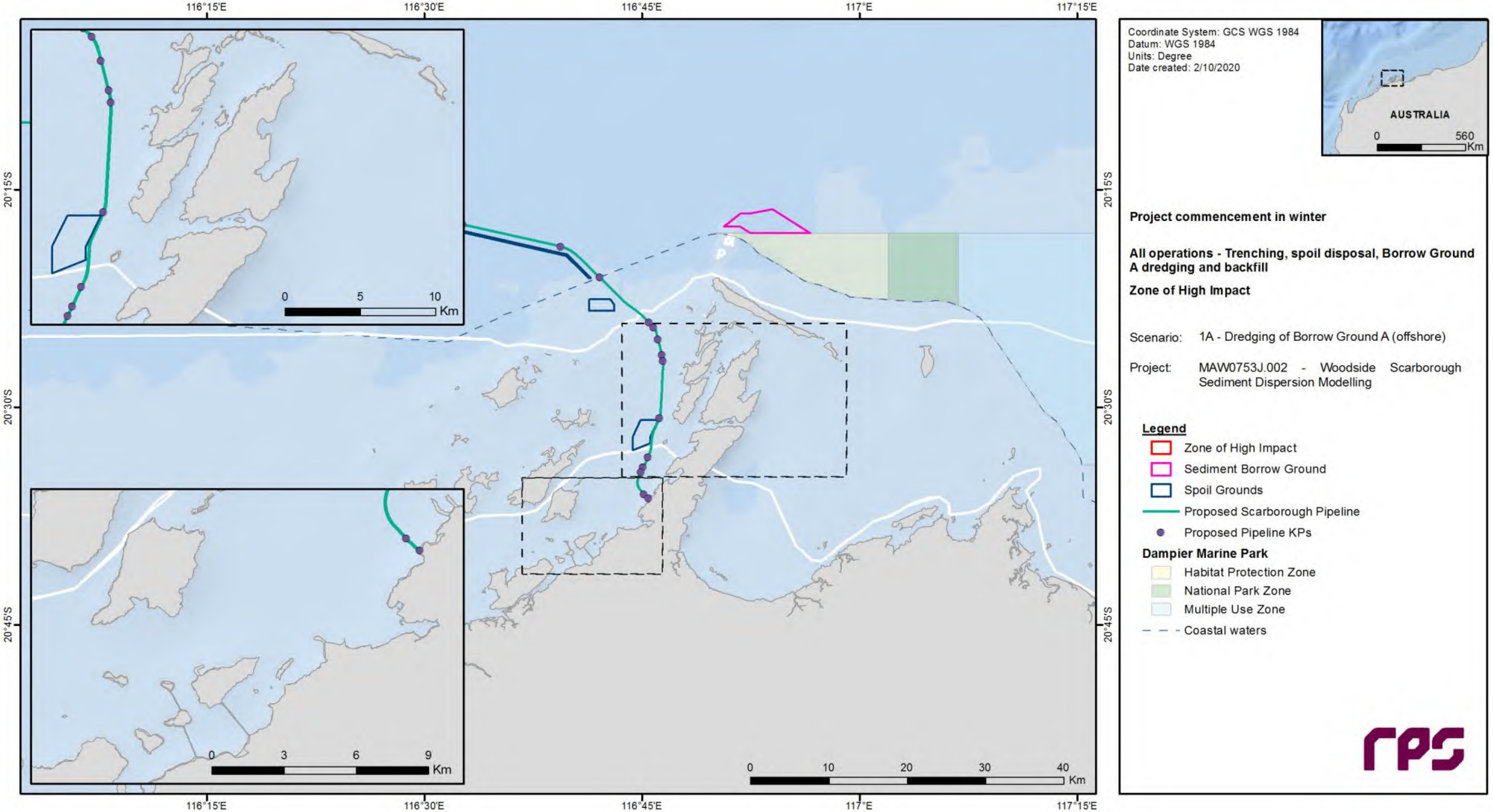


Figure 5.13 Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 14-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st July 2016 to 23rd May 2017).

5.2.2.2 Scenario 2: Dredging Operations Commencing during Summer, with Backfill Material Sourced from Borrow Ground A

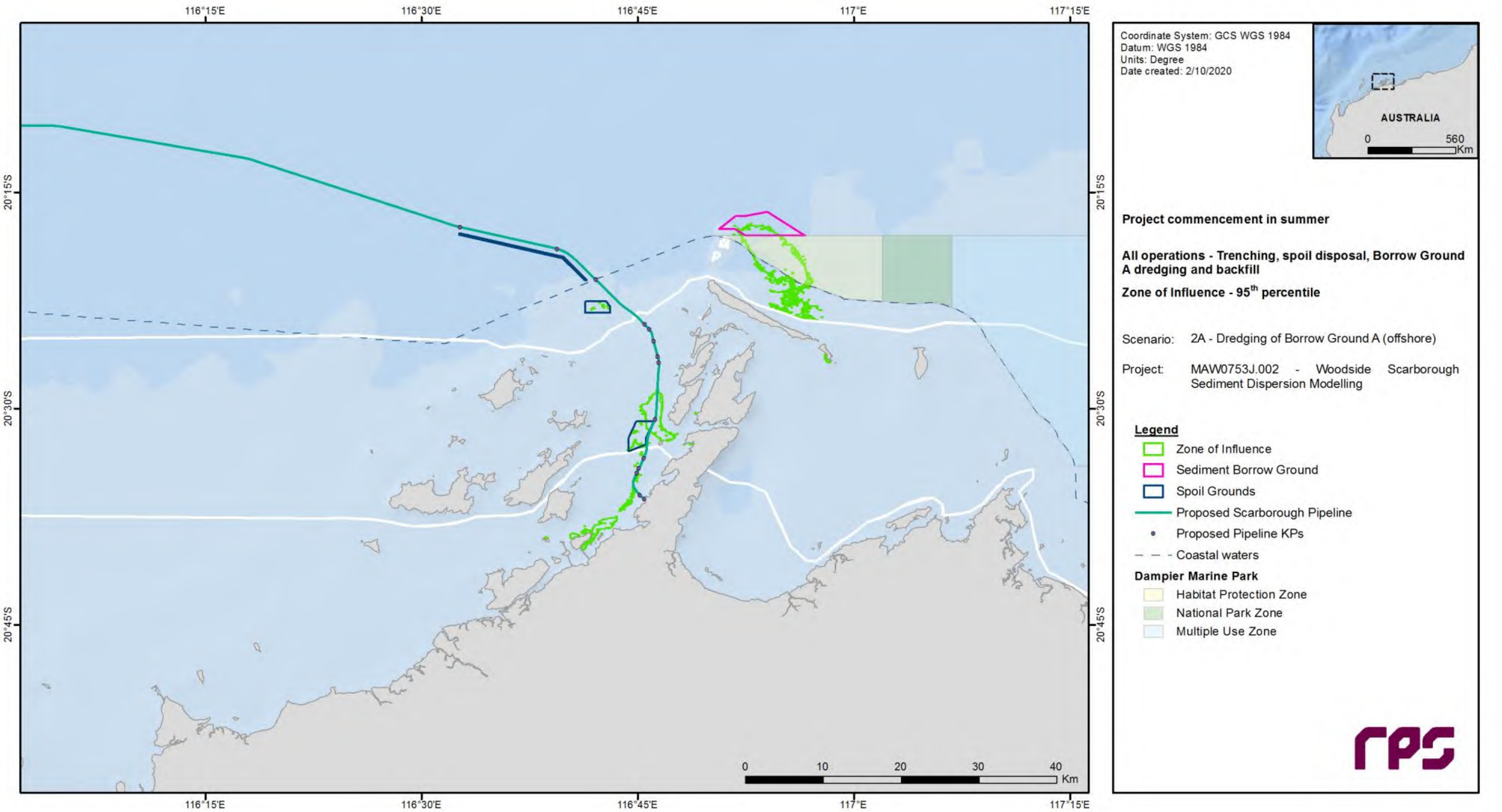


Figure 5.14 **Predicted 95th percentile Zone of Influence following application of the appropriate spatial thresholds in Table 4.2 to a 24-hour rolling average of total (dredge and background) SSC throughout the entire scenario duration (1st January 2017 to 21st November 2017).**

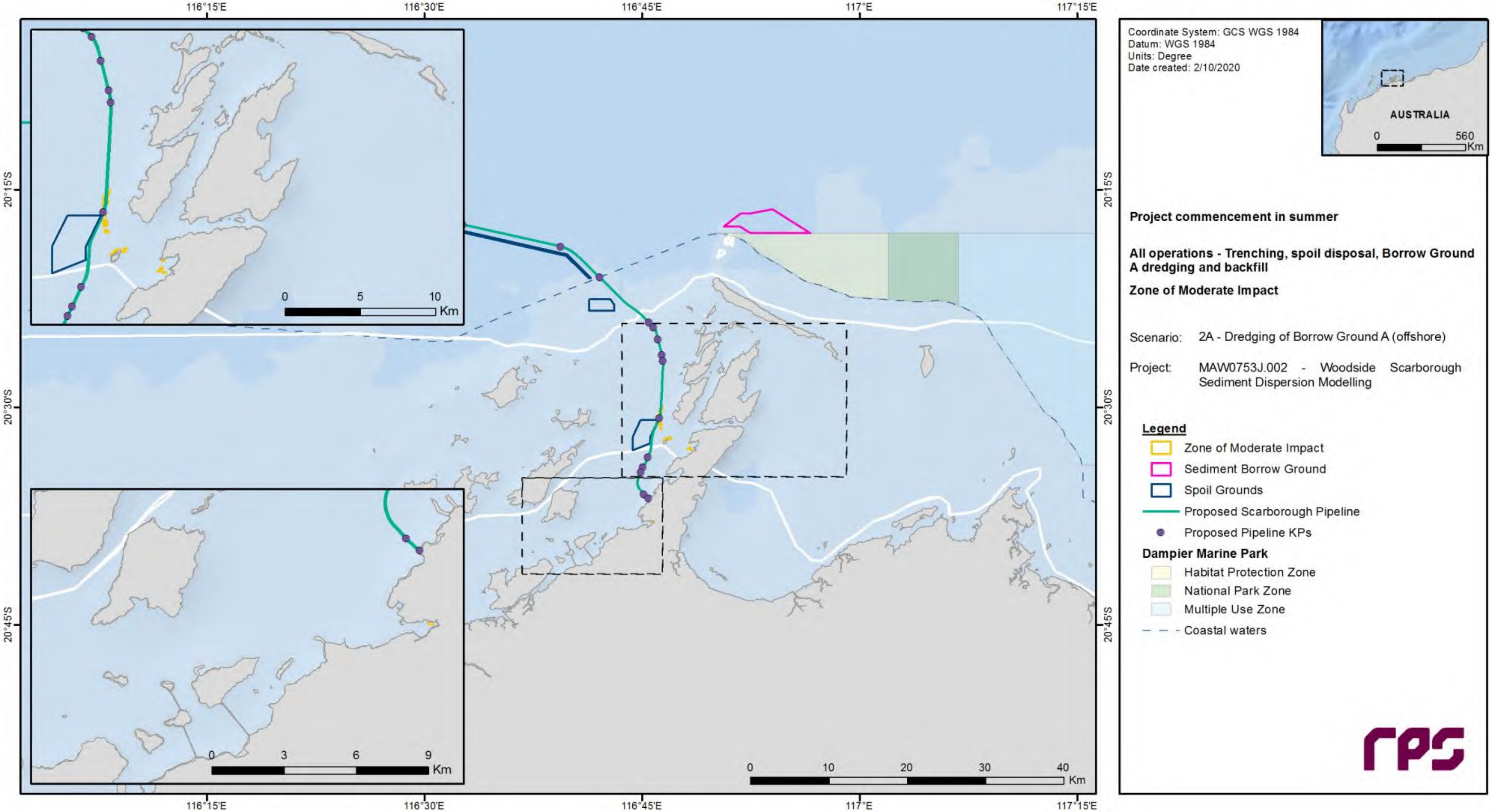


Figure 5.15 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 3-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st January 2017 to 21st November 2017).

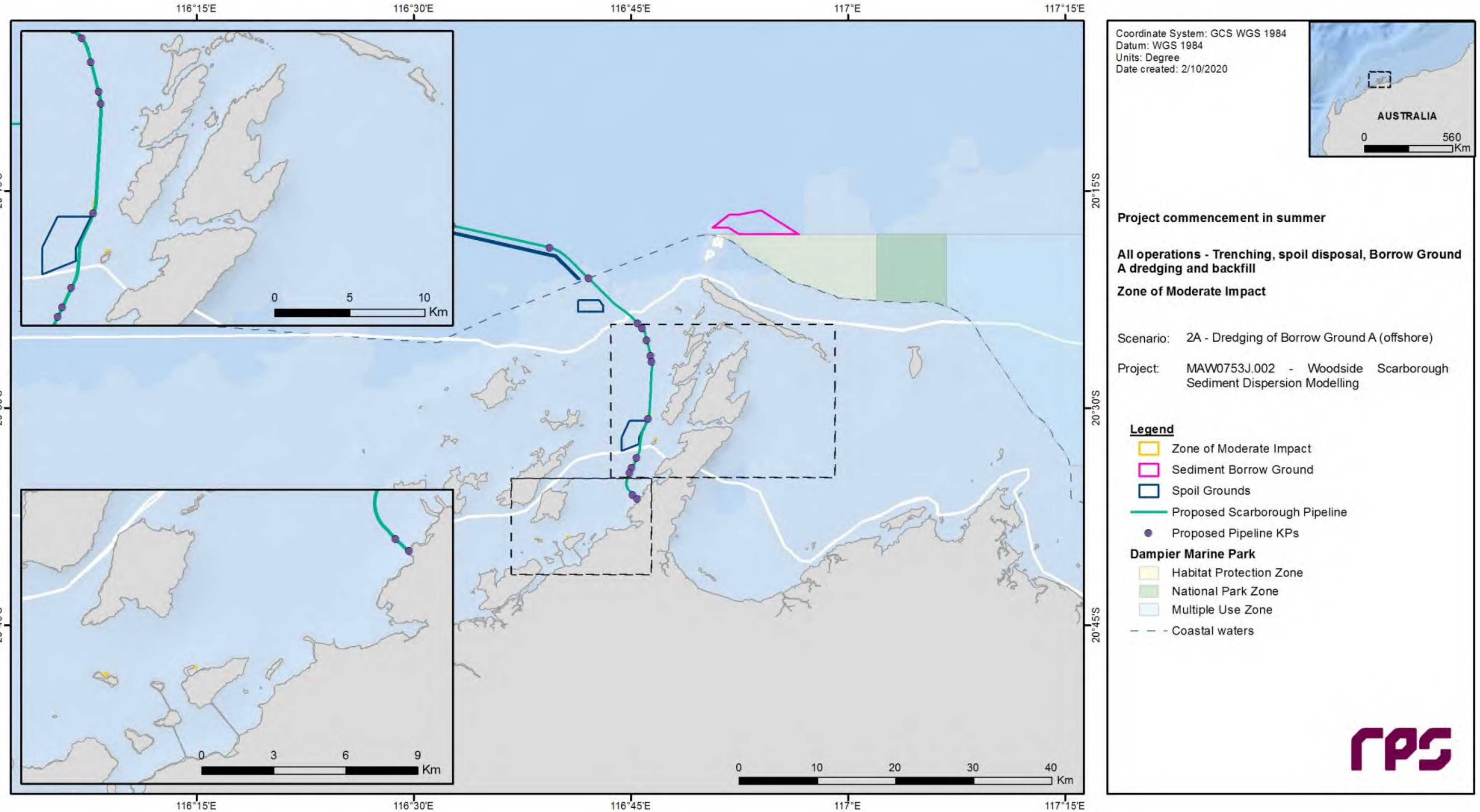


Figure 5.16 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 7-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st January 2017 to 21st November 2017).

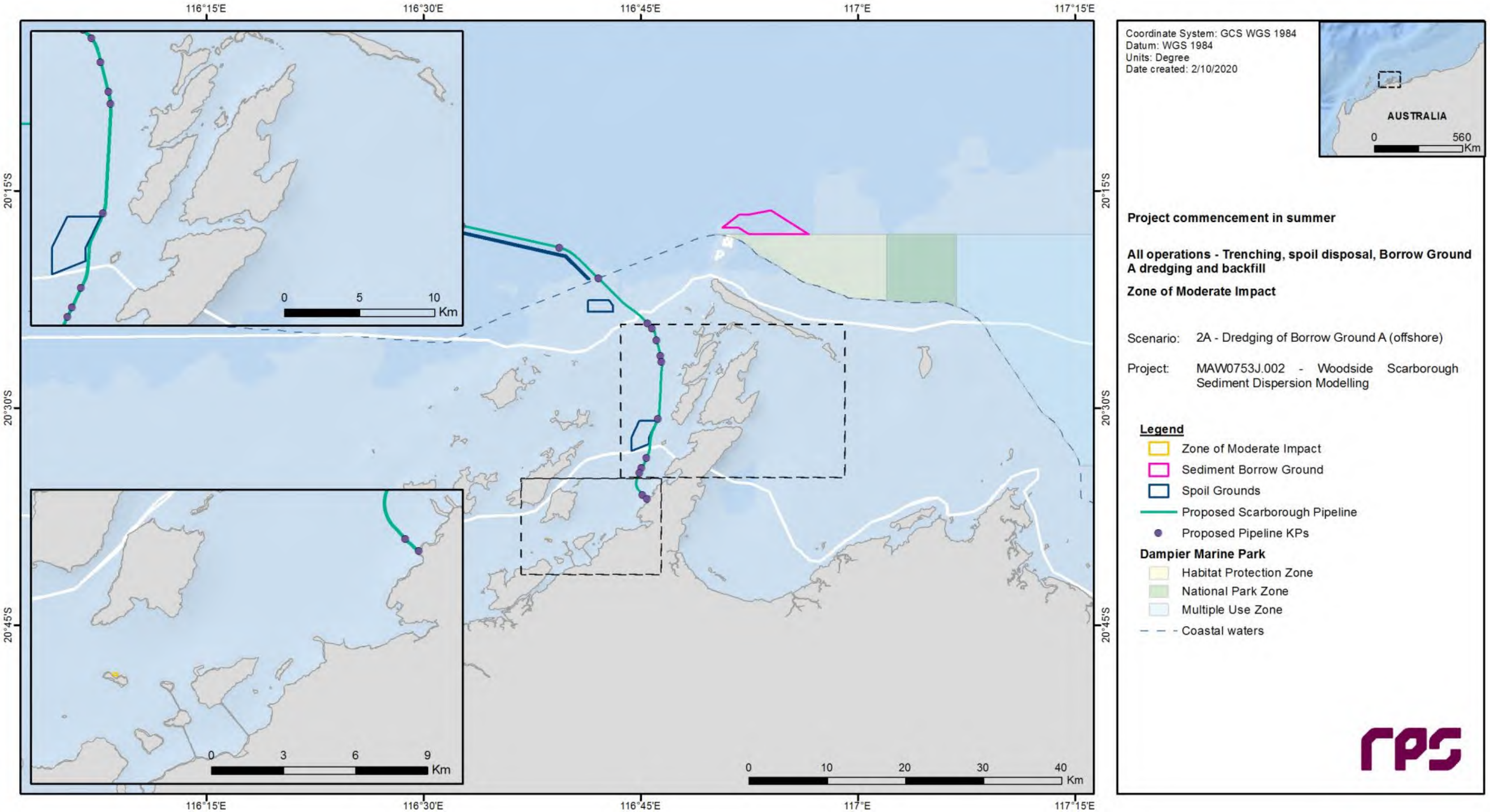


Figure 5.17 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 10-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st January 2017 to 21st November 2017).

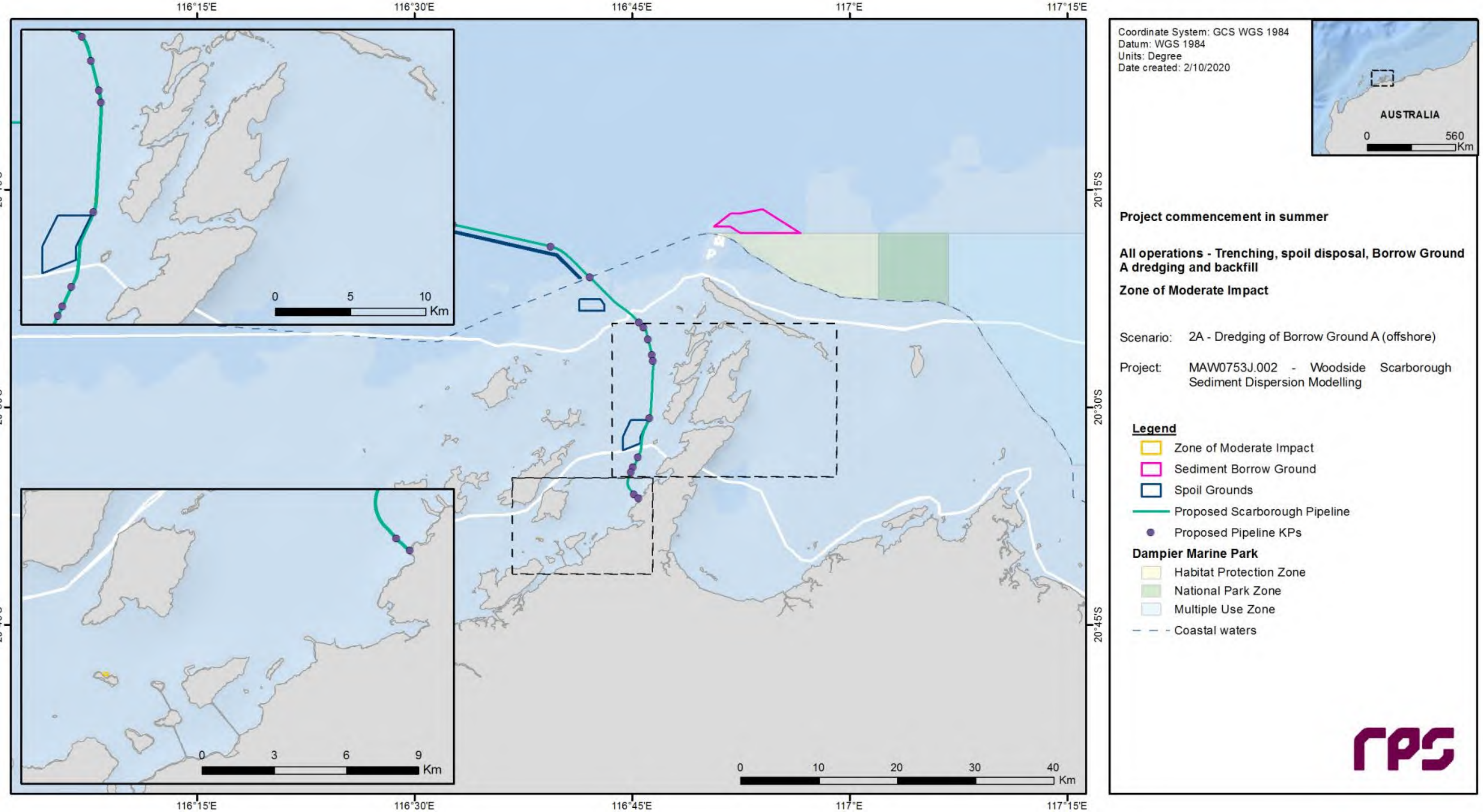


Figure 5.18 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 14-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st January 2017 to 21st November 2017).

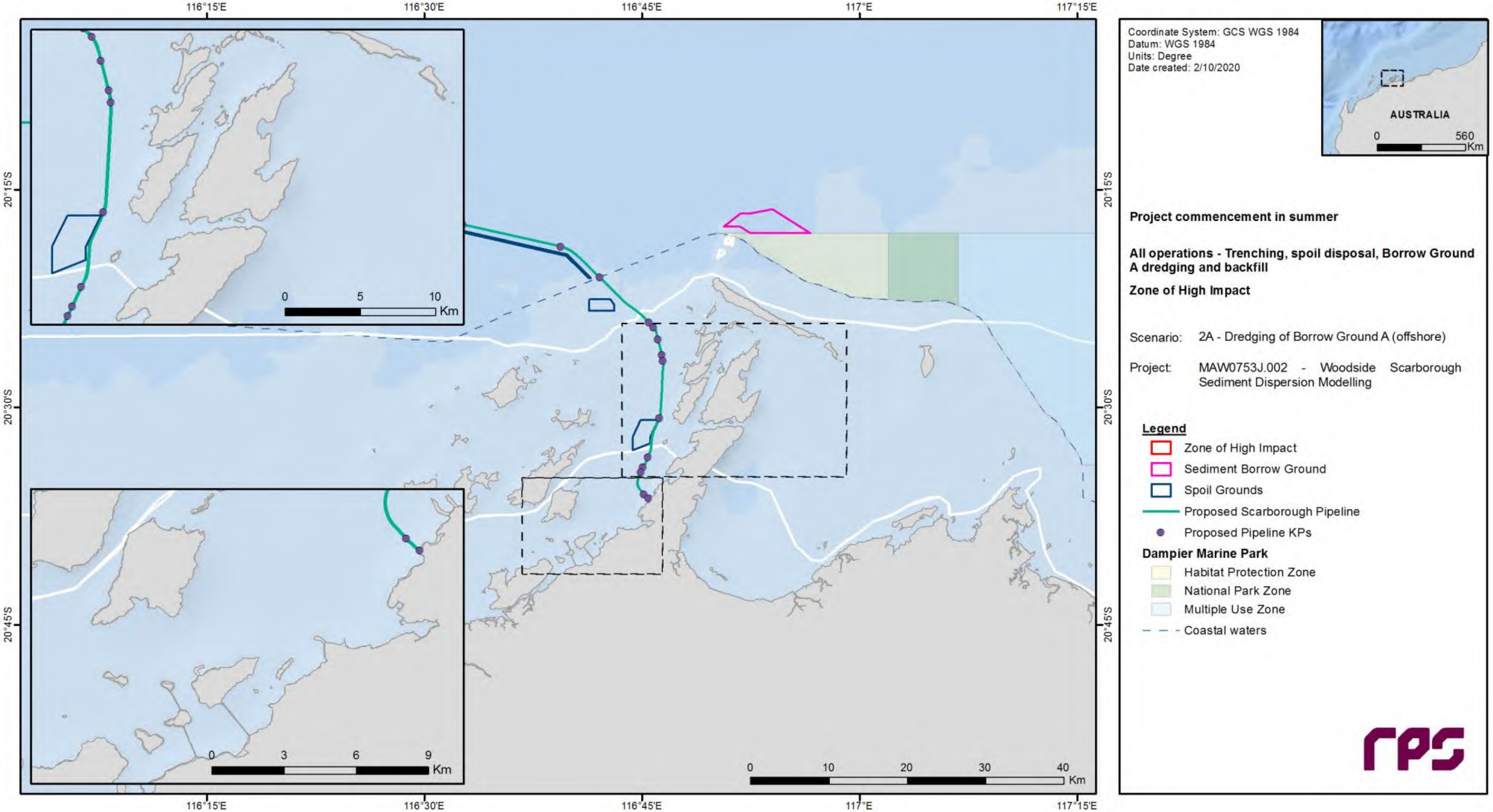


Figure 5.19 Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 3-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st January 2017 to 21st November 2017).

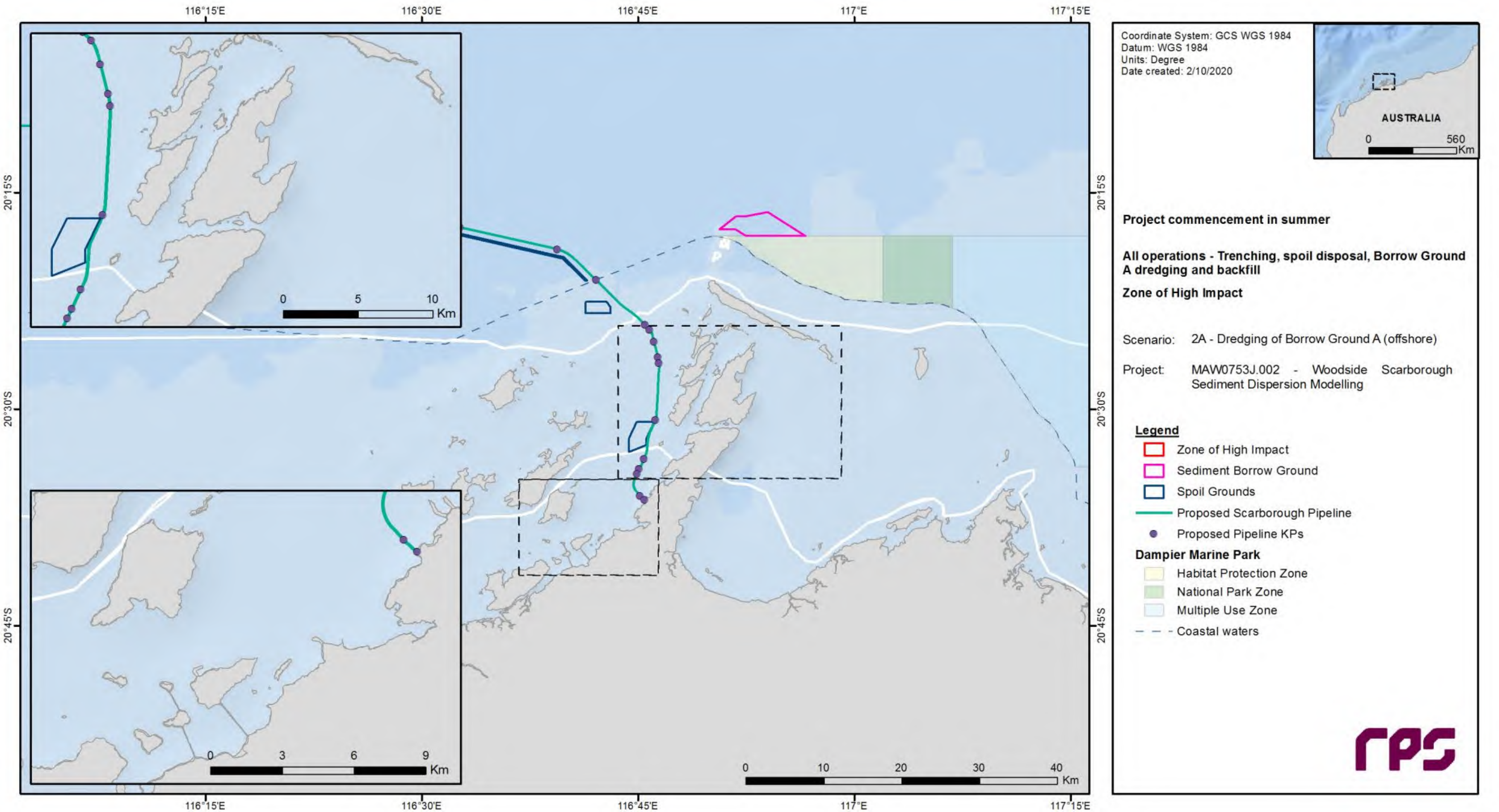


Figure 5.20 Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 7-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st January 2017 to 21st November 2017).

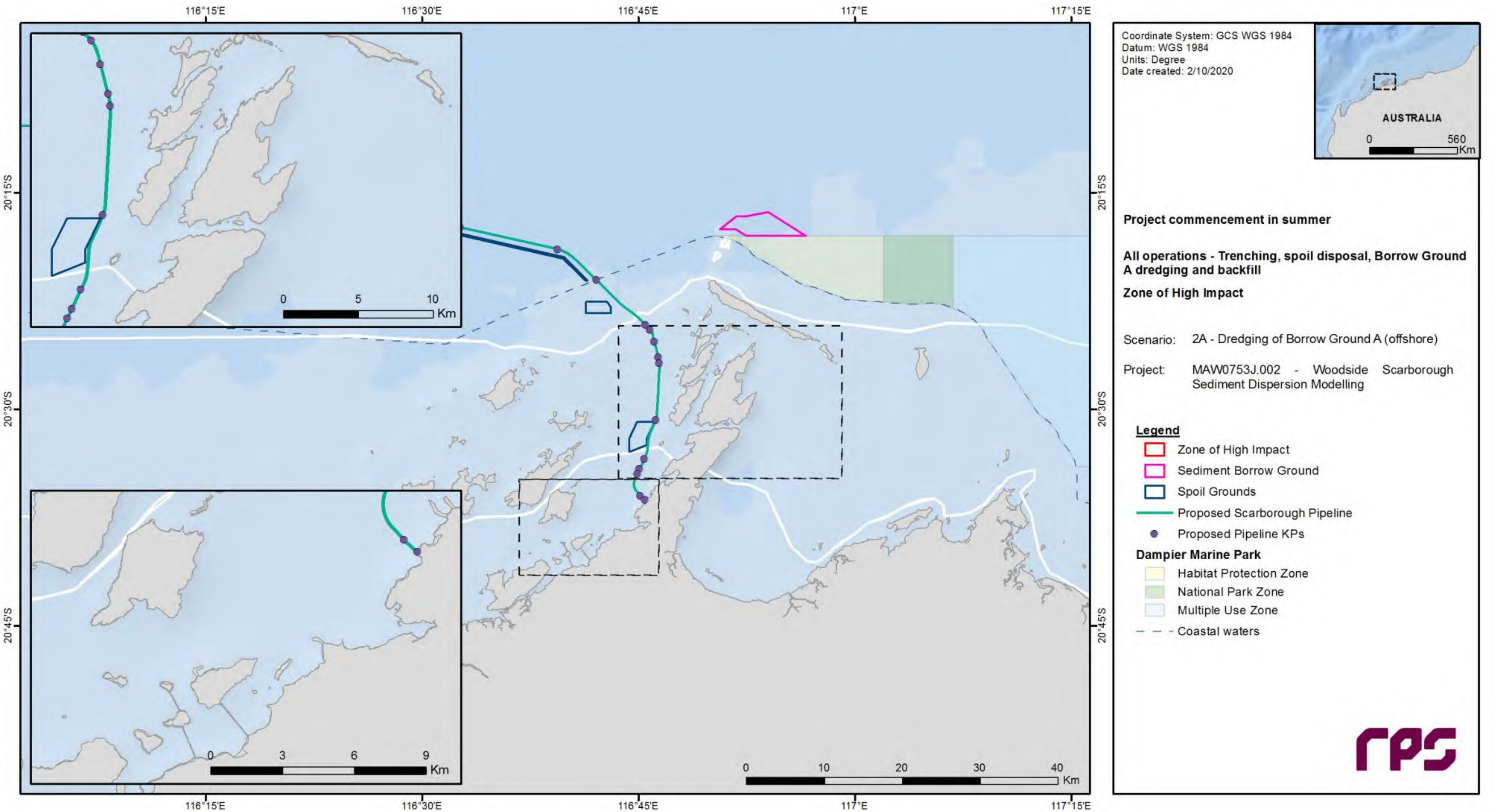


Figure 5.21 Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 10-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st January 2017 to 21st November 2017).

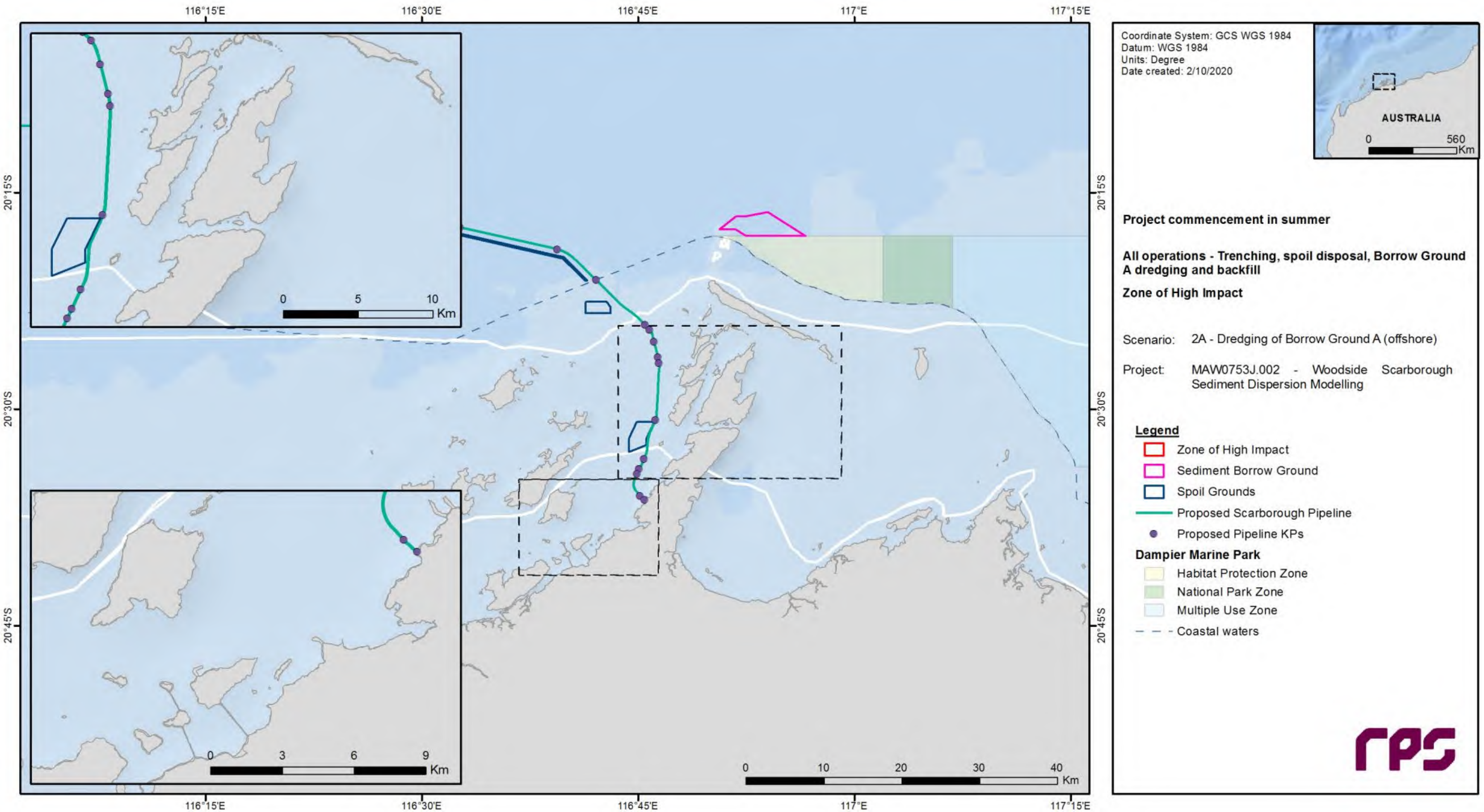


Figure 5.22 Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 14-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the entire scenario duration (1st January 2017 to 21st November 2017).

5.3 Activities in Commonwealth Waters

To provide an indication of the characteristics of sediment plumes associated only with activities occurring – or directly related to those occurring – in Commonwealth waters, additional figures are presented in Sections B.1 (Scenario 1) and B.2 (Scenario 2) of Appendix B. These figures comprise overall percentile contours and overall management zone extents, and are representative of the following activities:

- Pipeline trenching and spoil disposal activities only beyond the State waters boundary.
- All borrow-ground dredging activities.
- All pipeline backfill activities (including those within State waters due to the direct correlation of backfill operations with borrow-ground dredging in Commonwealth waters).

It is emphasised that the intention of these outputs is to provide added context to the full-program outcomes described in the preceding sections. By design, the additional outputs exclude the cumulative effects of all dredging and disposal activities occurring within State waters. Therefore, while the influence of sediment plumes originating offshore and migrating to State waters is clear in the figures, the corresponding potential for influence on Commonwealth waters by plumes originating inshore is not fully considered.

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Appendix A: Additional Figures of Spatial Outcomes

A.1 Scenario 1: Dredging Operations Commencing during Winter, with Backfill Material Sourced from Borrow Ground A

A.1.1 Monthly Snapshots

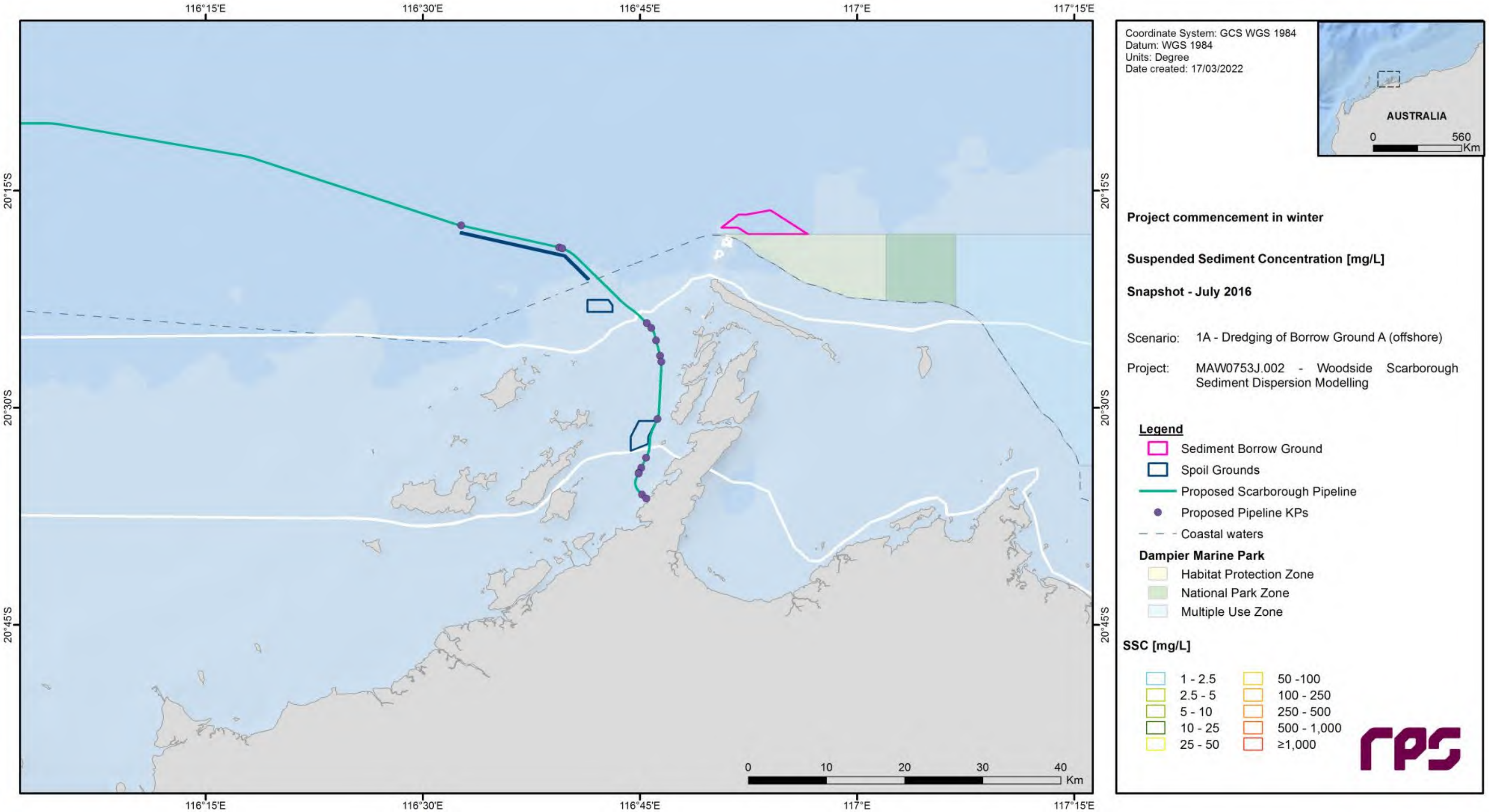


Figure A.1 Predicted instantaneous dredge-excess SSC on 1st July 2016.

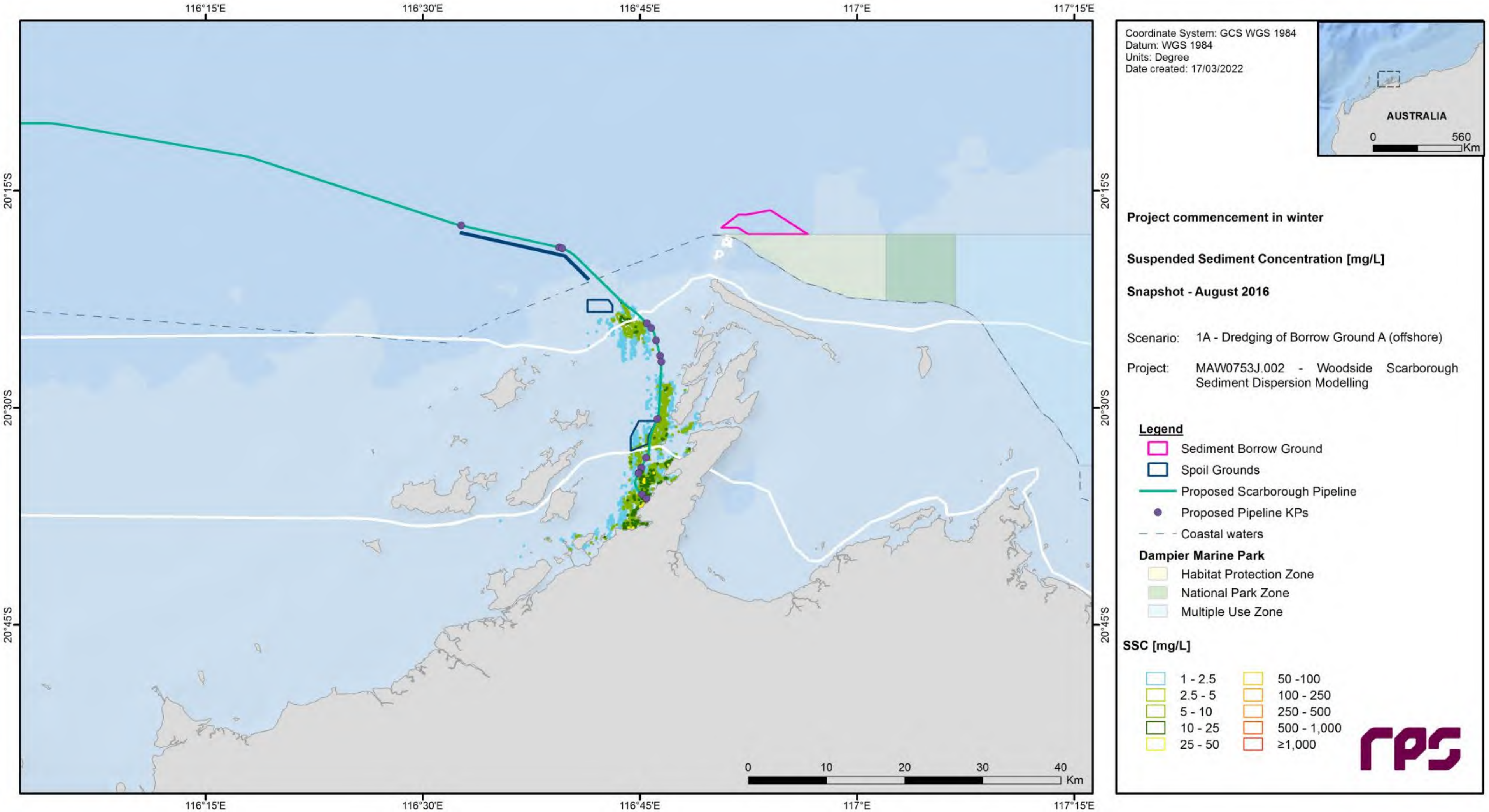


Figure A.2 Predicted instantaneous dredge-excess SSC on 1st August 2016.

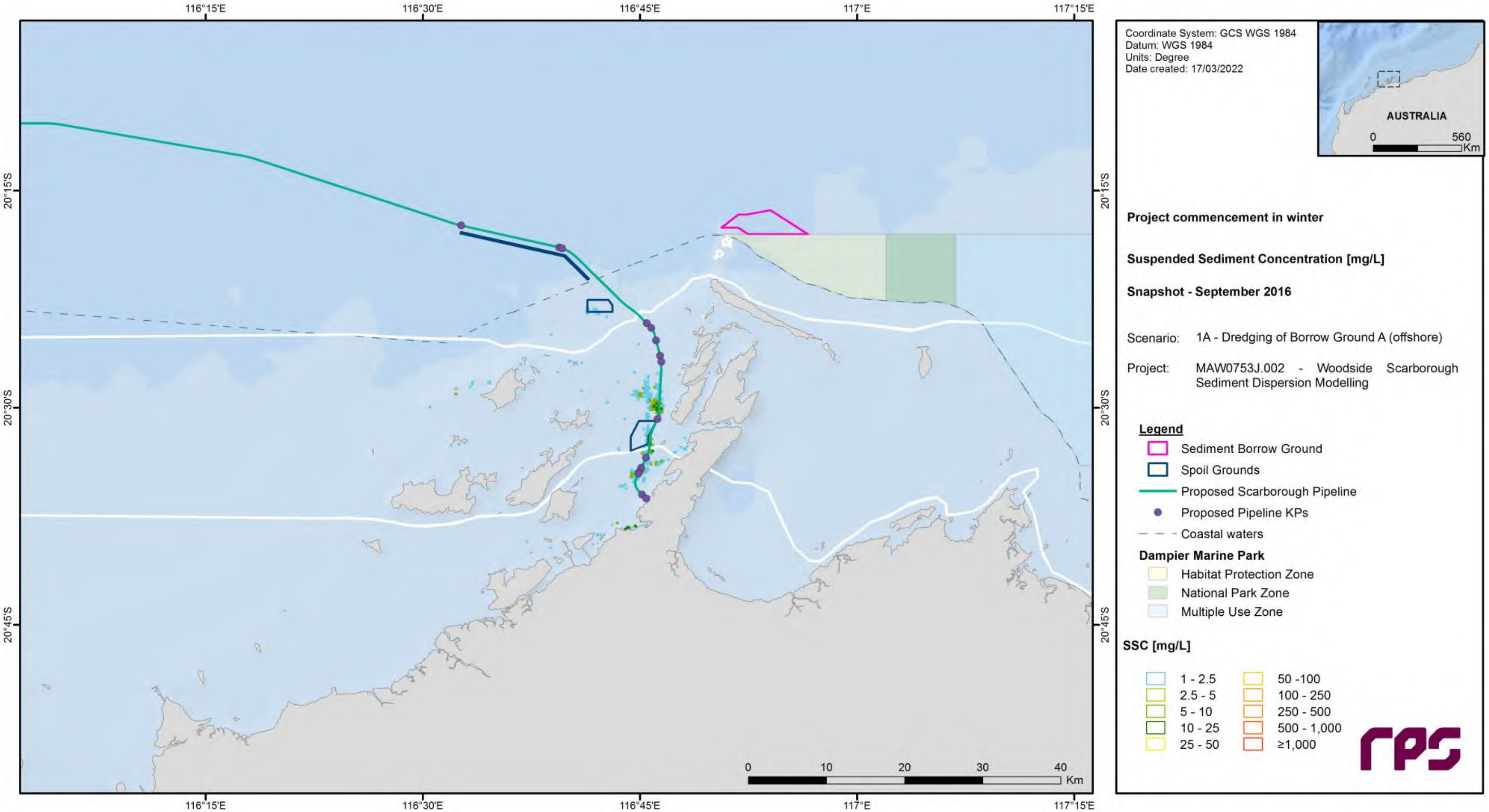


Figure A.3 Predicted instantaneous dredge-excess SSC on 1st September 2016.

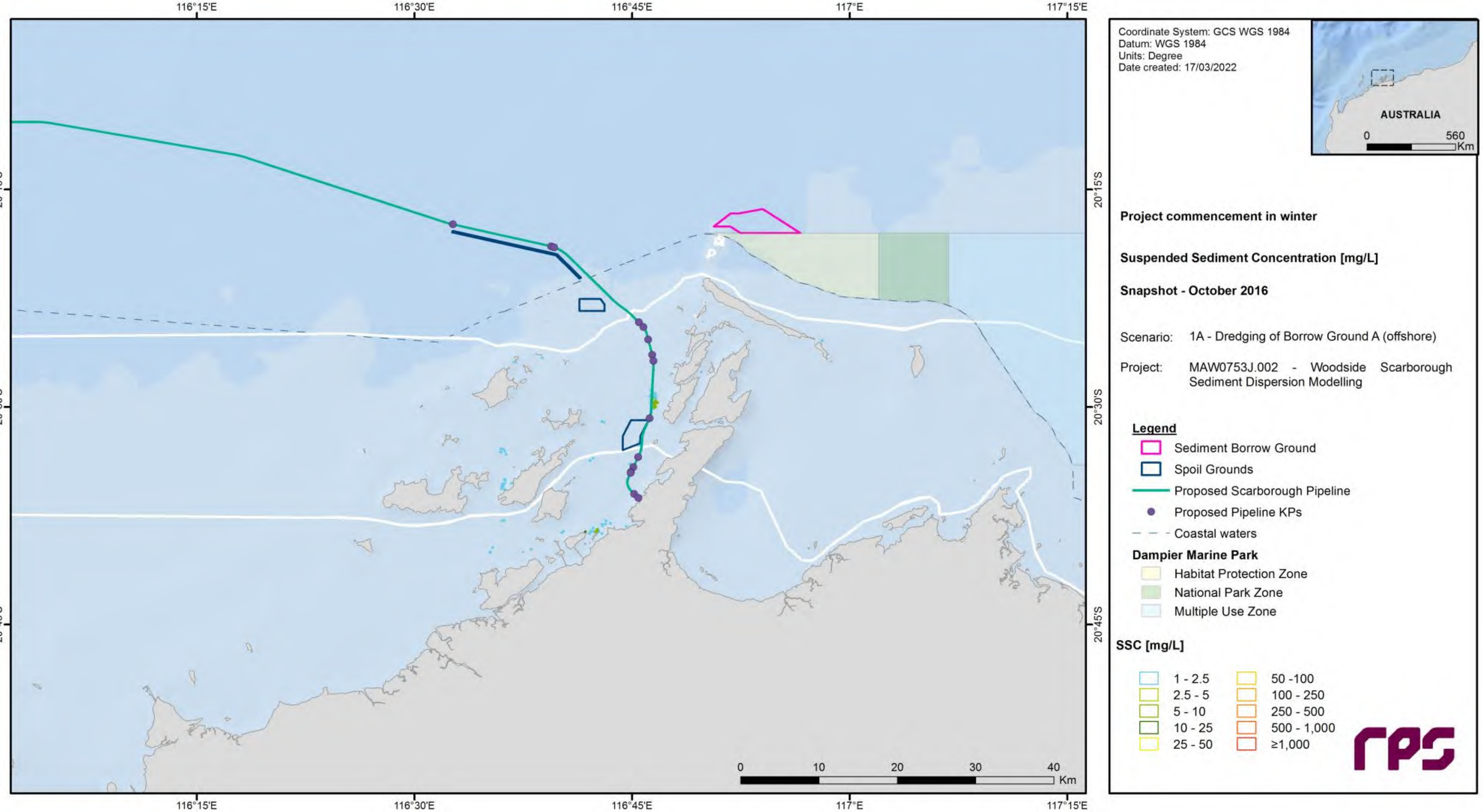


Figure A.4 Predicted instantaneous dredge-excess SSC on 1st October 2016.

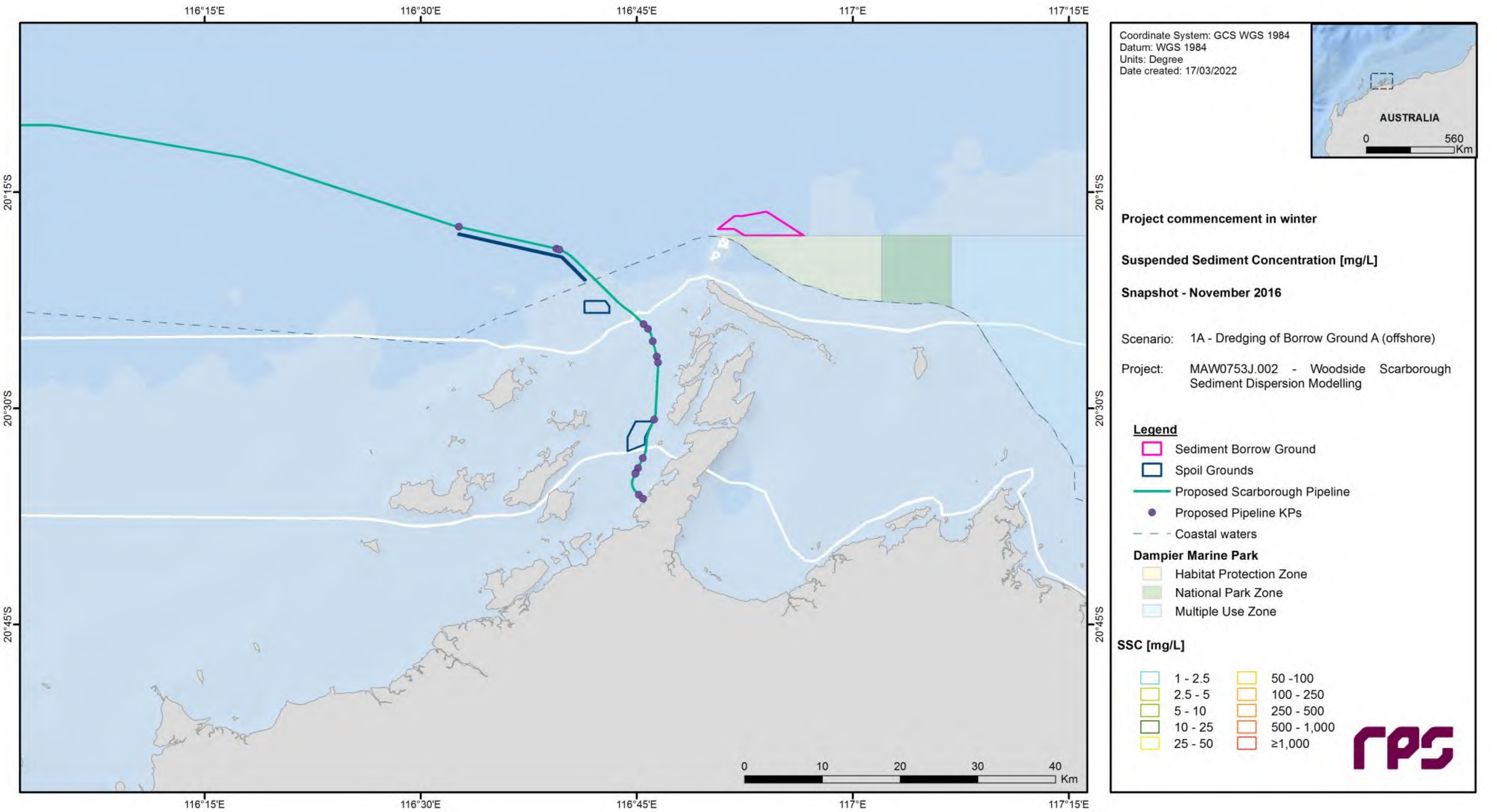


Figure A.5 Predicted instantaneous dredge-excess SSC on 1st November 2016.

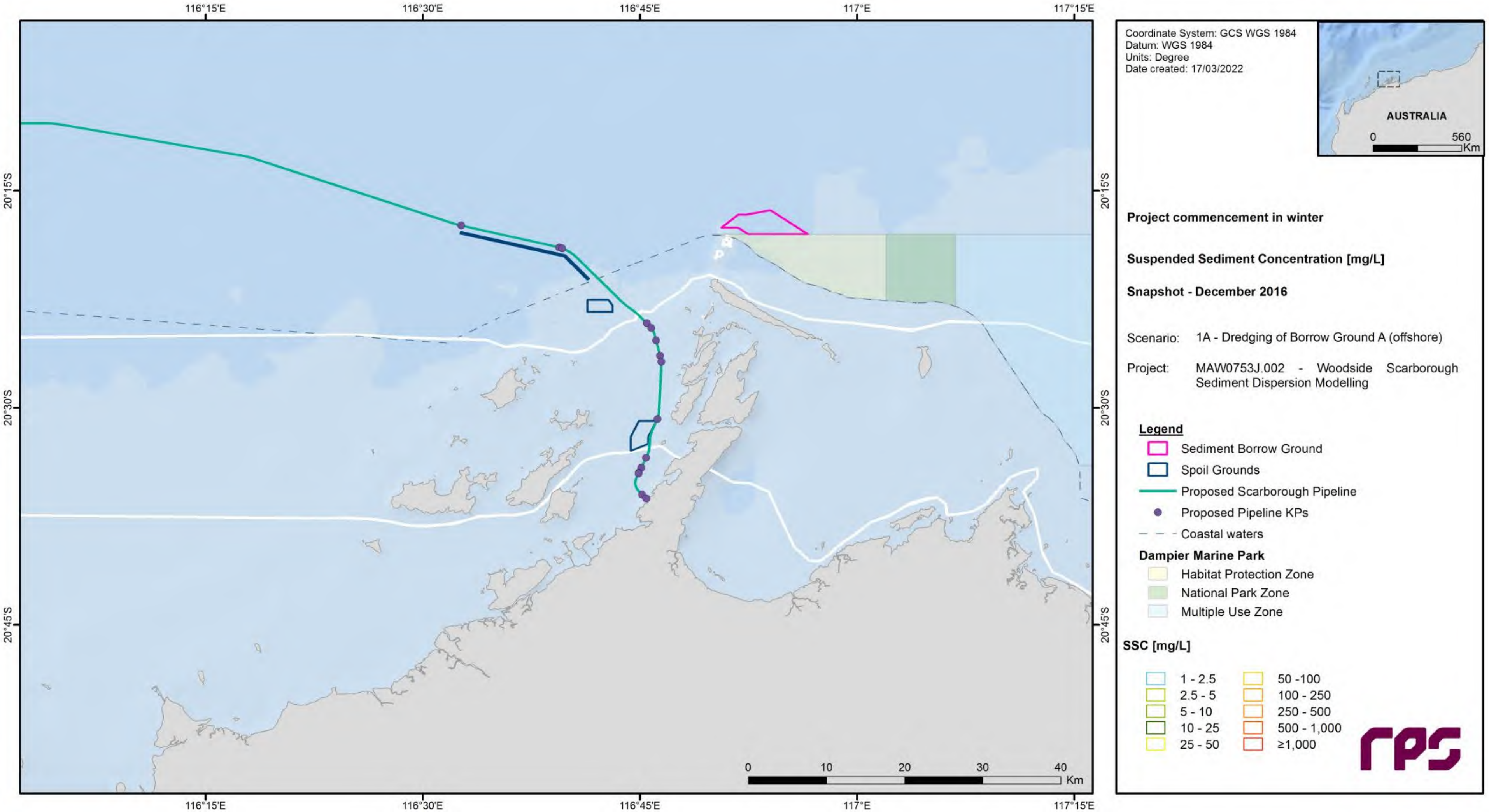


Figure A.6 Predicted instantaneous dredge-excess SSC on 1st December 2016.

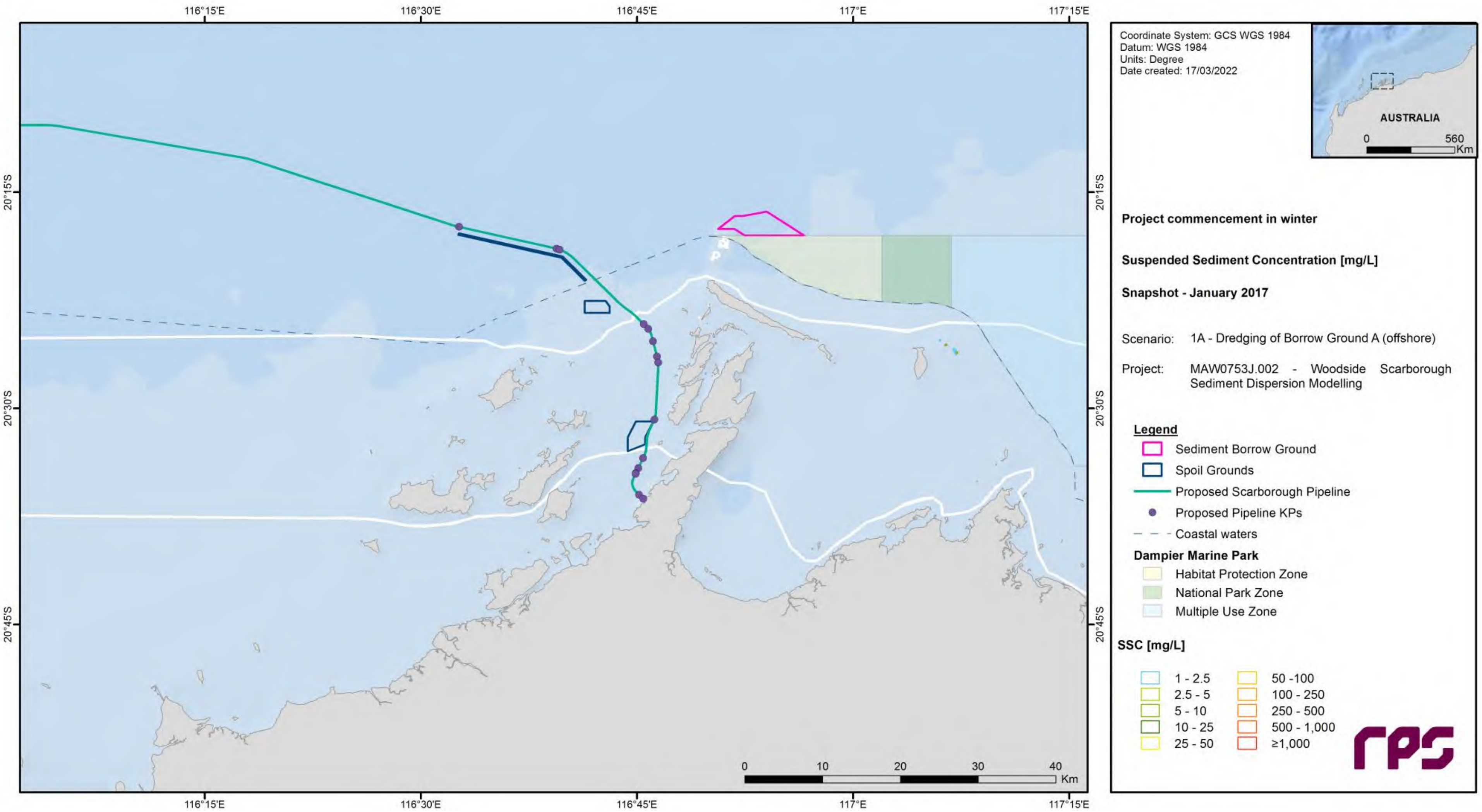


Figure A.7 Predicted instantaneous dredge-excess SSC on 1st January 2017.

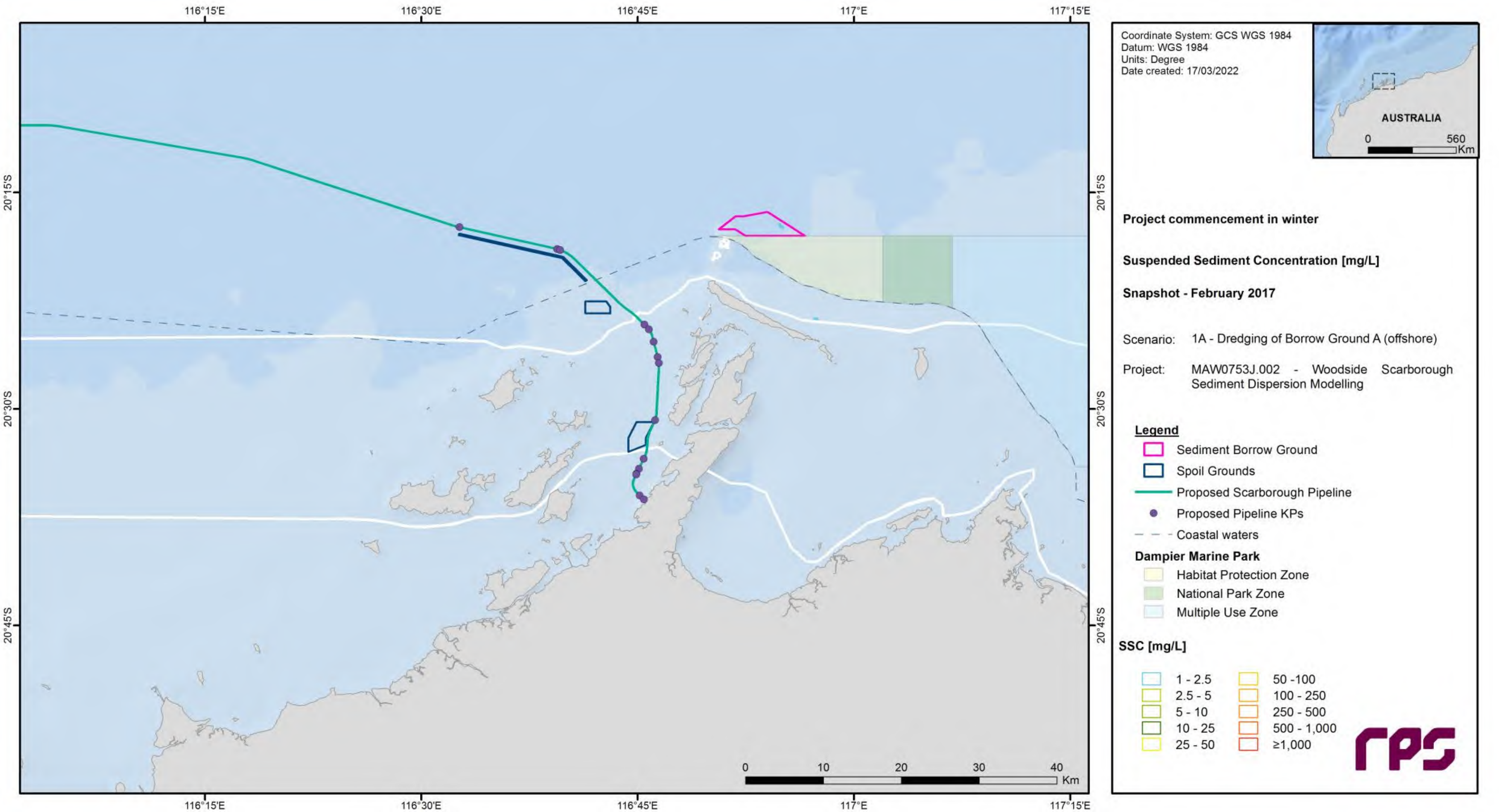


Figure A.8 Predicted instantaneous dredge-excess SSC on 1st February 2017.

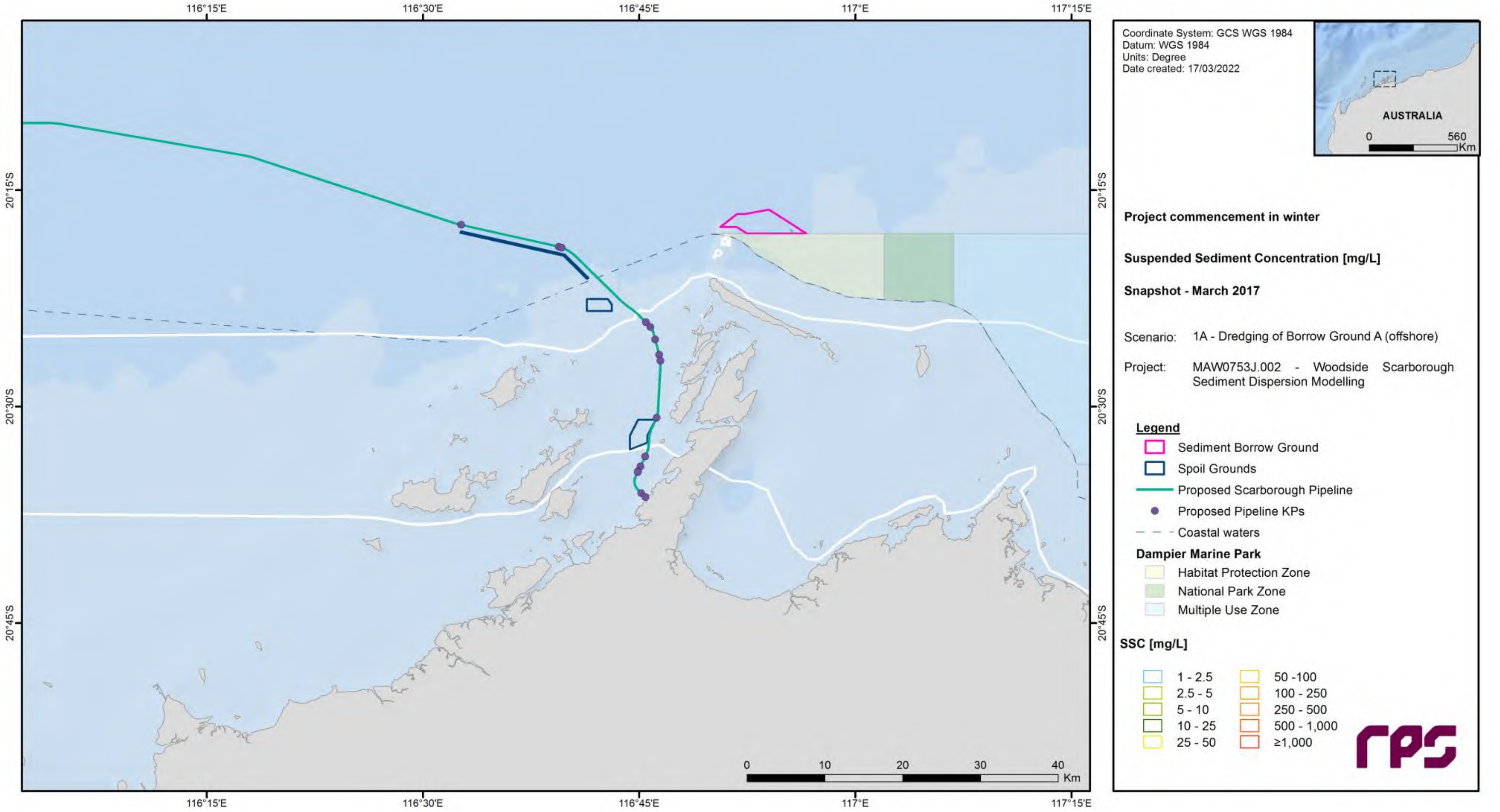


Figure A.9 Predicted instantaneous dredge-excess SSC on 1st March 2017.

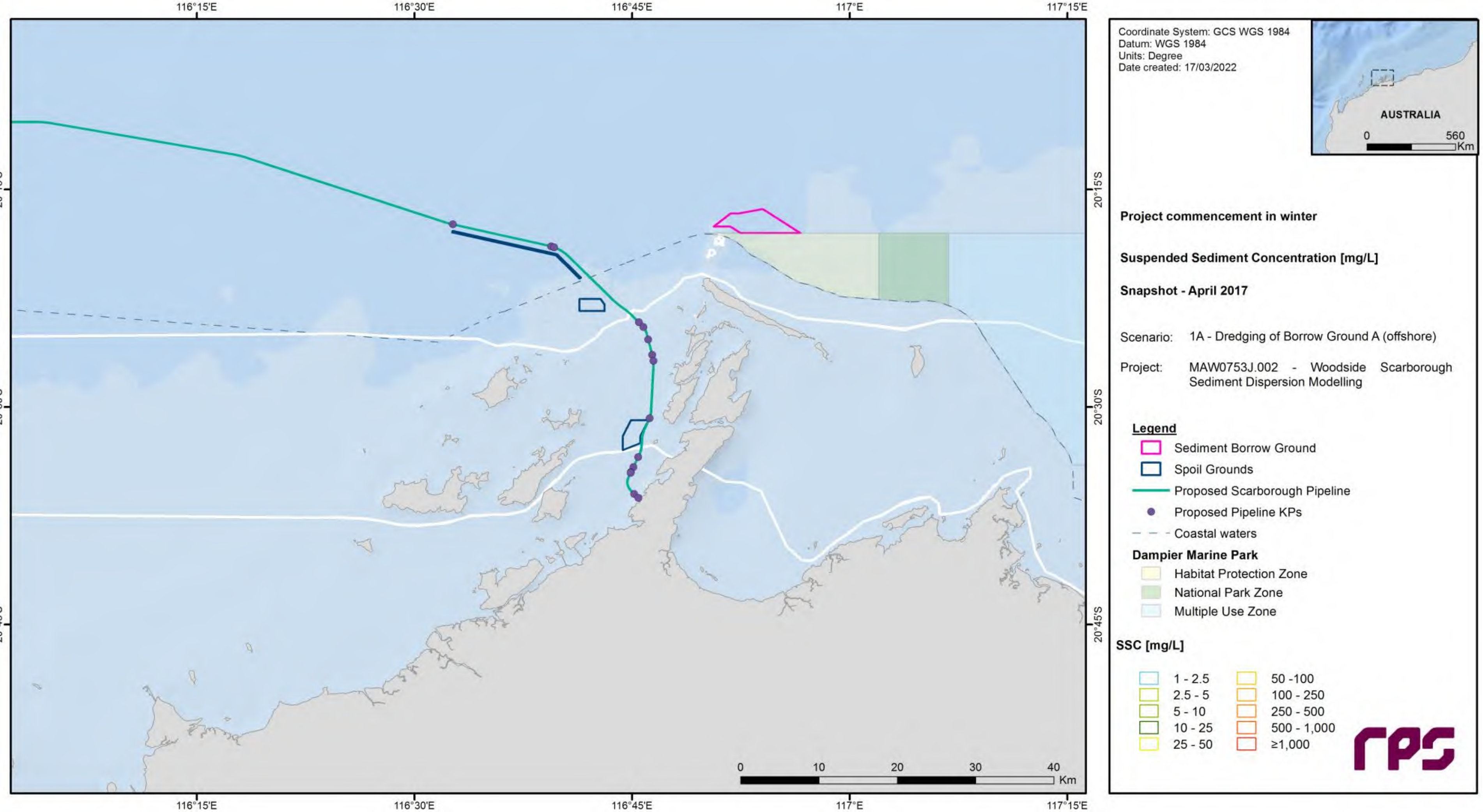


Figure A.10 Predicted instantaneous dredge-excess SSC on 1st April 2017.

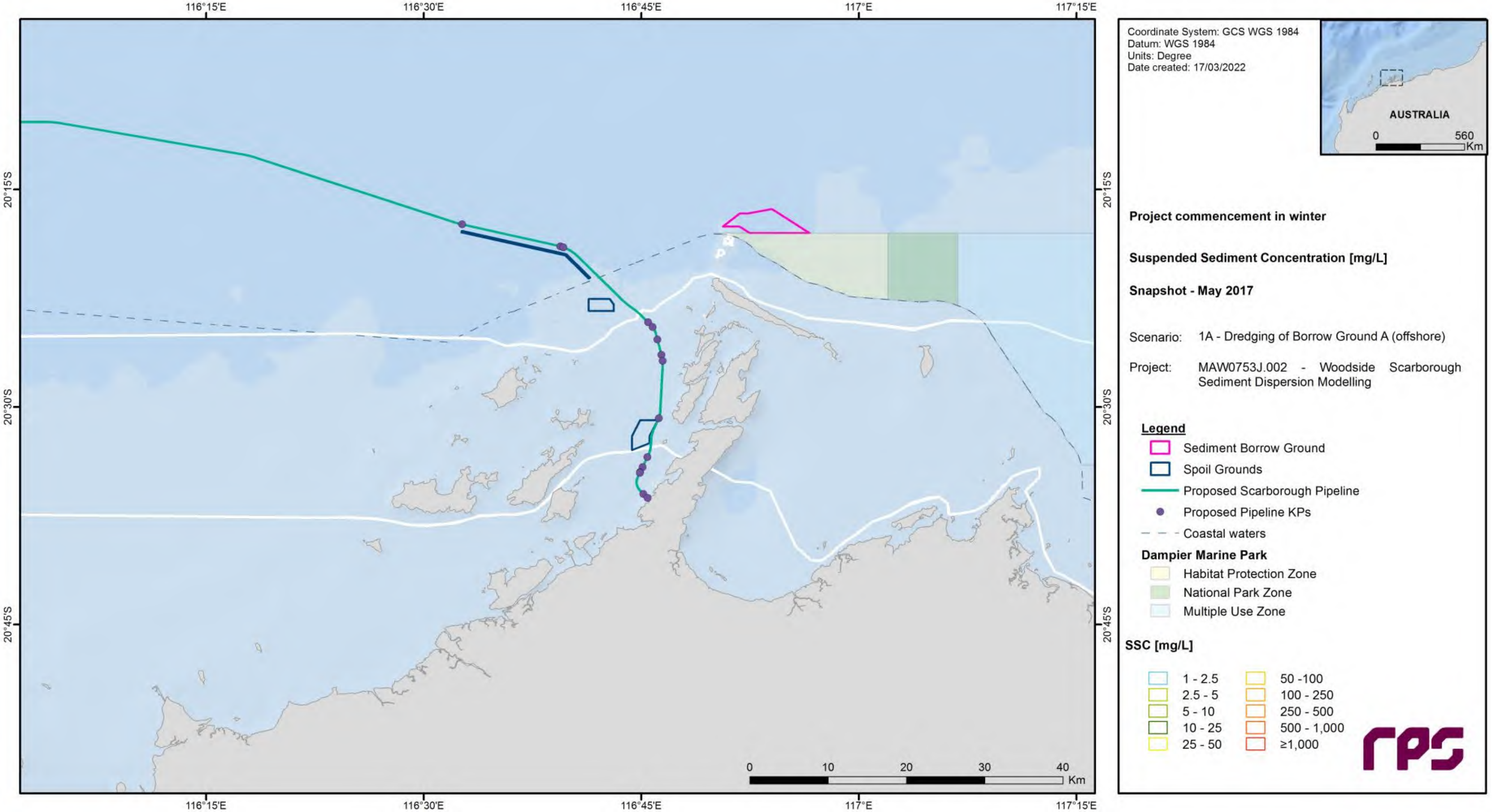


Figure A.11 Predicted instantaneous dredge-excess SSC on 1st May 2017.

A.2 Scenario 2: Dredging Operations Commencing during Summer, with Backfill Material Sourced from Borrow Ground A

A.2.1 Monthly Snapshots

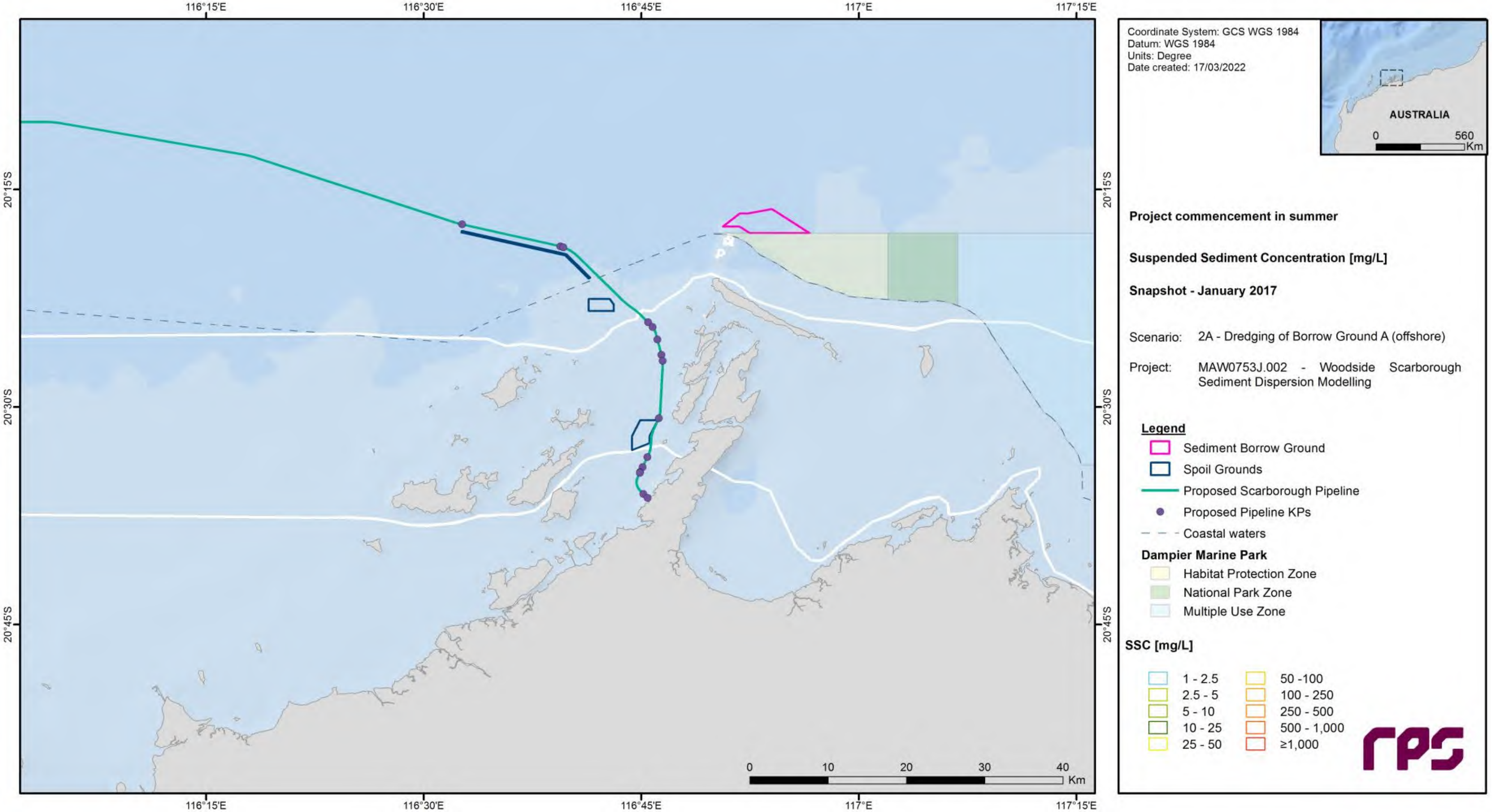


Figure A.12 Predicted instantaneous dredge-excess SSC on 1st January 2017.

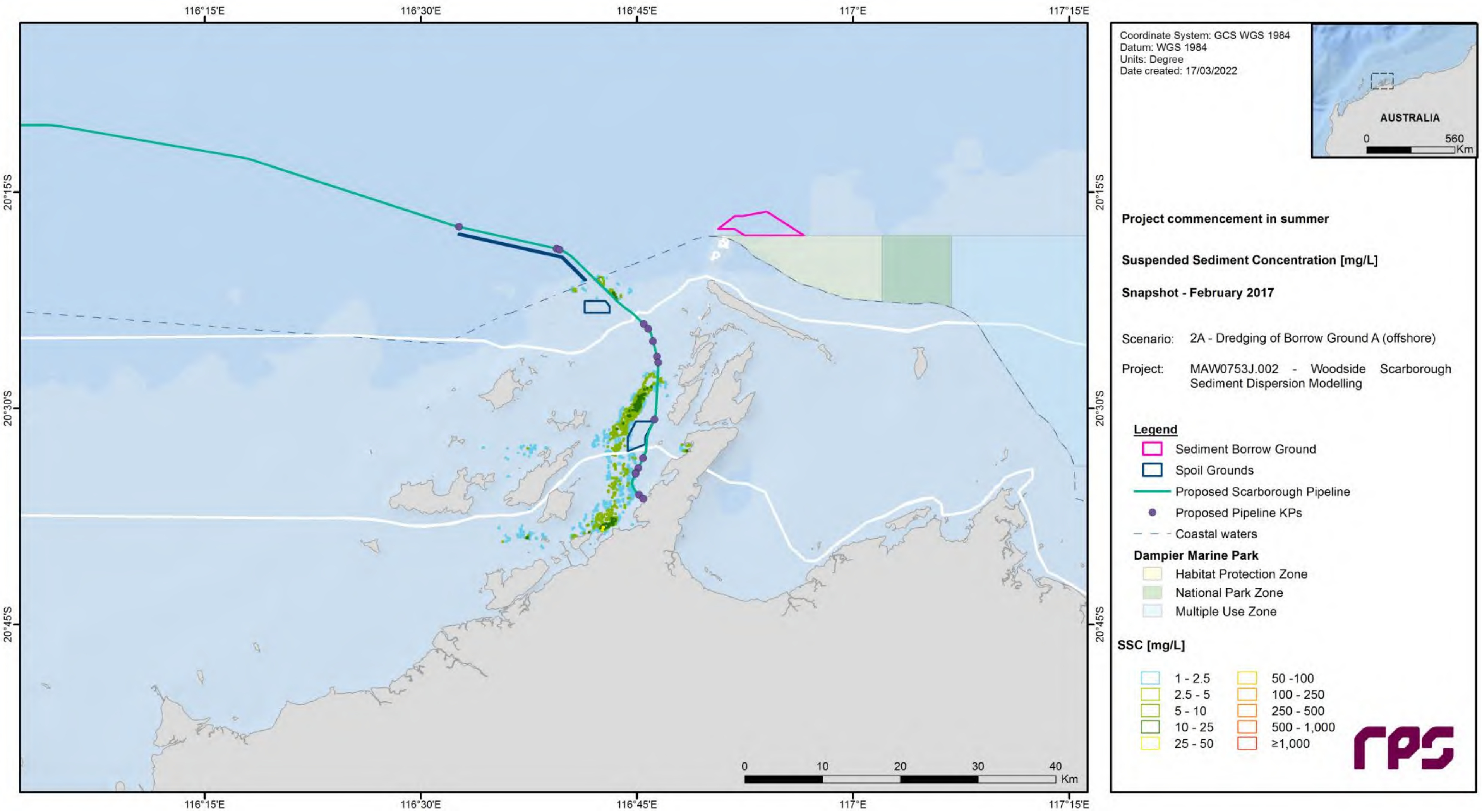


Figure A.13 Predicted instantaneous dredge-excess SSC on 1st February 2017.

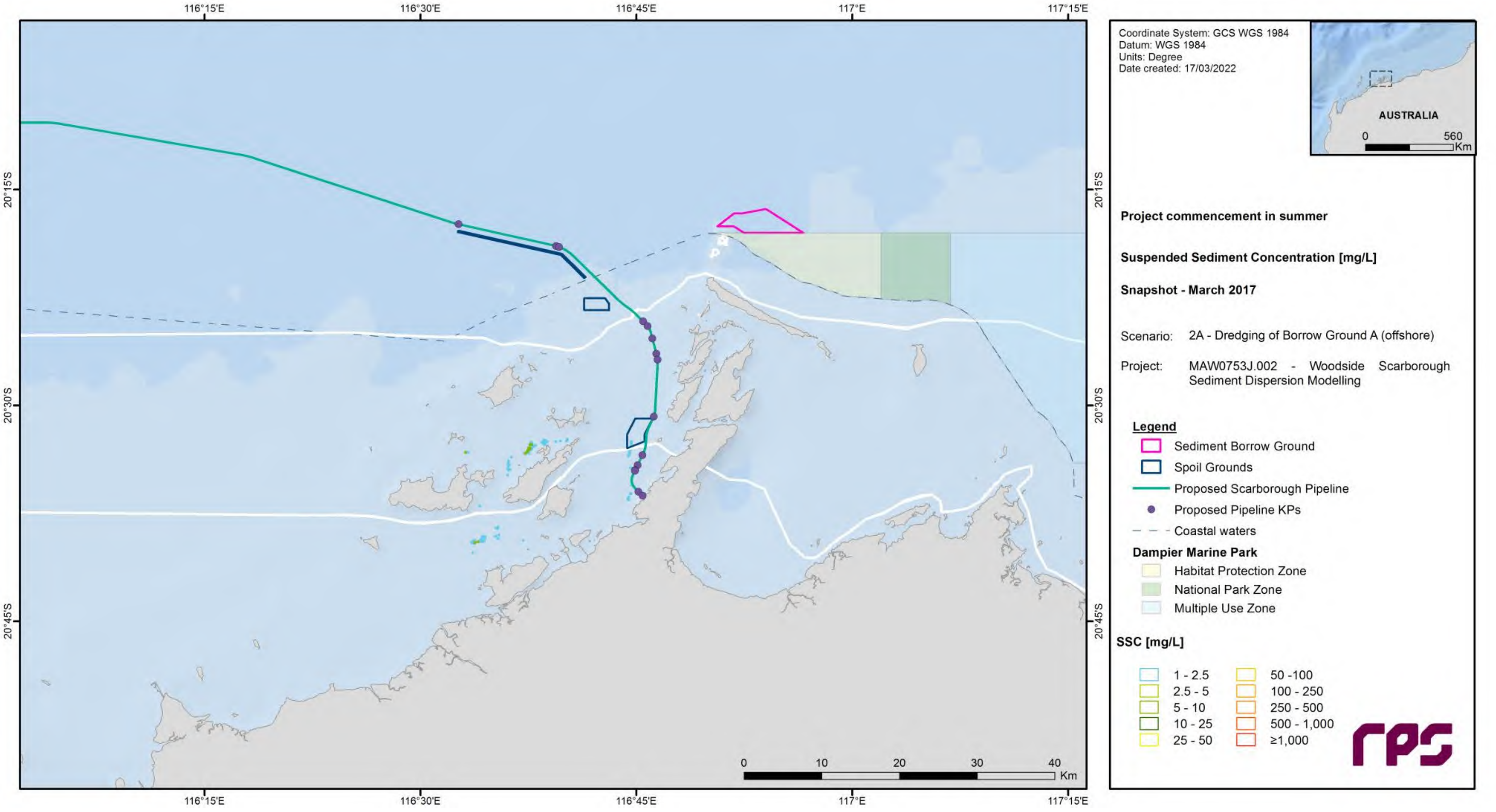


Figure A.14 Predicted instantaneous dredge-excess SSC on 1st March 2017.

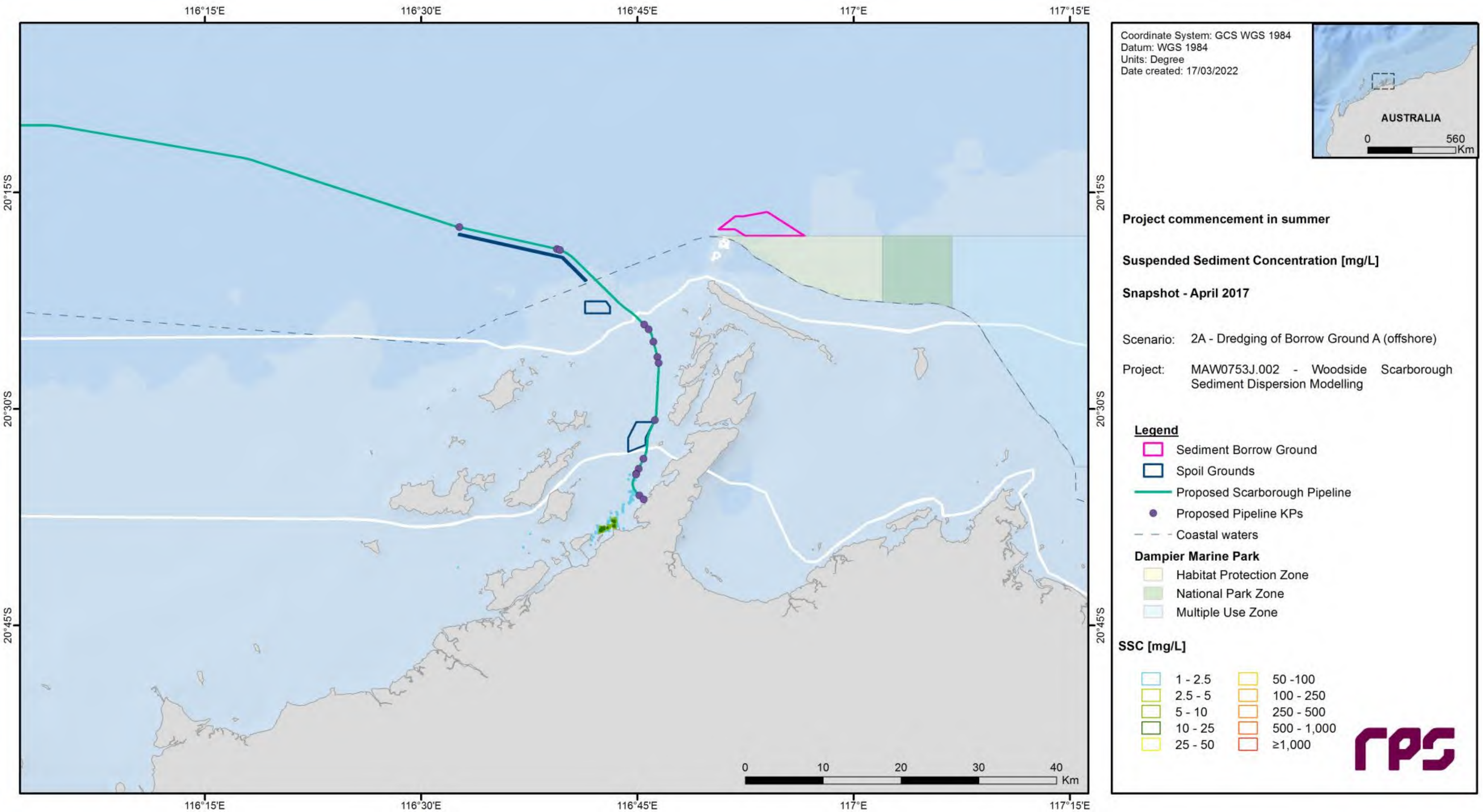


Figure A.15 Predicted instantaneous dredge-excess SSC on 1st April 2017.

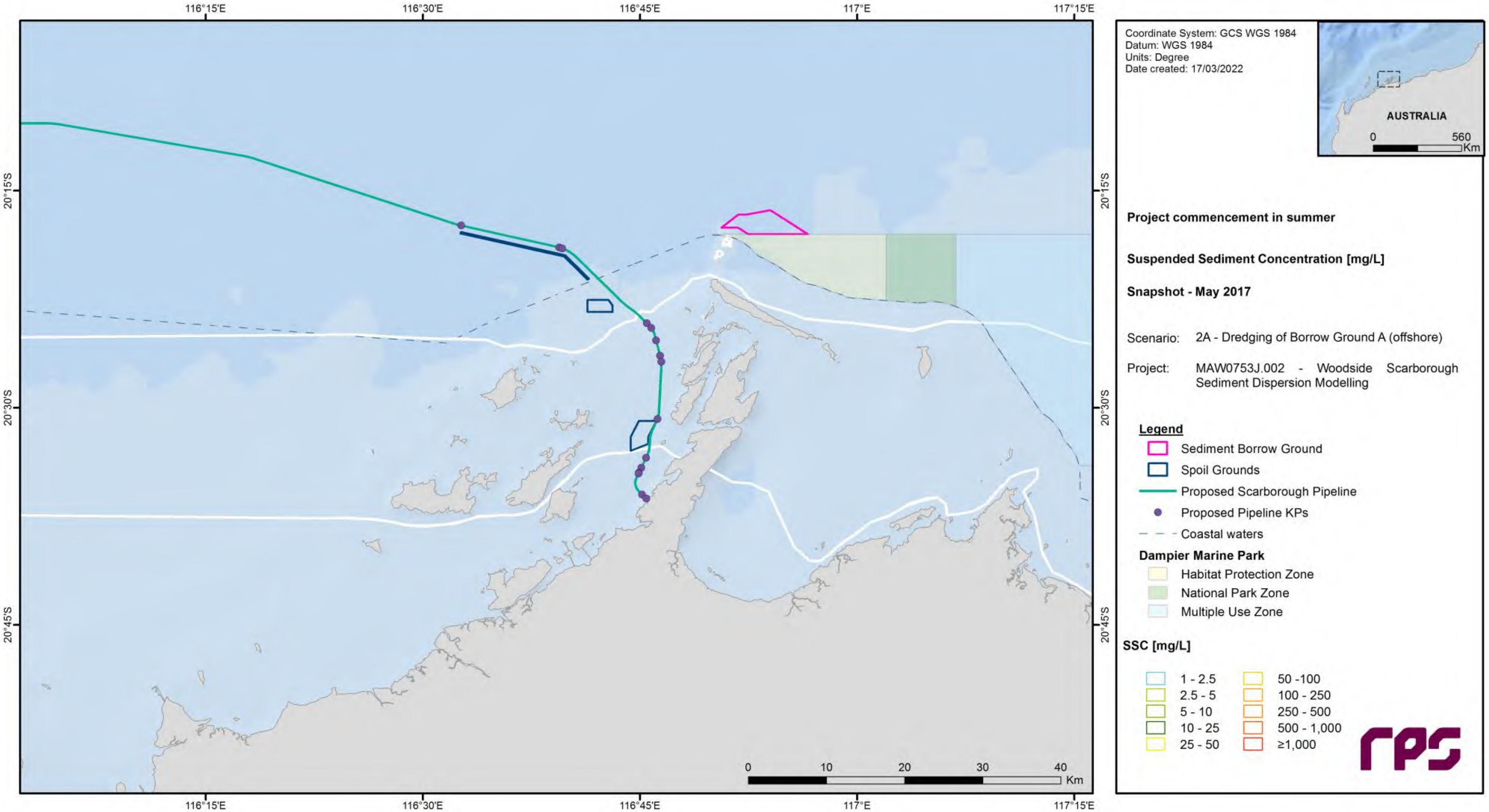


Figure A.16 Predicted instantaneous dredge-excess SSC on 1st May 2017.

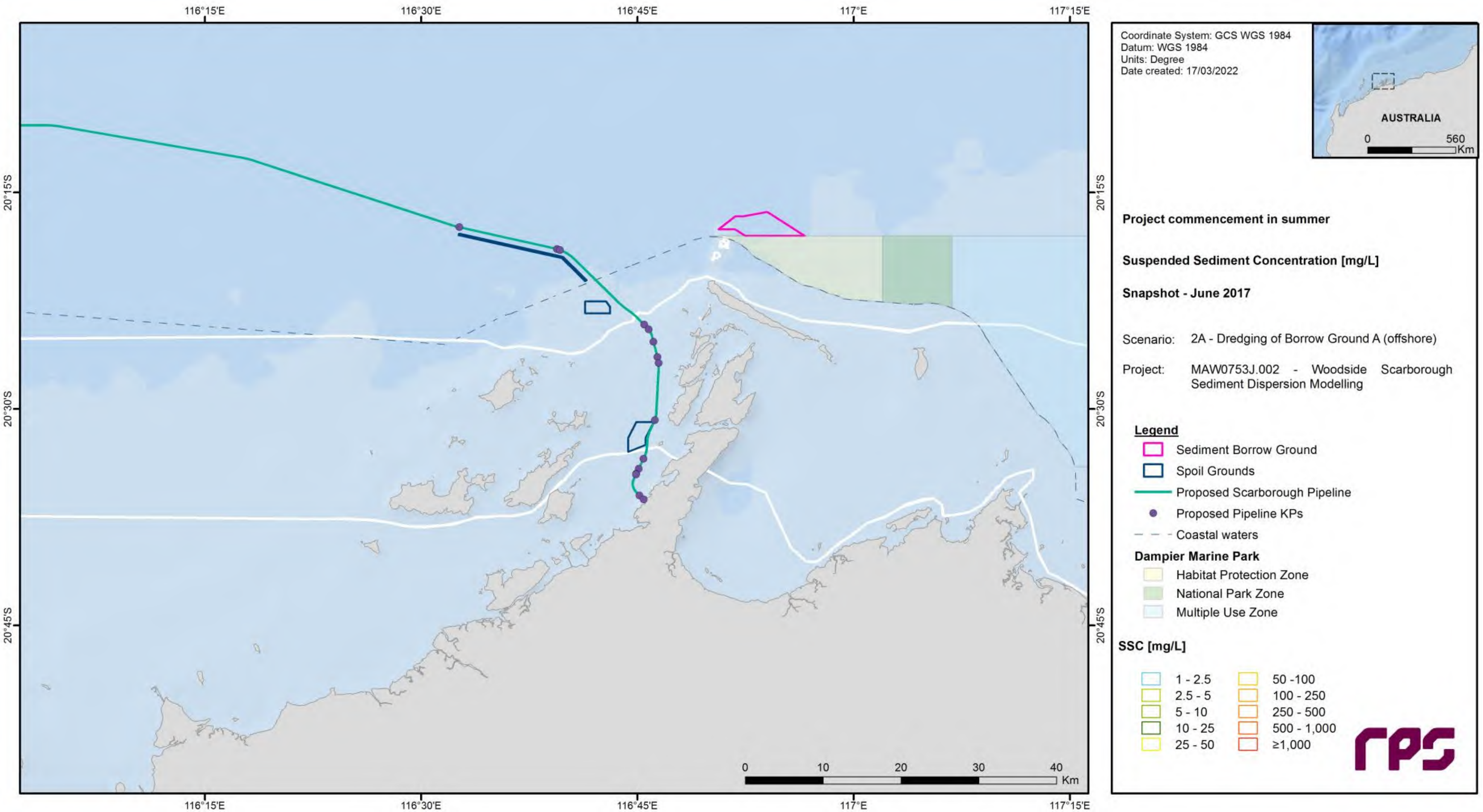


Figure A.17 Predicted instantaneous dredge-excess SSC on 1st June 2017.

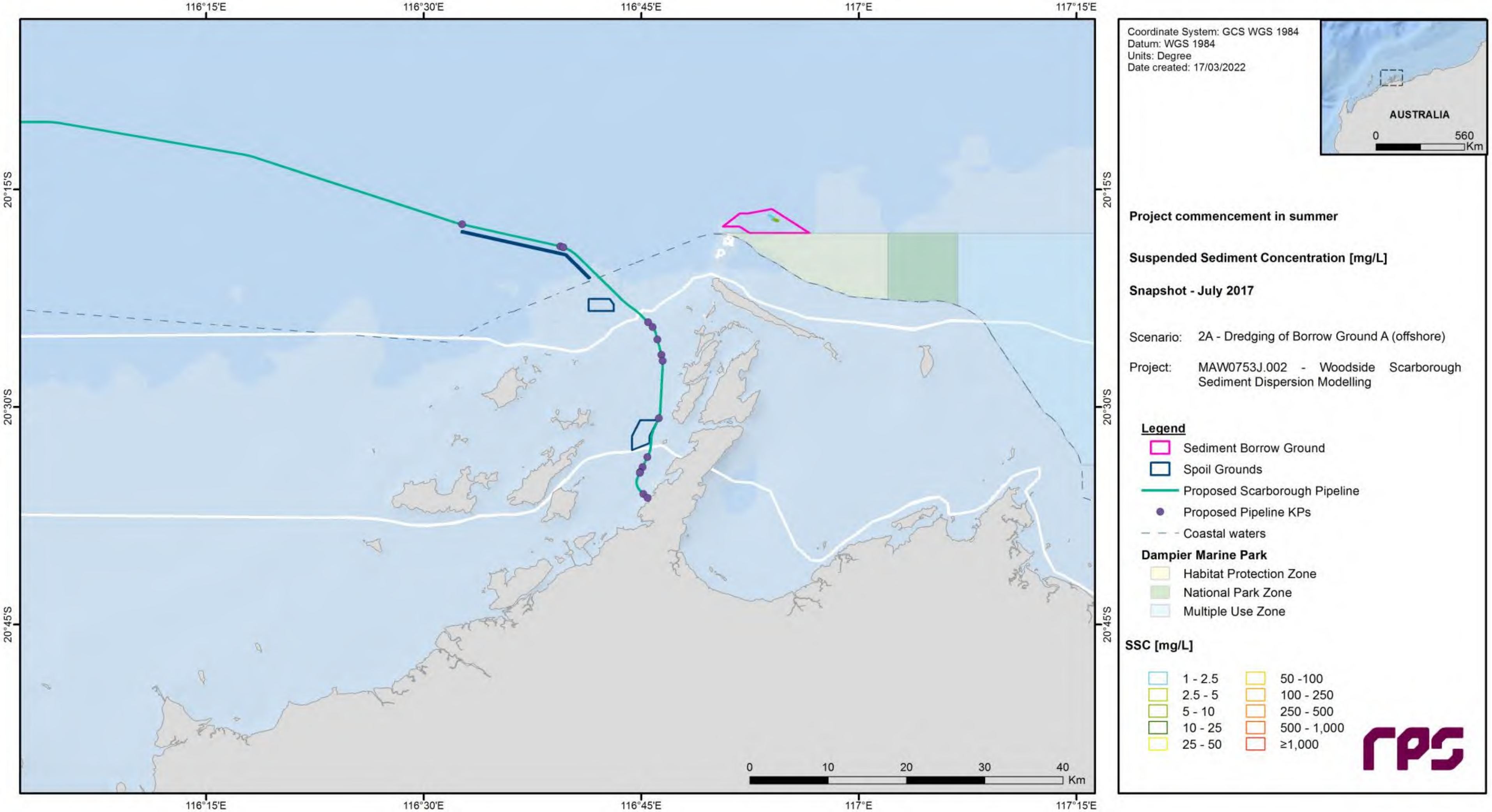


Figure A.18 Predicted instantaneous dredge-excess SSC on 1st July 2017.

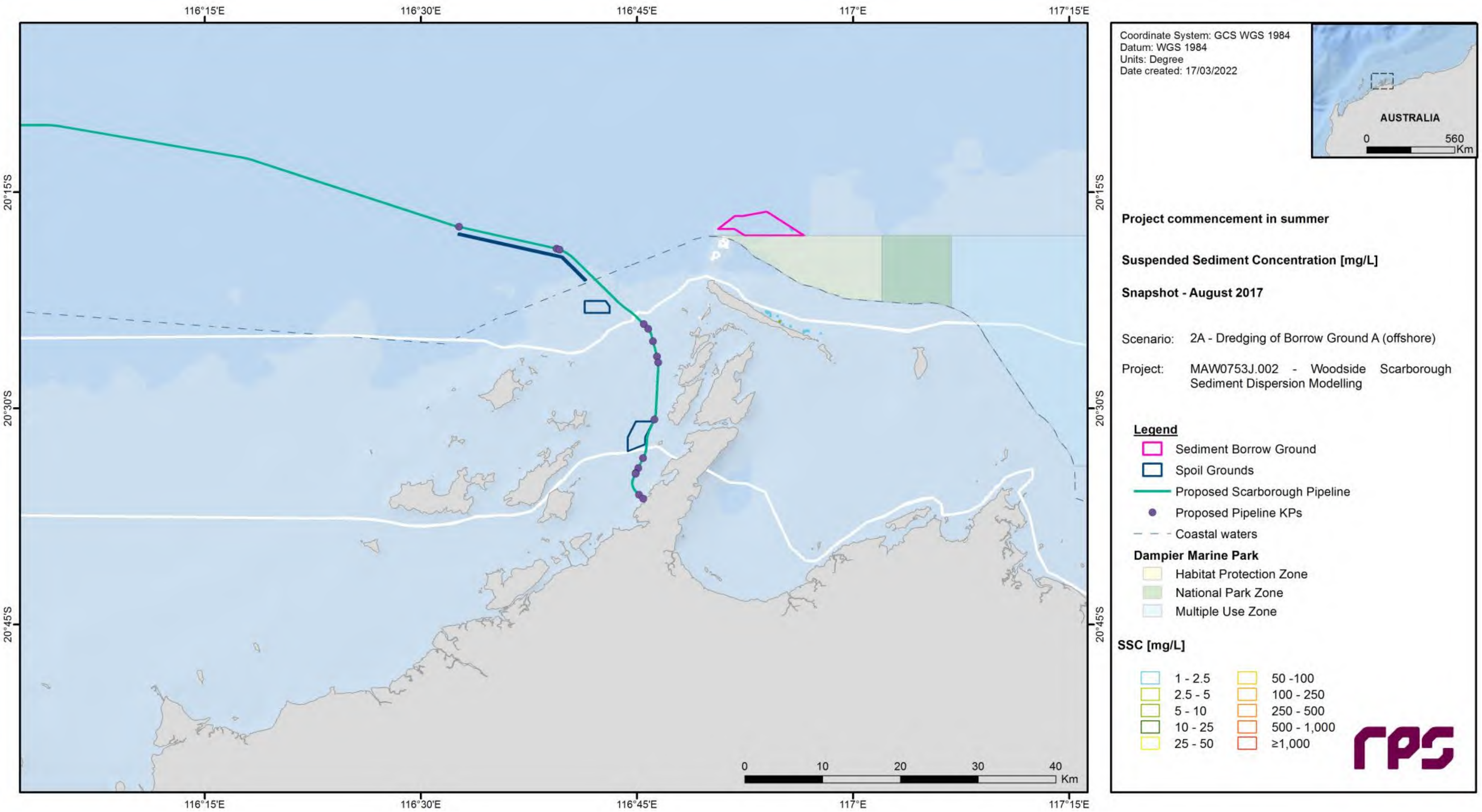


Figure A.19 Predicted instantaneous dredge-excess SSC on 1st August 2017.

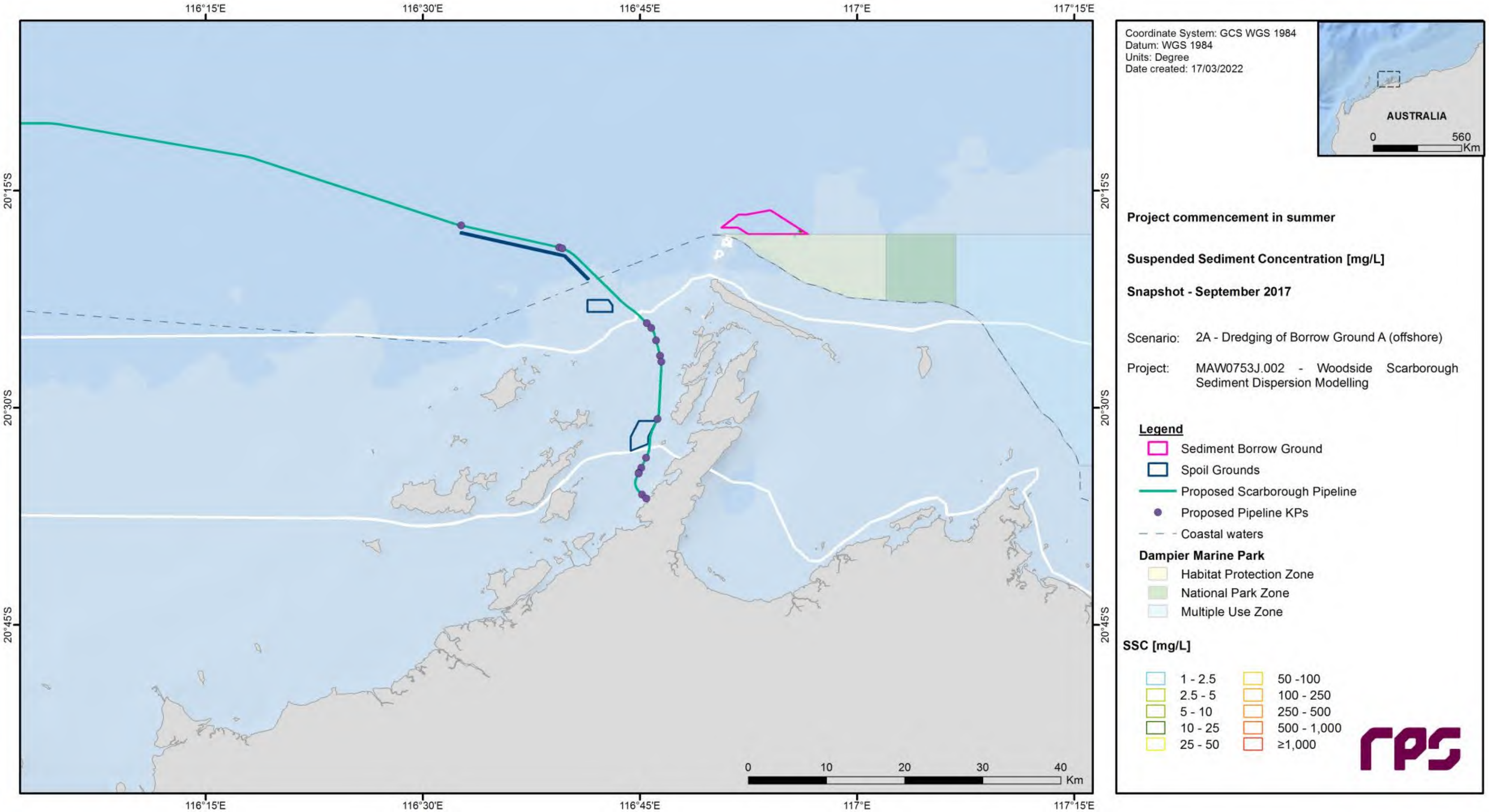


Figure A.20 Predicted instantaneous dredge-excess SSC on 1st September 2017.

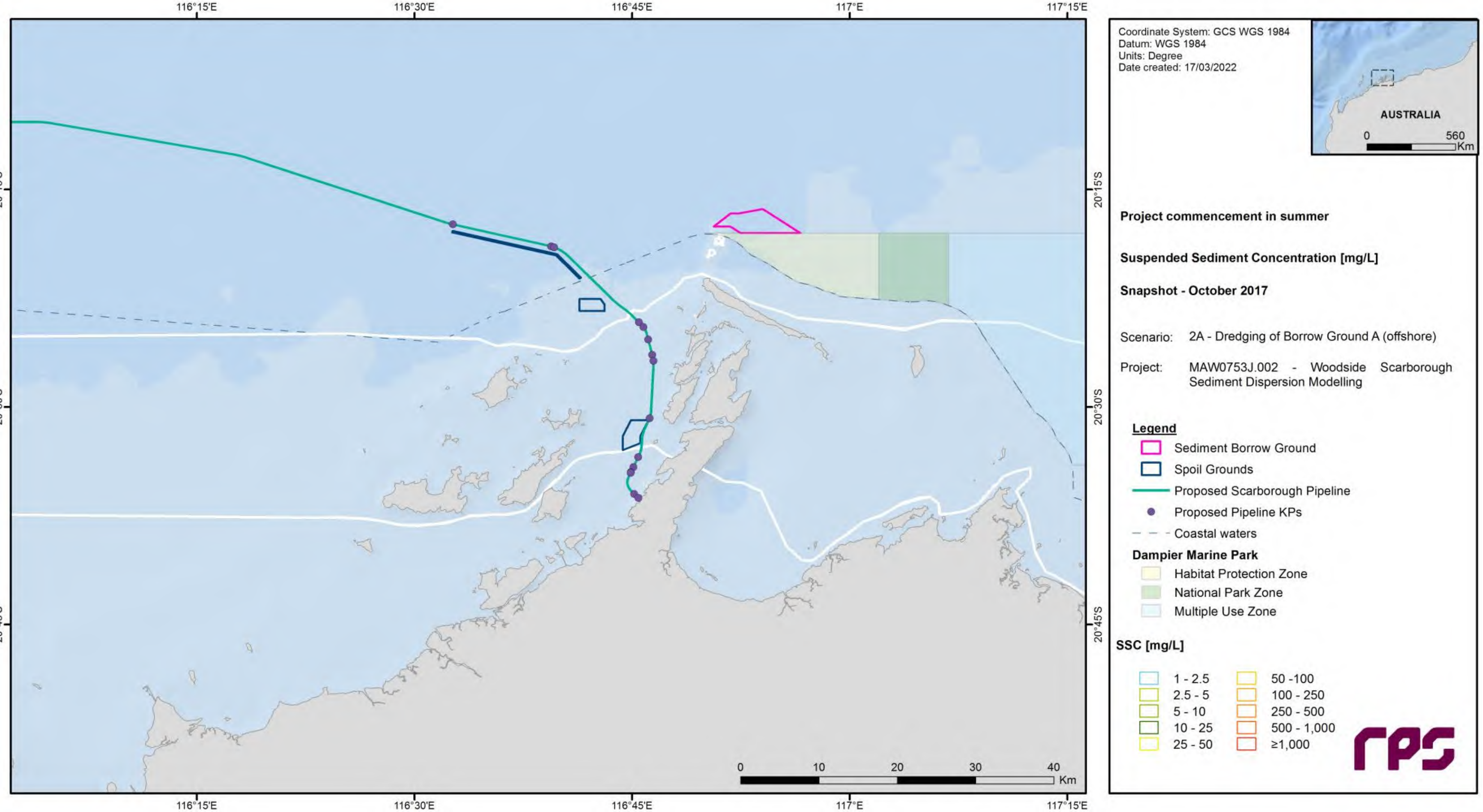


Figure A.21 Predicted instantaneous dredge-excess SSC on 1st October 2017.

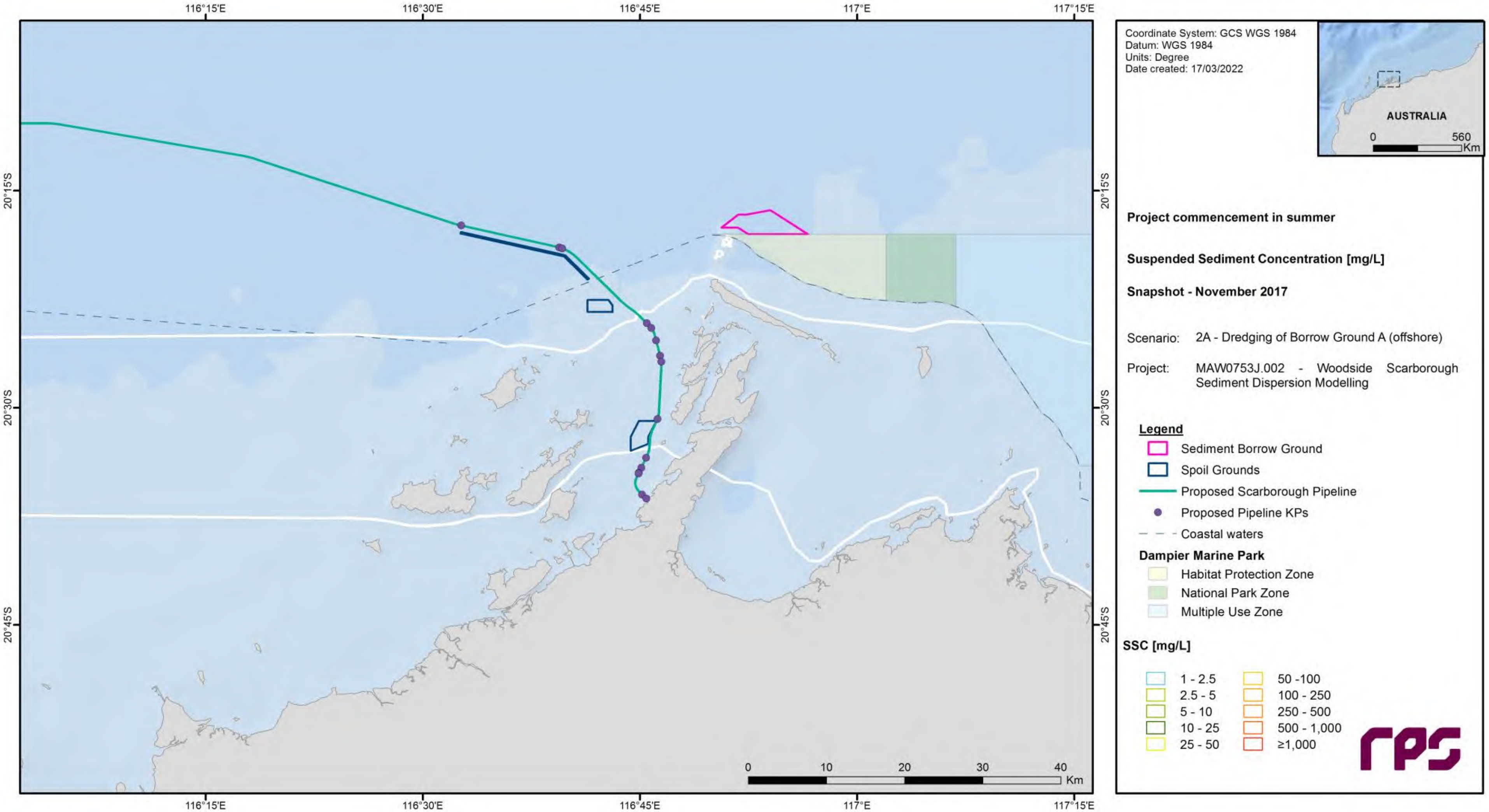


Figure A.22 Predicted instantaneous dredge-excess SSC on 1st November 2017.

Appendix B: Figures of Spatial Outcomes for Activities in Commonwealth Waters

B.1 Scenario 1: Project Commencement in Winter – Commonwealth Waters Activities Only

B.1.1 Overall Percentiles

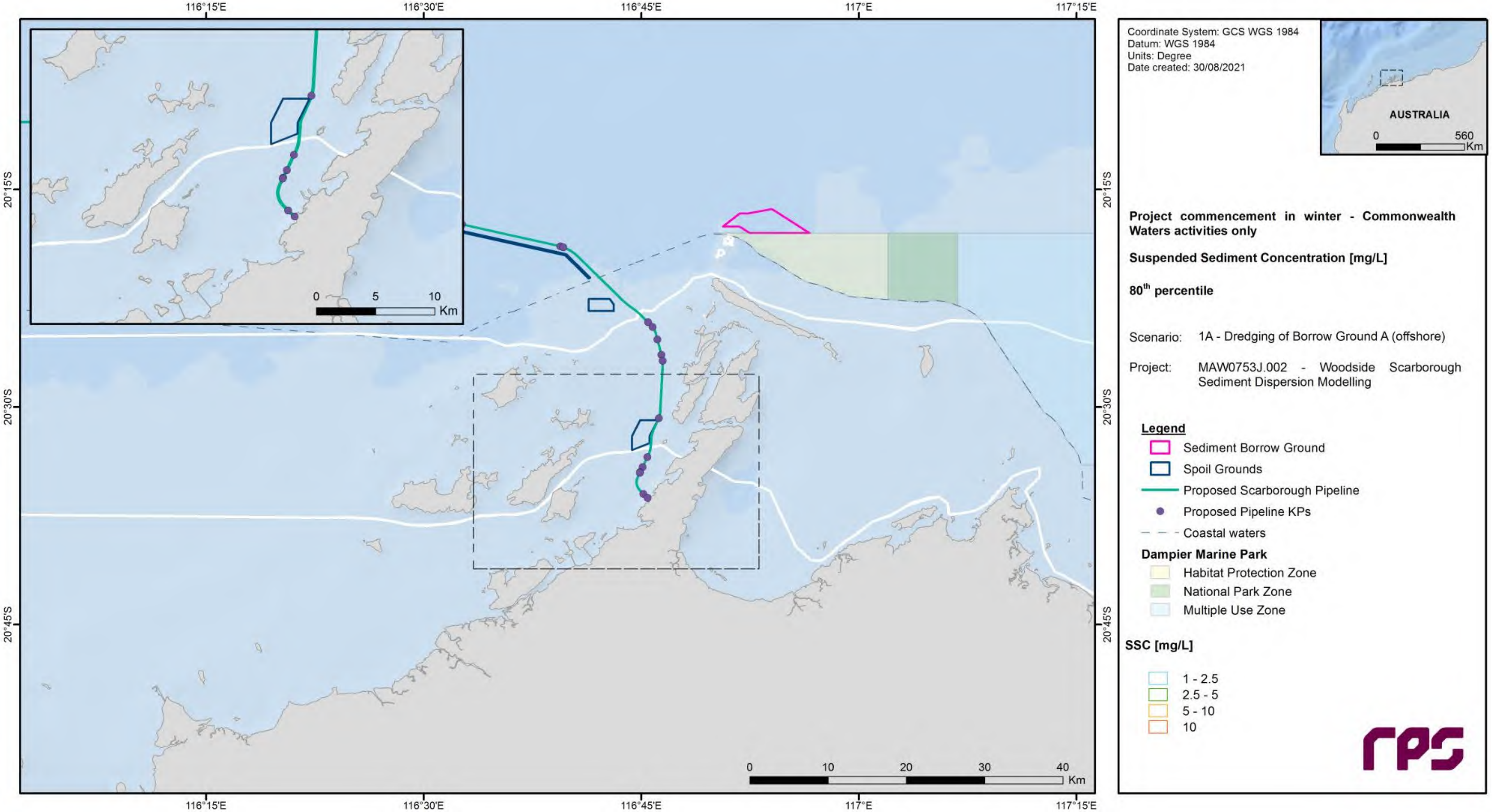


Figure B.23 Predicted 80th percentile dredge-excess SSC throughout the duration of the relevant activities (1st August 2016 to 23rd May 2017).

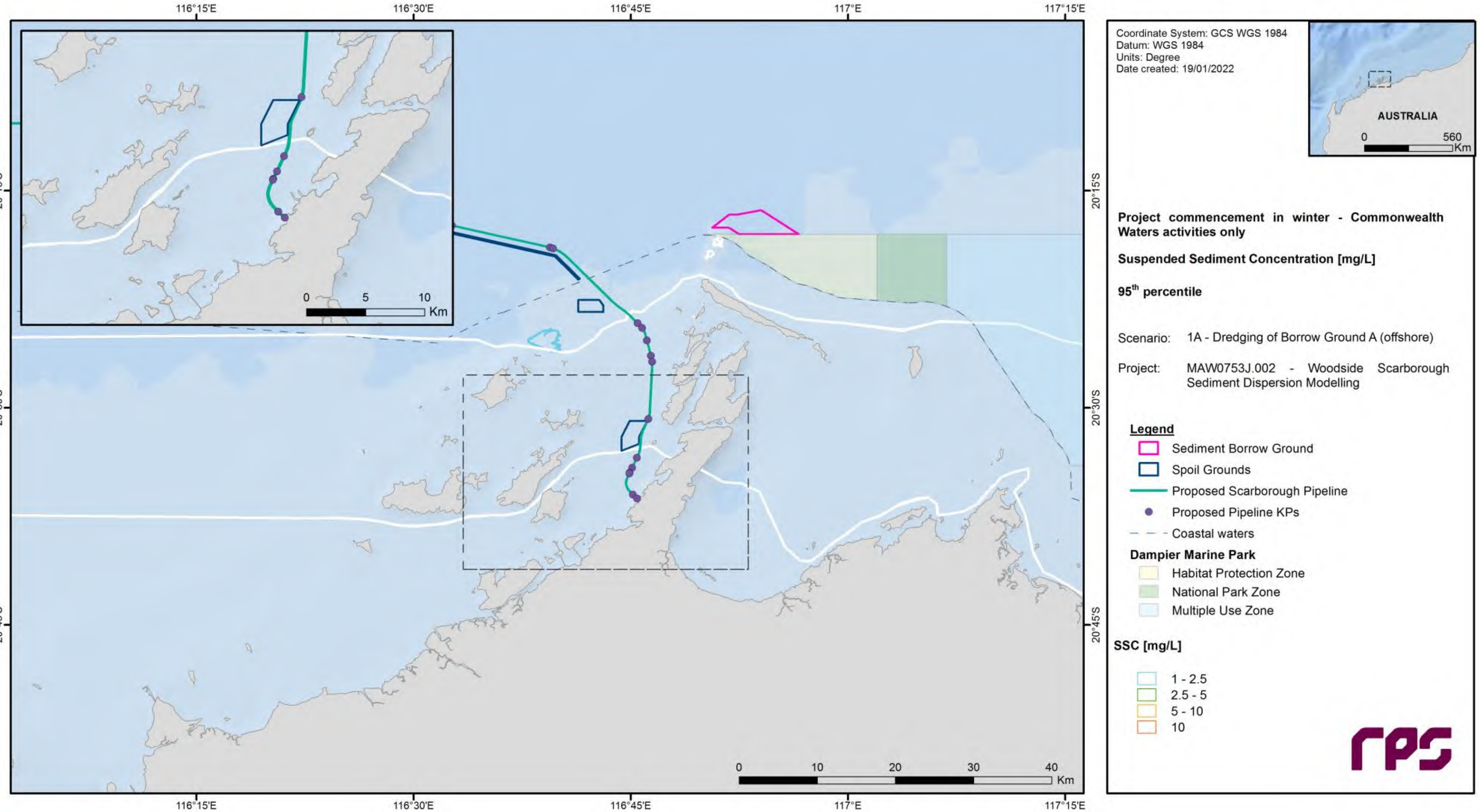


Figure B.24 **Predicted 95th percentile dredge-excess SSC throughout the duration of the relevant activities (1st August 2016 to 23rd May 2017).**

B.1.2 Overall Management Zones

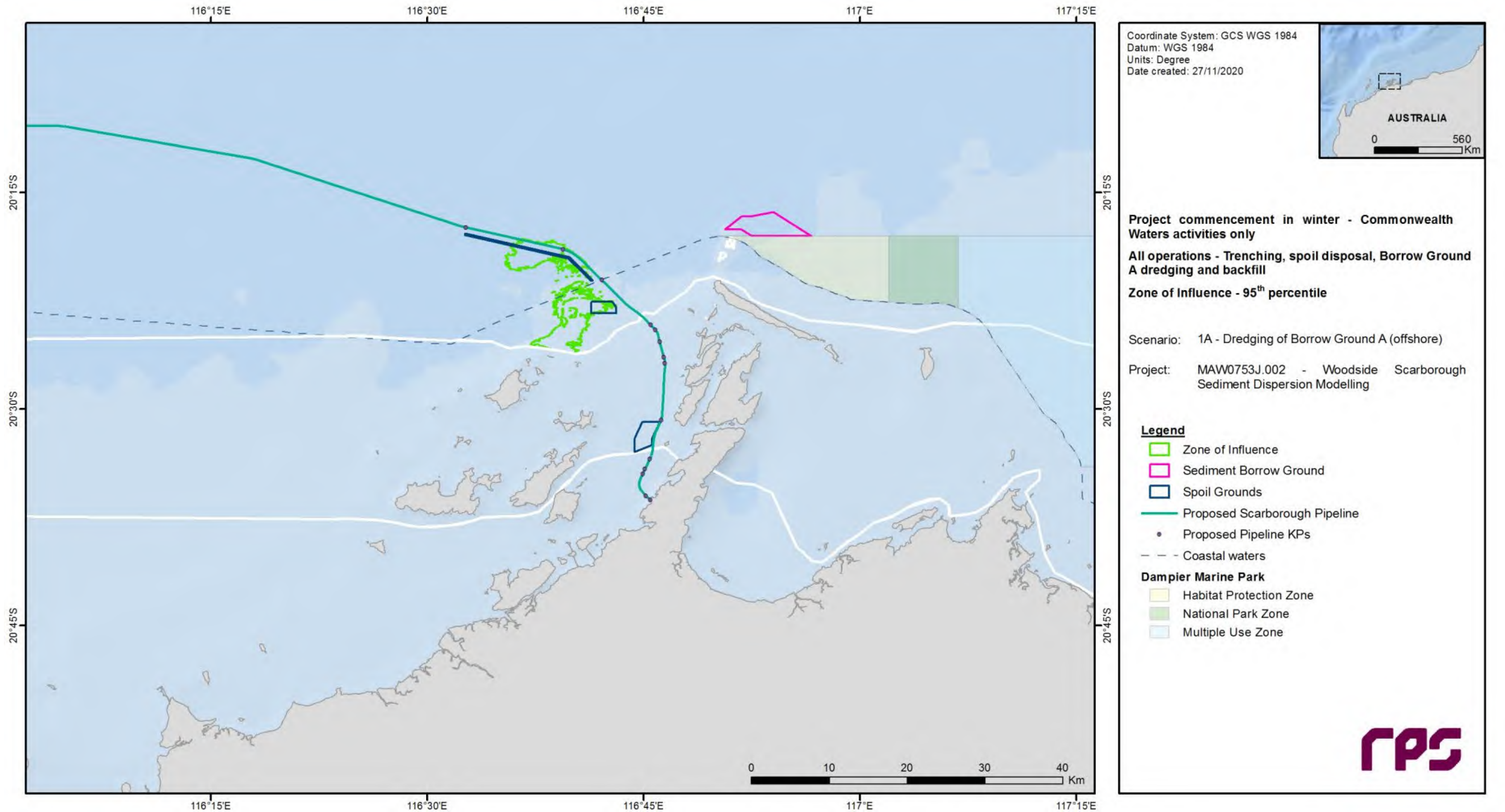


Figure B.25 Predicted 95th percentile Zone of Influence following application of the appropriate spatial thresholds in Table 4.2 to a 24-hour rolling average of total (dredge and background) SSC throughout the duration of the relevant activities (1st August 2016 to 23rd May 2017).

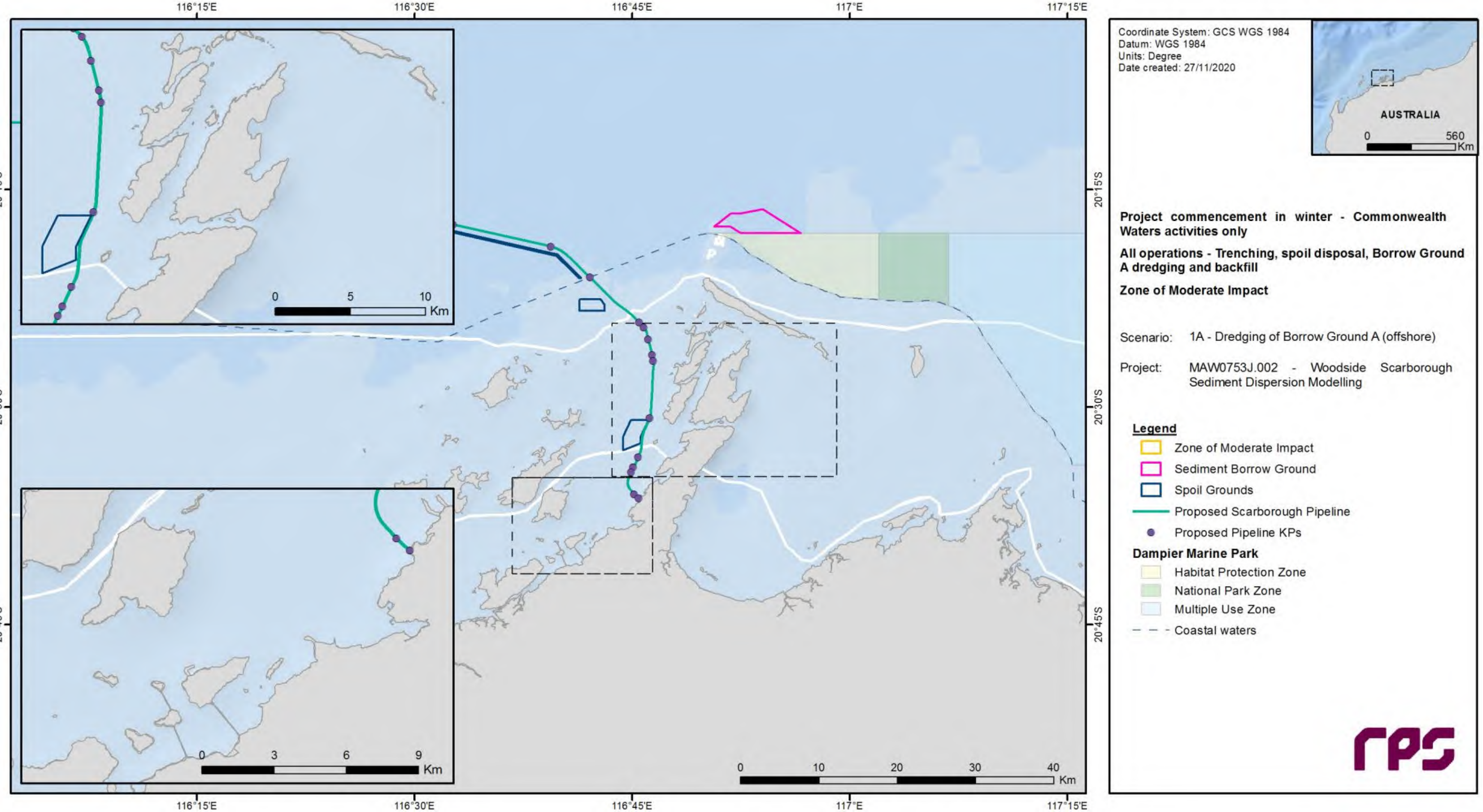


Figure B.26 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 3-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st August 2016 to 23rd May 2017).

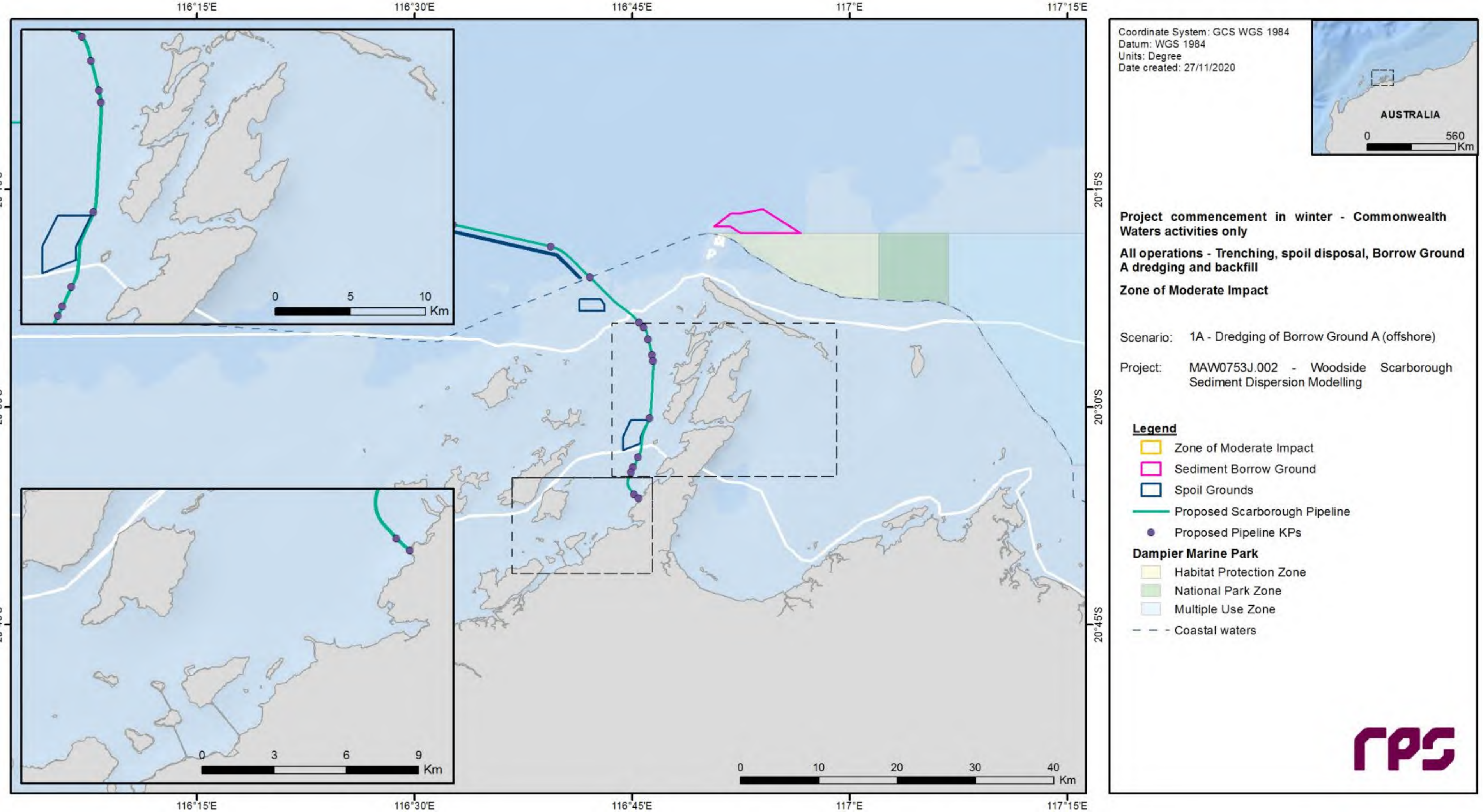


Figure B.27 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 7-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st August 2016 to 23rd May 2017).

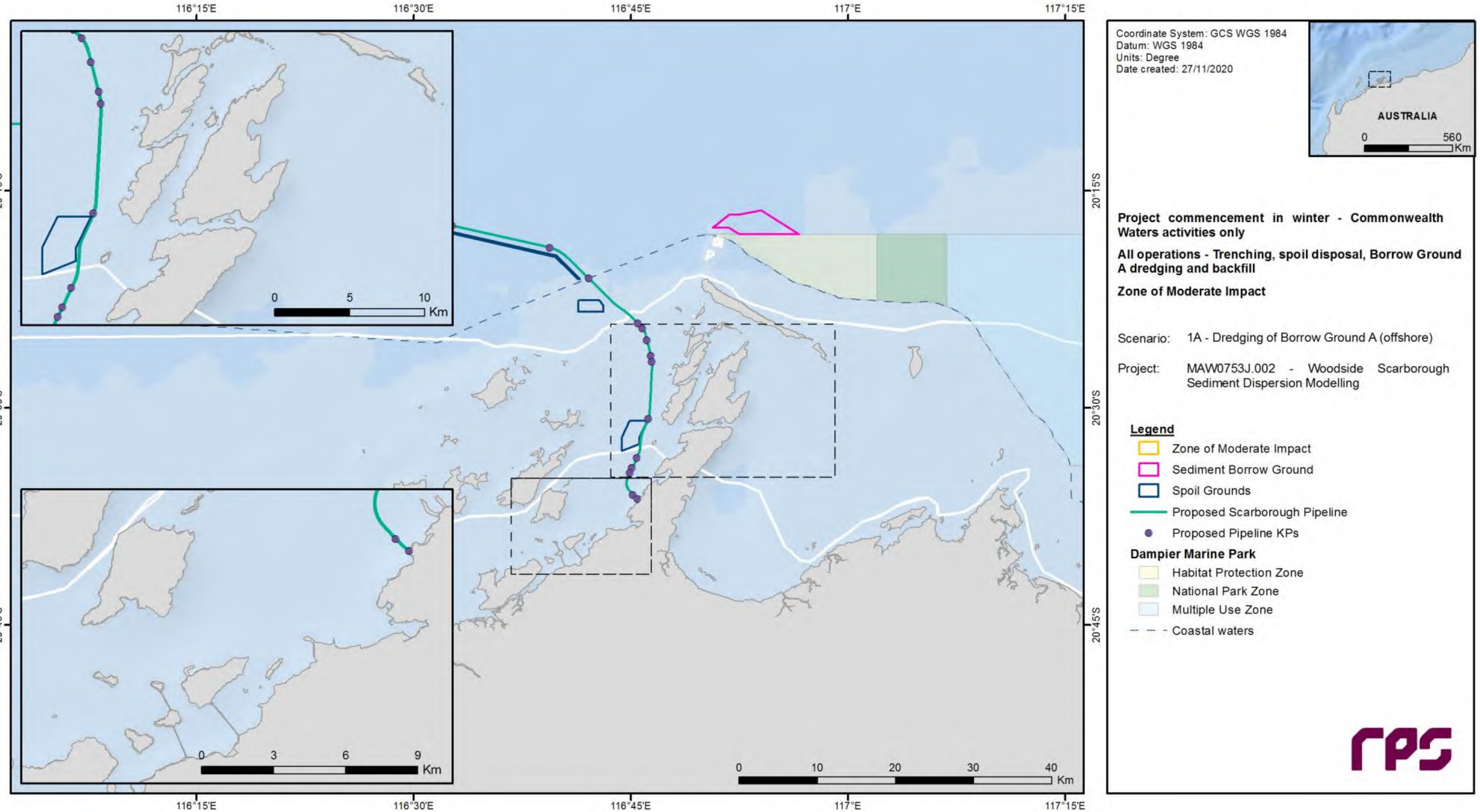


Figure B.28 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 10-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st August 2016 to 23rd May 2017).

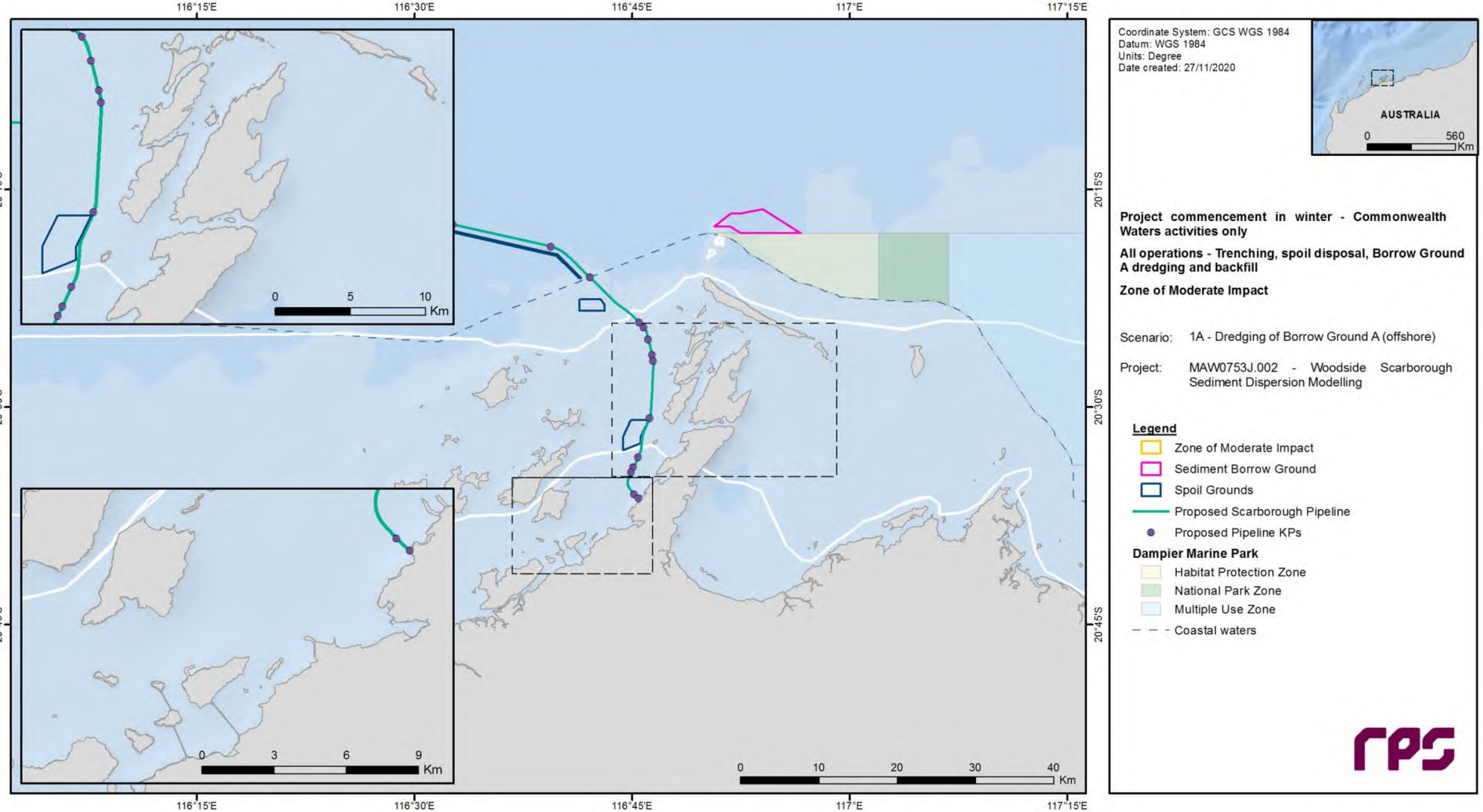


Figure B.29 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 14-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st August 2016 to 23rd May 2017).

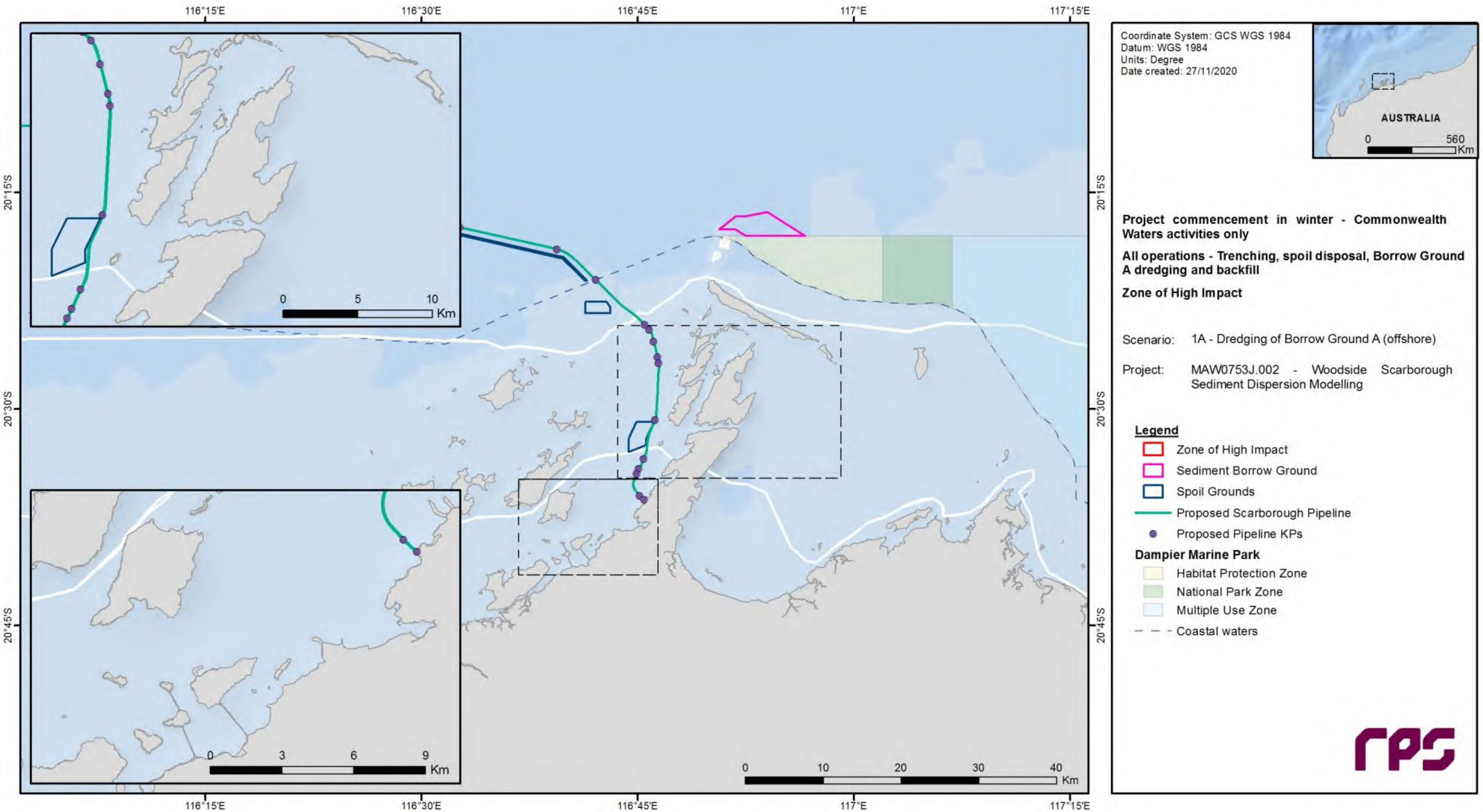


Figure B.30 Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 3-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st August 2016 to 23rd May 2017).

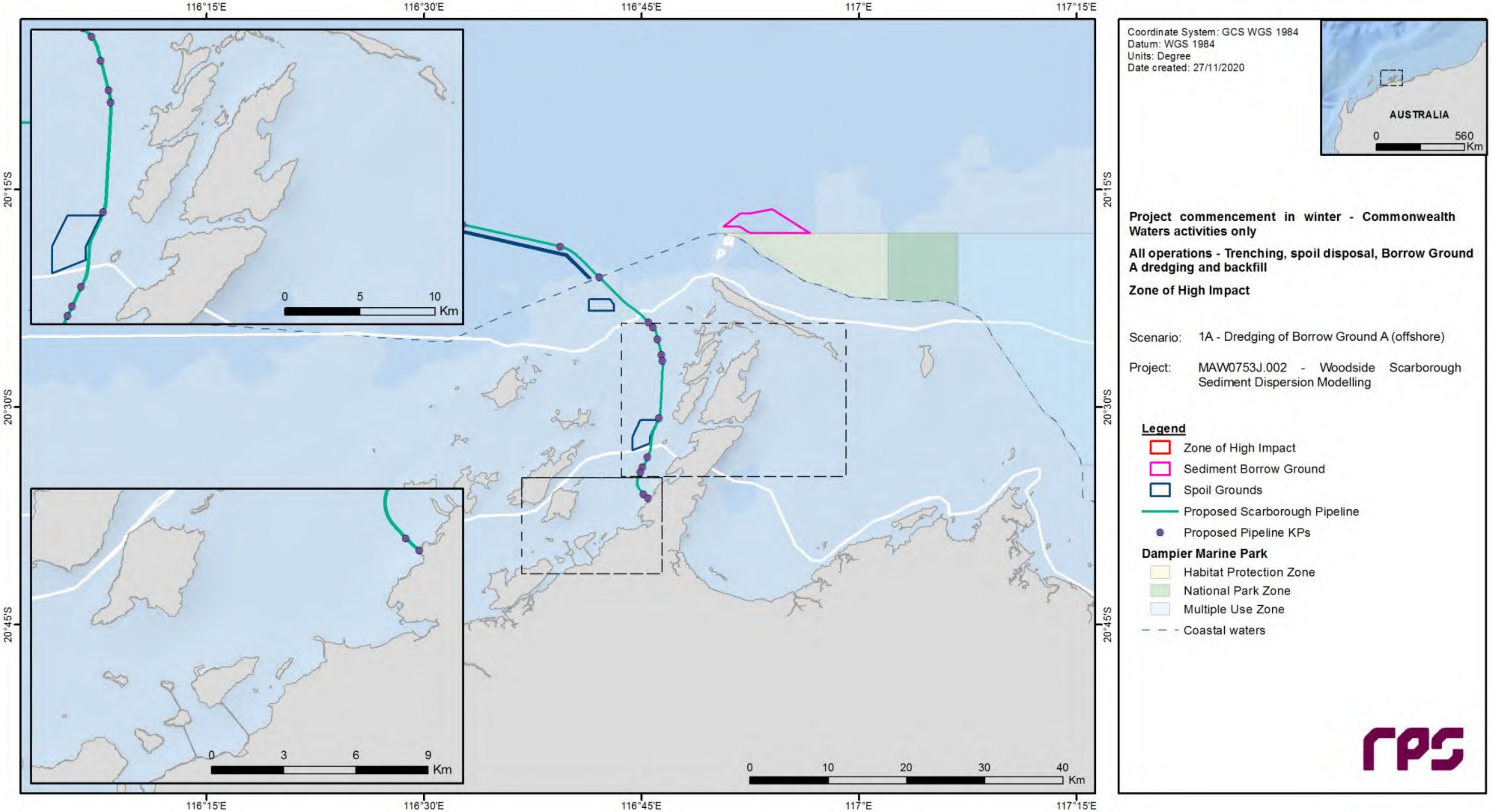


Figure B.31 Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 7-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st August 2016 to 23rd May 2017).

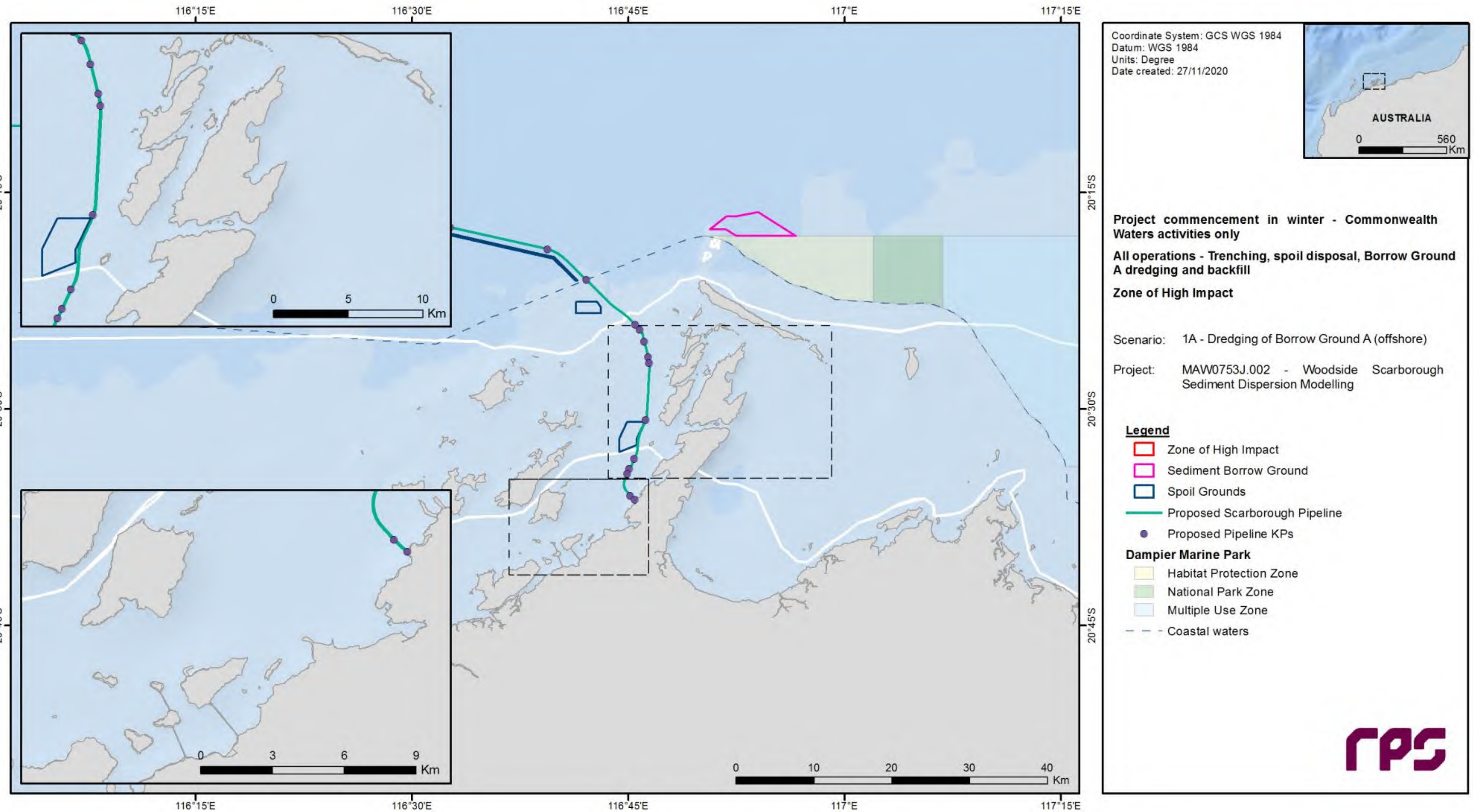


Figure B.32 Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 10-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st August 2016 to 23rd May 2017).

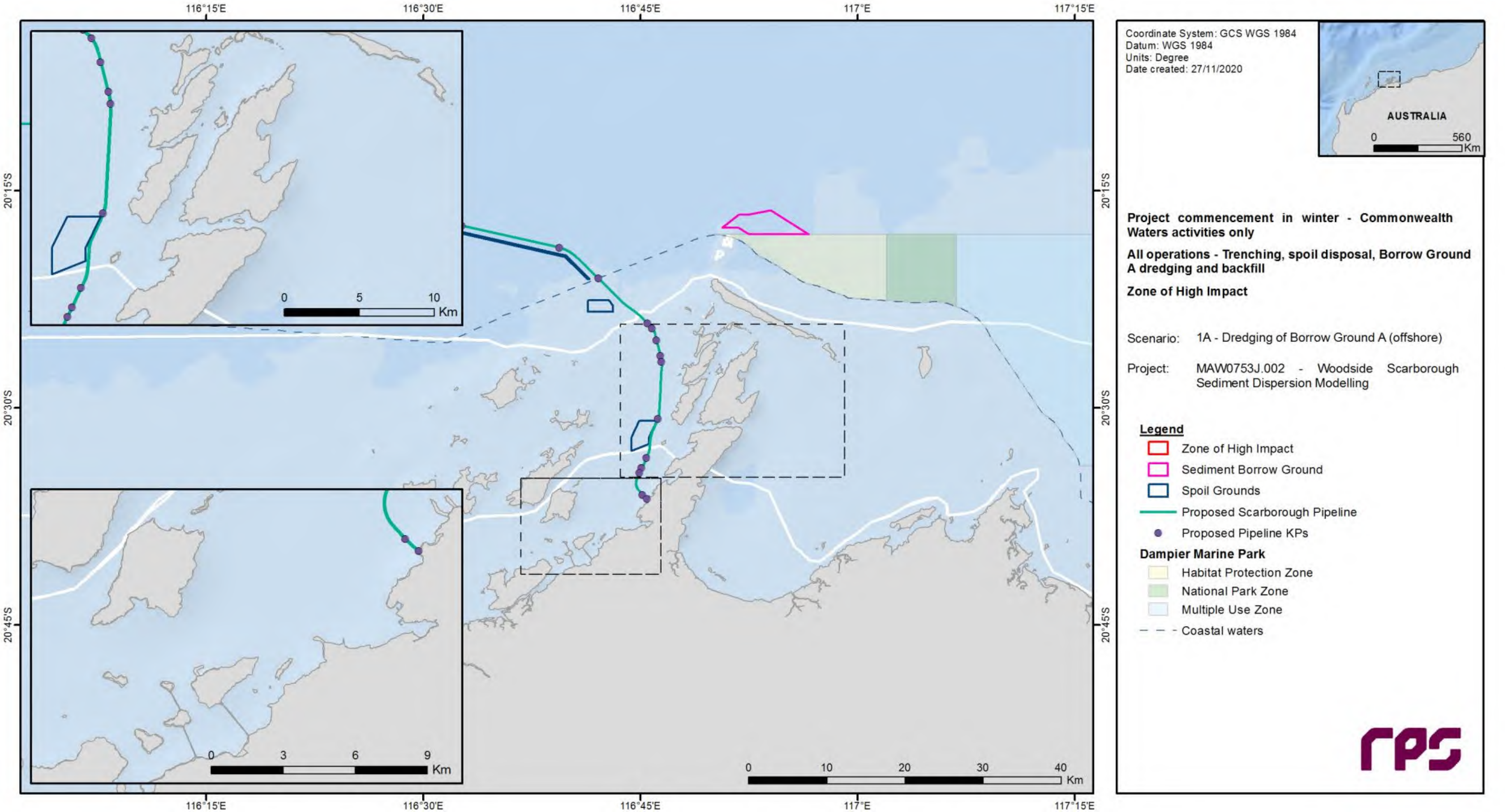


Figure B.33 Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 14-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st August 2016 to 23rd May 2017).

B.2 Scenario 2: Project Commencement in Summer – Commonwealth Waters Activities Only

B.2.1 Overall Percentiles

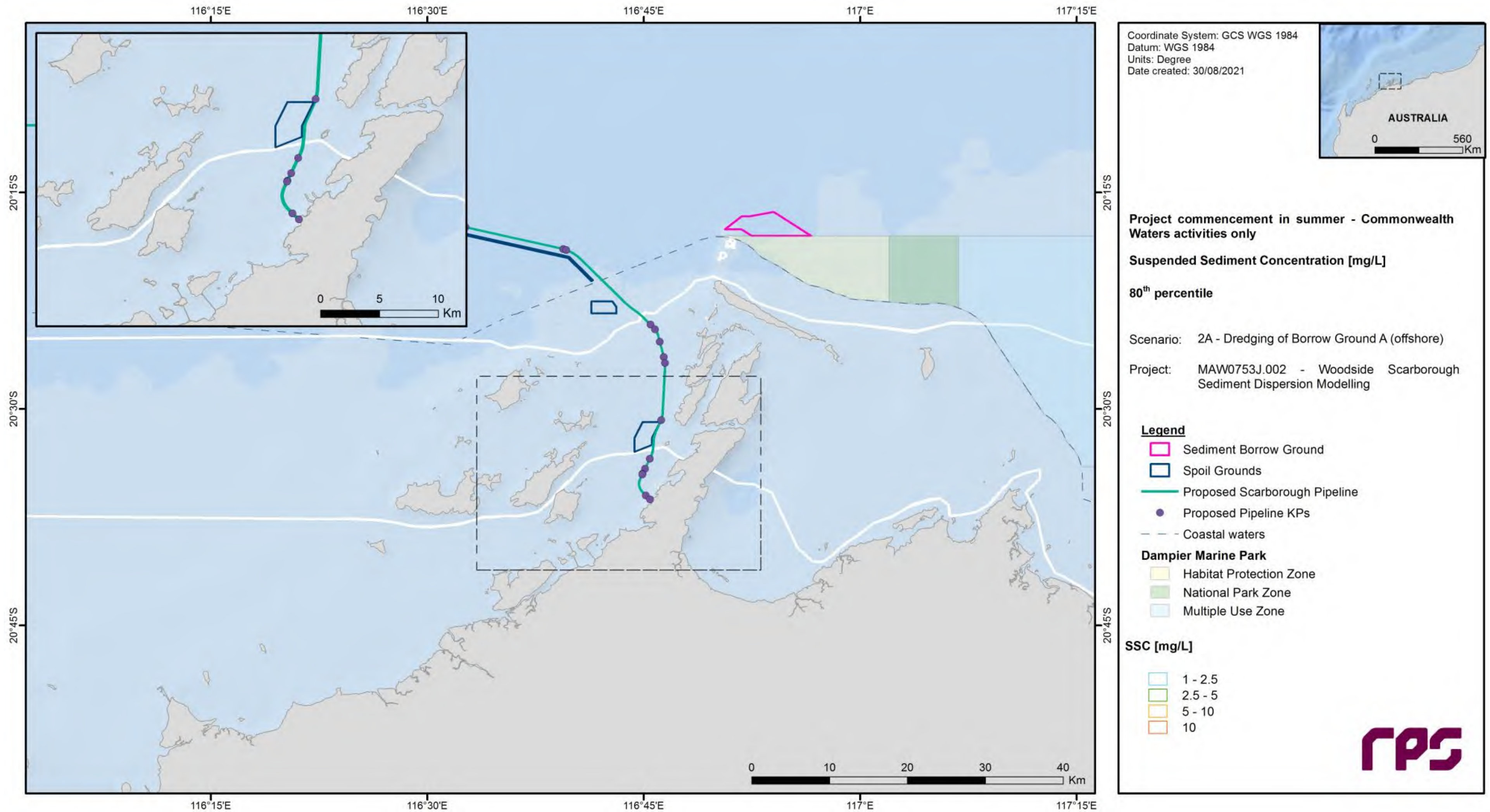


Figure B.34 Predicted 80th percentile dredge-excess SSC throughout the duration of the relevant activities (1st February 2017 to 21st November 2017).

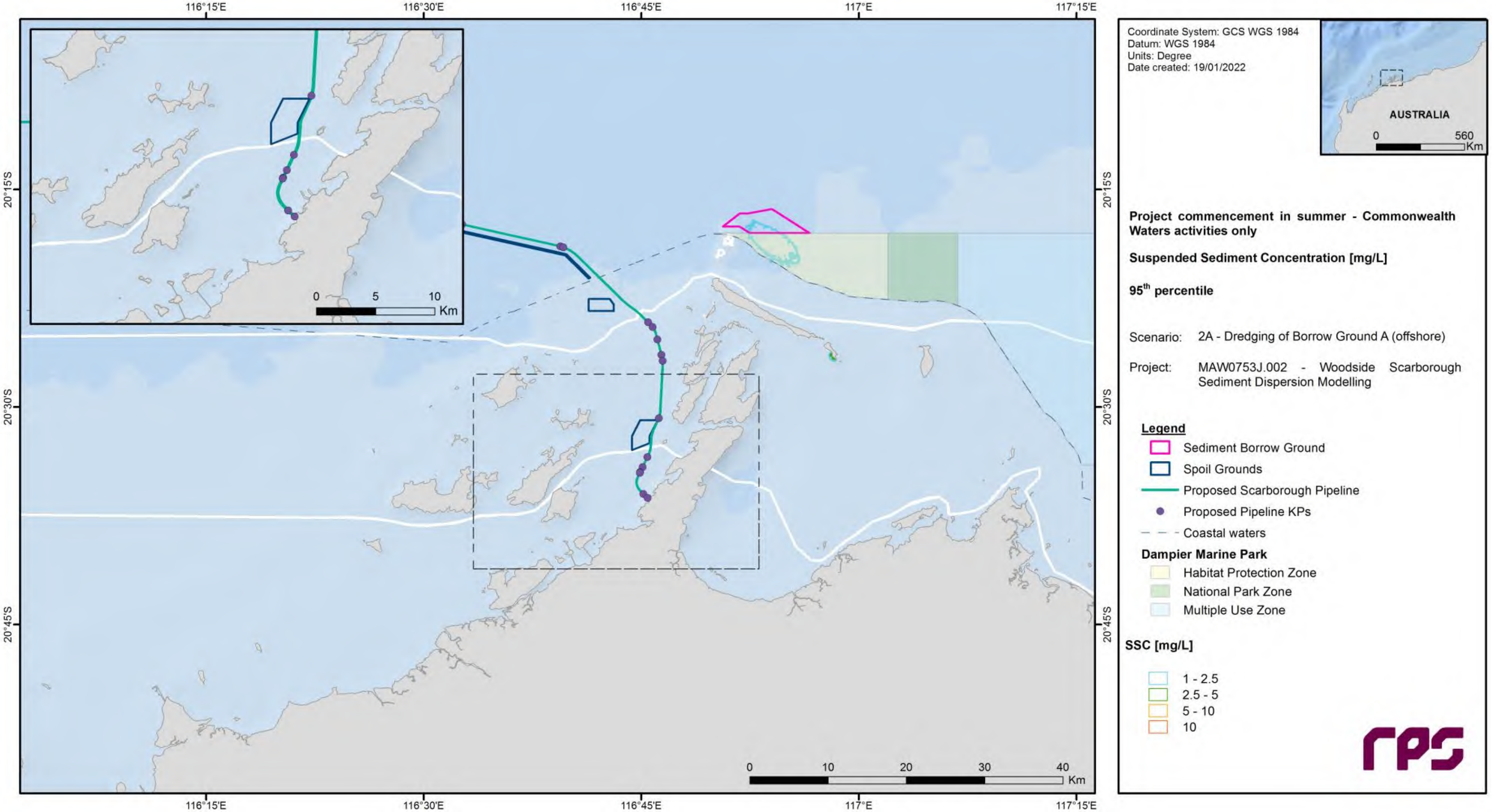


Figure B.35 Predicted 95th percentile dredge-excess SSC throughout the duration of the relevant activities (1st February 2017 to 21st November 2017).

B.2.2 Overall Management Zones

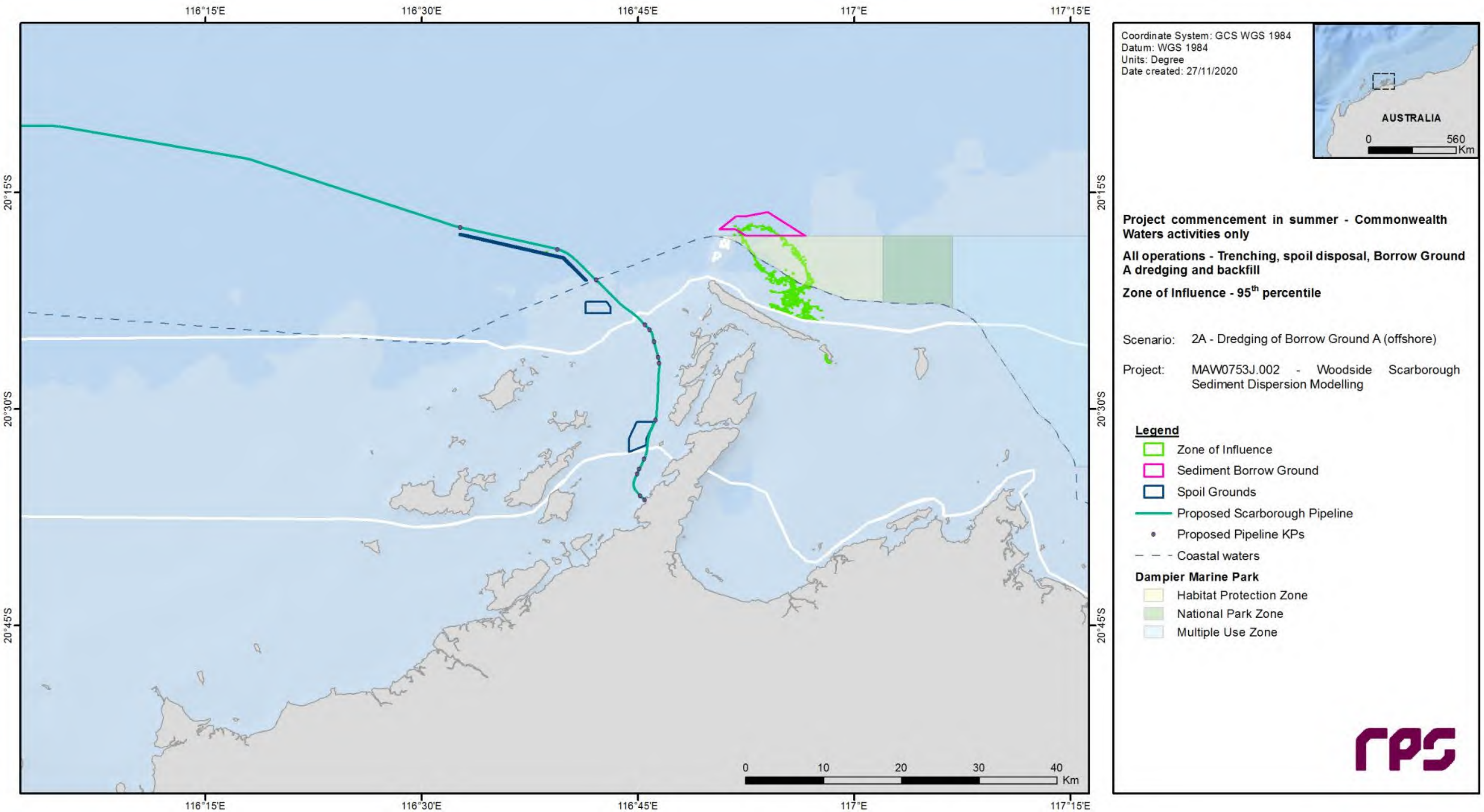


Figure B.36 Predicted 95th percentile Zone of Influence following application of the appropriate spatial thresholds in Table 4.2 to a 24-hour rolling average of total (dredge and background) SSC throughout the duration of the relevant activities (1st February 2017 to 21st November 2017).

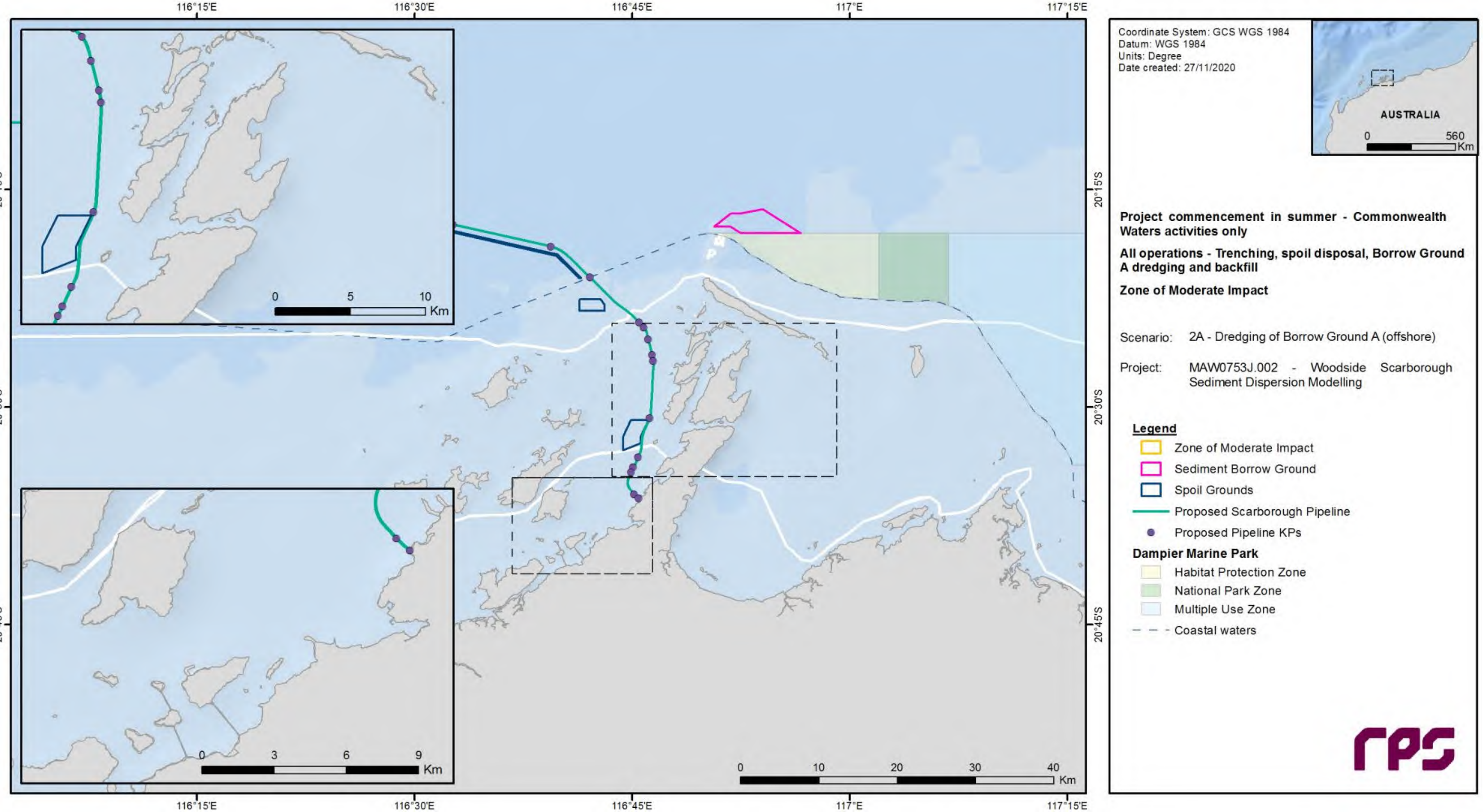


Figure B.37 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 3-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st February 2017 to 21st November 2017).

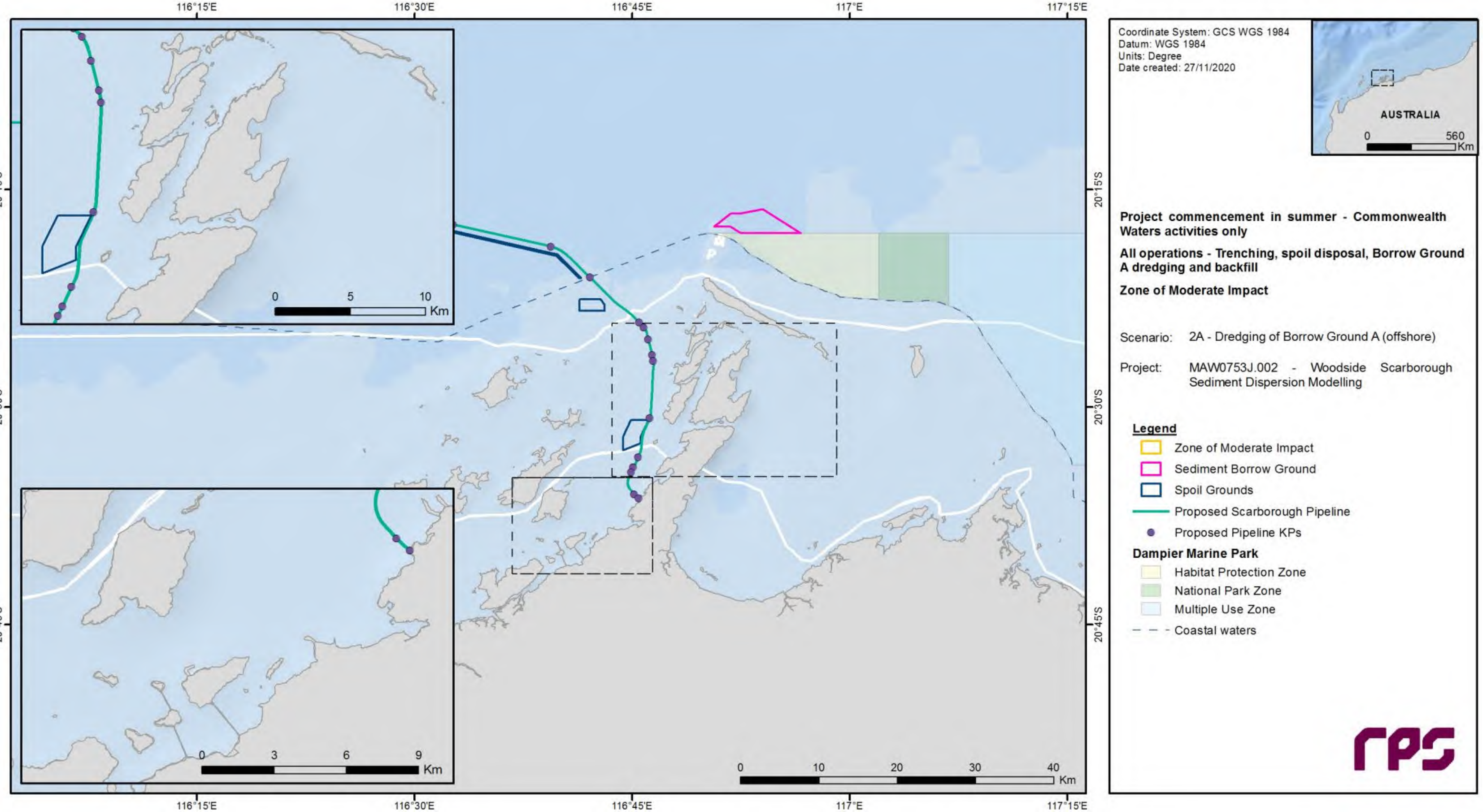


Figure B.38 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 7-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st February 2017 to 21st November 2017).

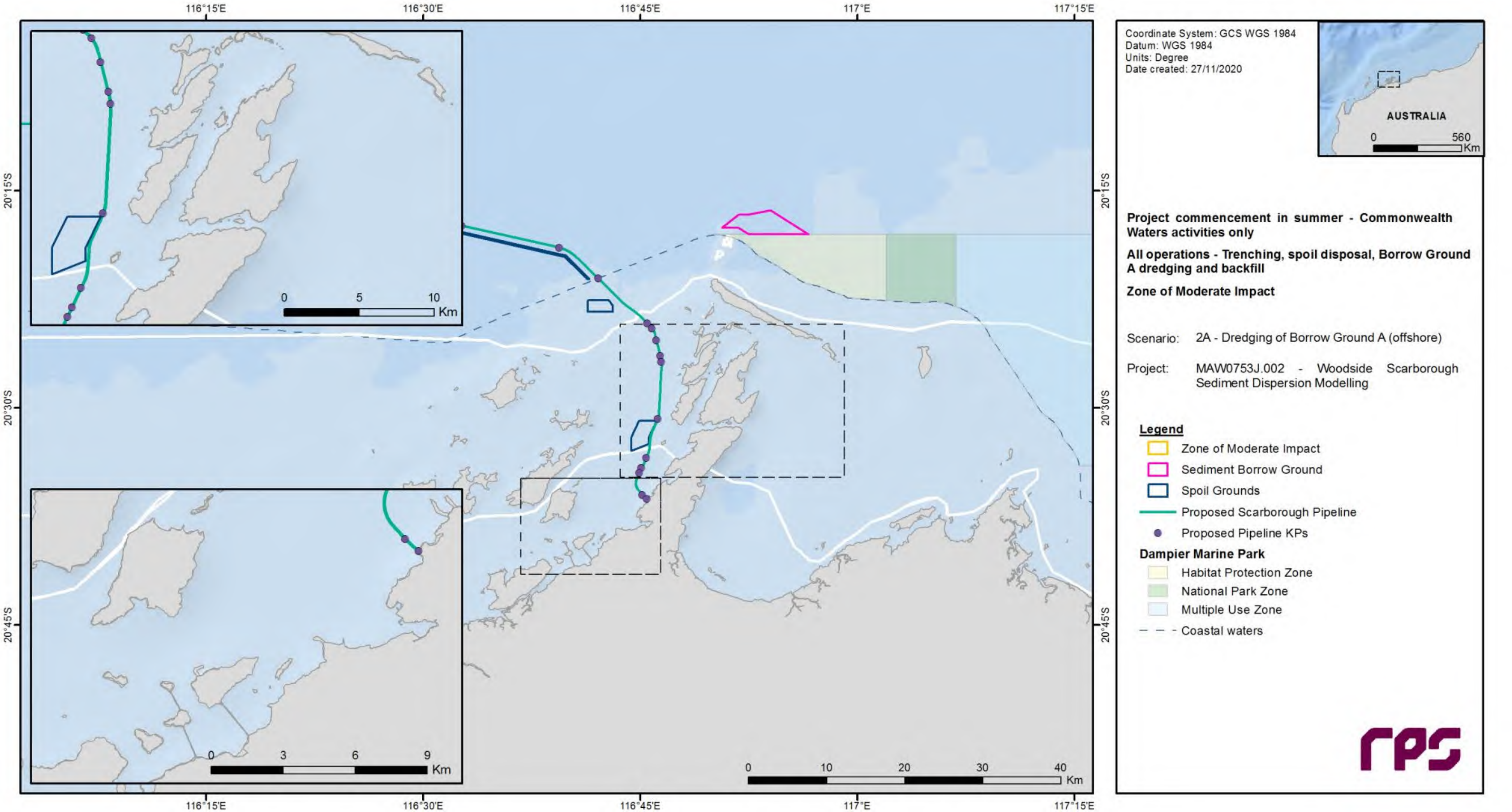


Figure B.39 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 10-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st February 2017 to 21st November 2017).

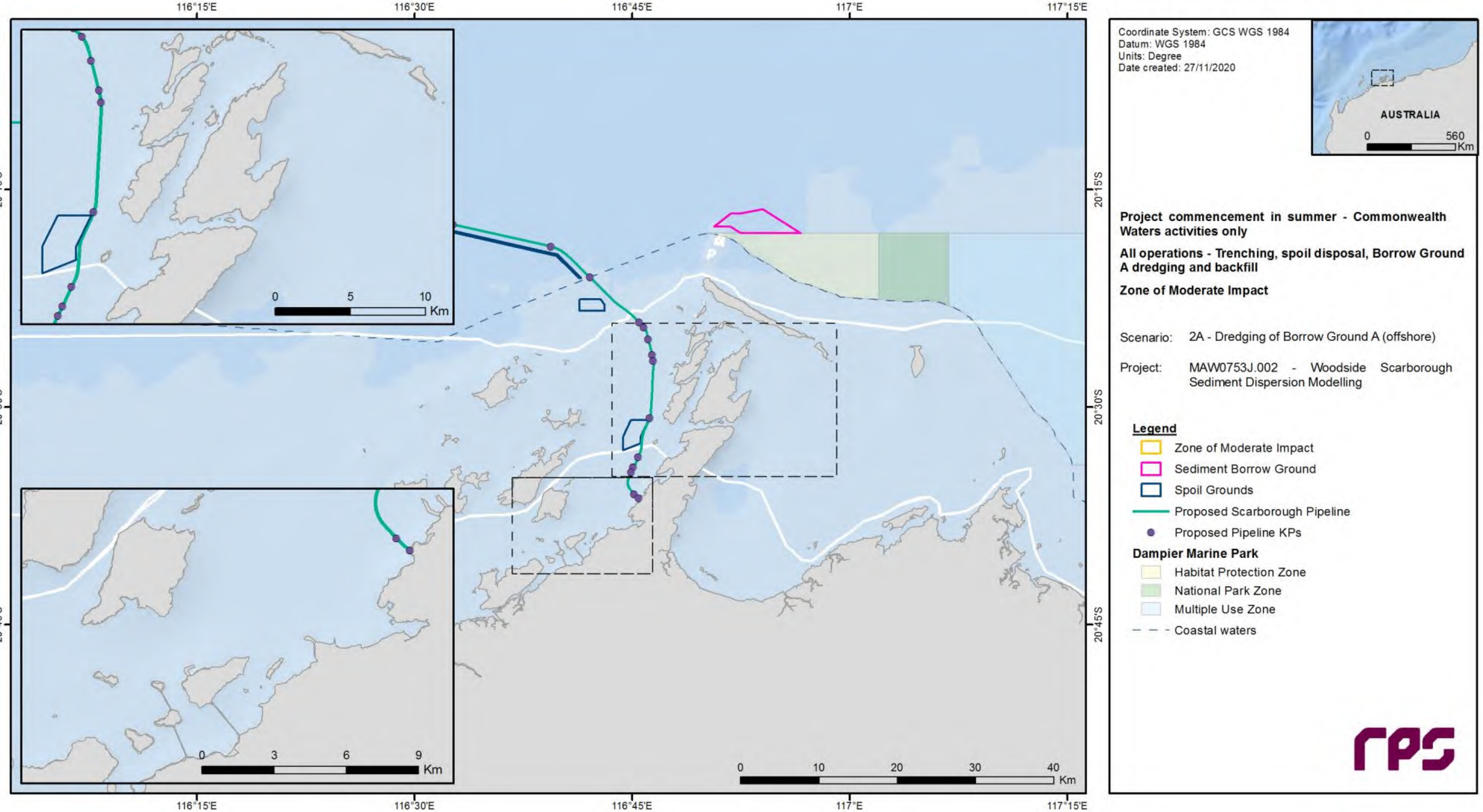


Figure B.40 Predicted Zone of Moderate Impact following application of the appropriate spatial thresholds in Table 4.3 to 14-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st February 2017 to 21st November 2017).

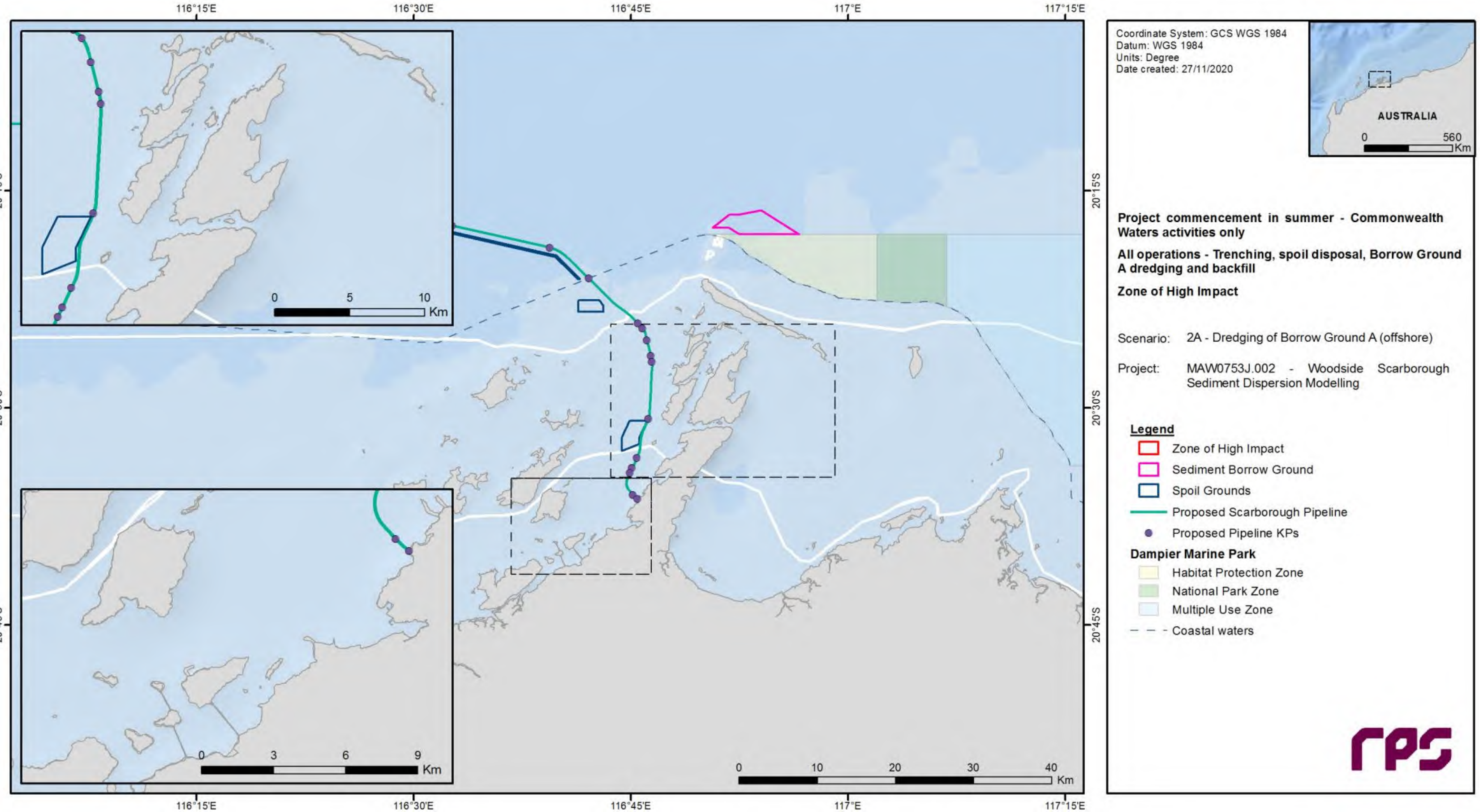


Figure B.41 Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 3-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st February 2017 to 21st November 2017).

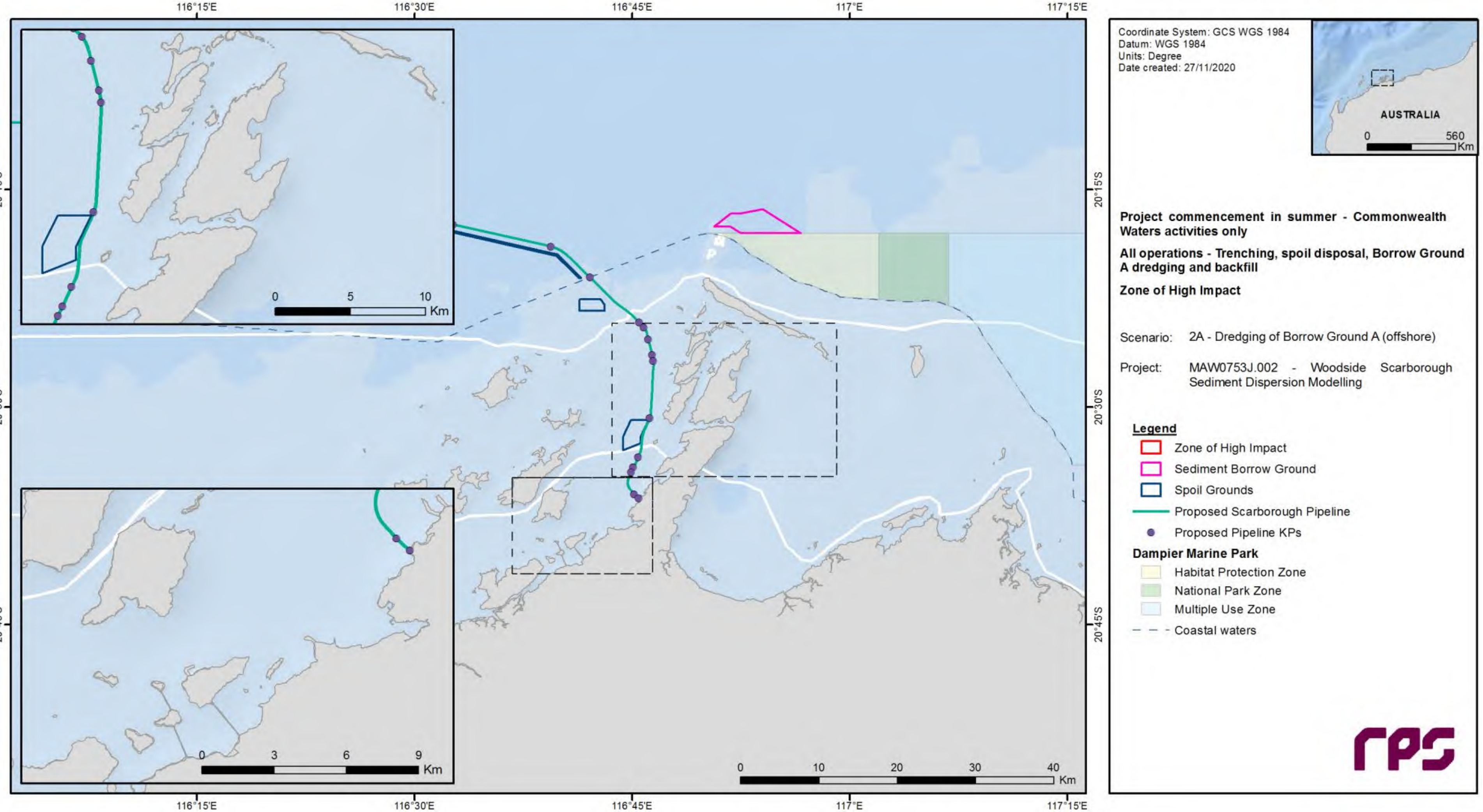


Figure B.42 **Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 7-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st February 2017 to 21st November 2017).**

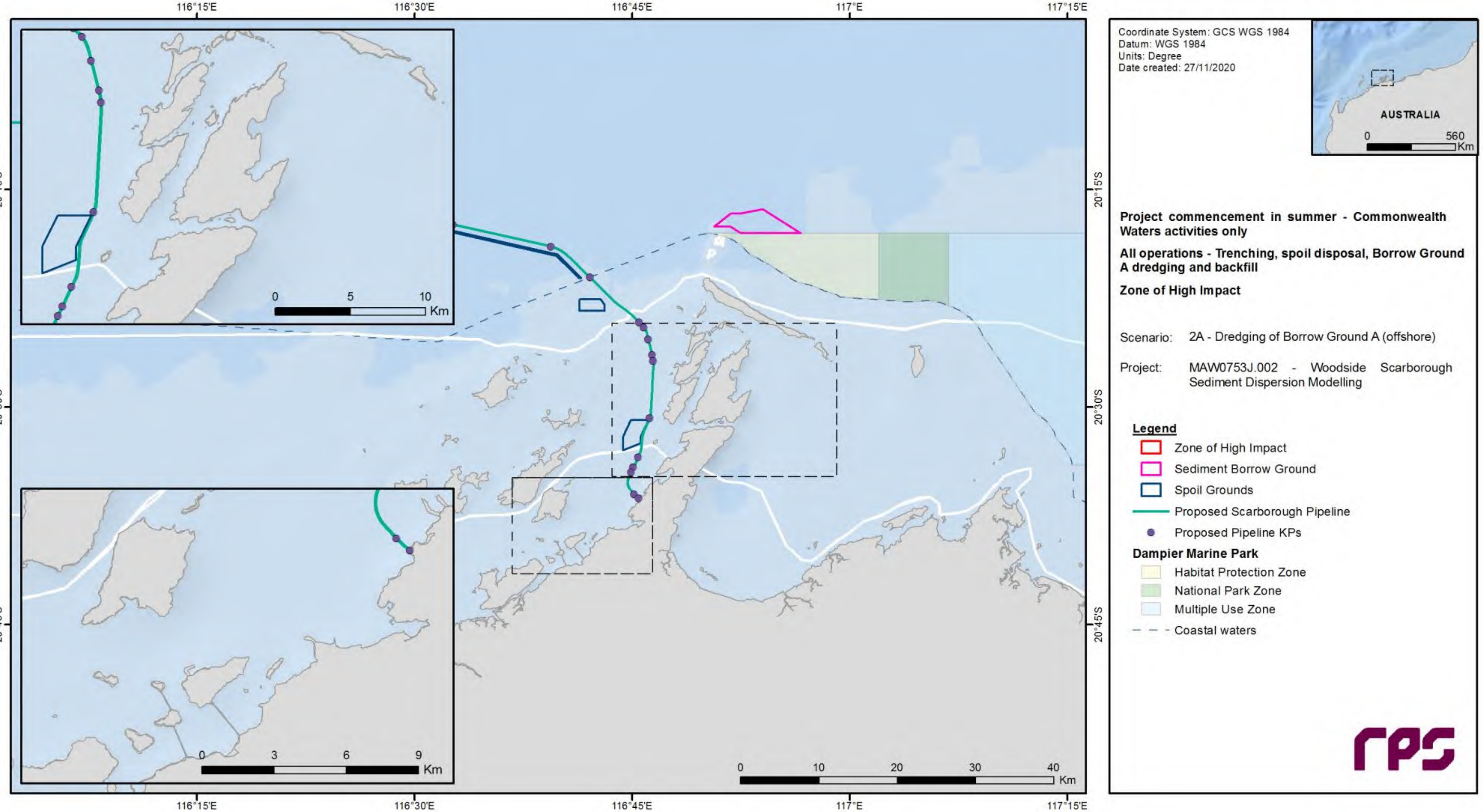


Figure B.43 **Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 10-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st February 2017 to 21st November 2017).**

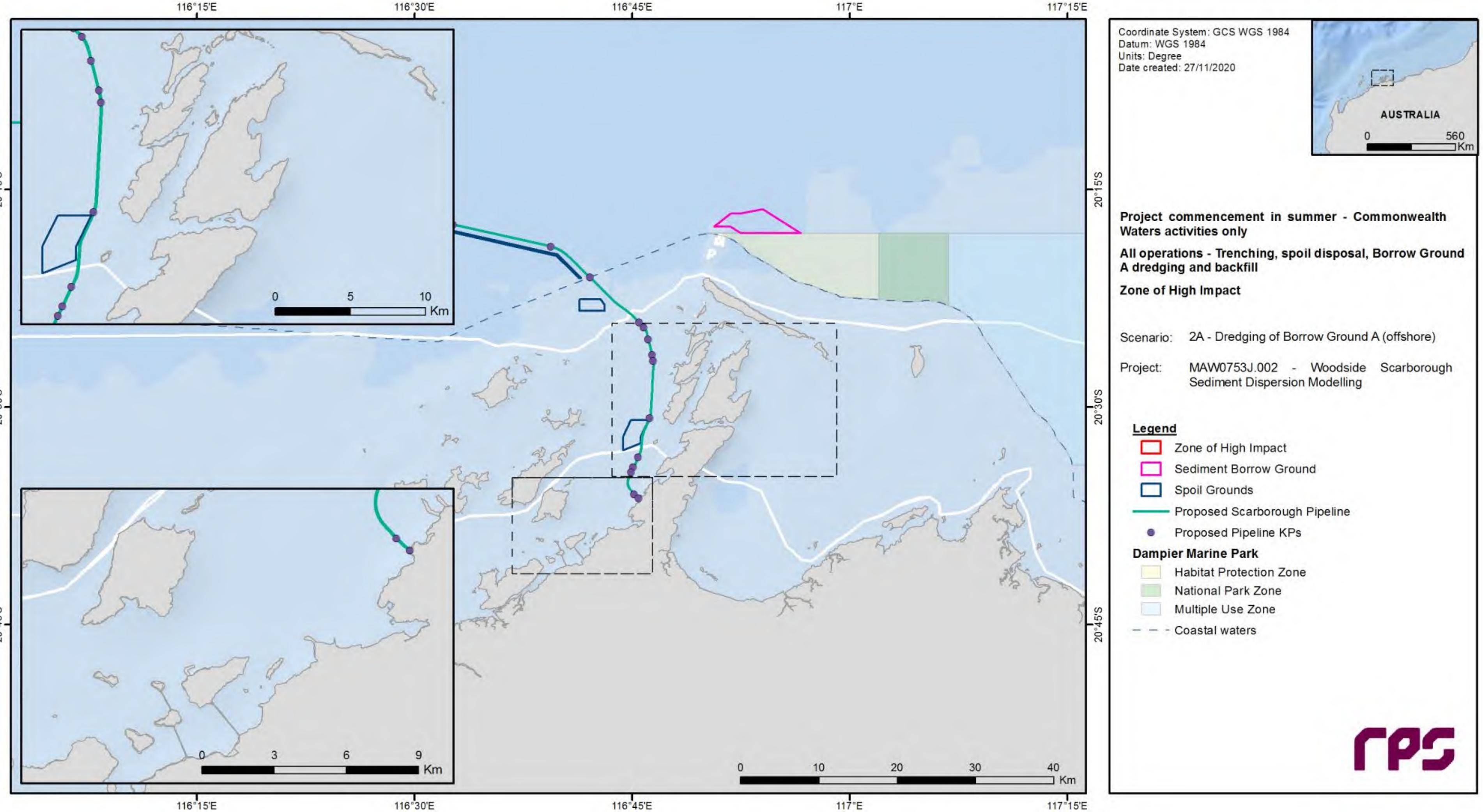


Figure B.44 Predicted Zone of High Impact following application of the appropriate spatial thresholds in Table 4.4 to 14-day (Zones A and B) and 28-day (Offshore) rolling averages of total (dredge and background) SSC throughout the duration of the relevant activities (1st February 2017 to 21st November 2017).

APPENDIX J OIL POLLUTION FIRST STRIKE PLAN

Scarborough Seabed Intervention and Trunkline Installation Oil Pollution First Strike Plan

Corporate HSE
Hydrocarbon Spill Preparedness

October 2023
Revision 0e

TABLE OF CONTENTS

SCARBOROUGH SEABED INTERVENTION AND TRUNKLINE INSTALLATION OIL POLLUTION FIRST STRIKE PLAN

SPILL FROM FACILITY INCLUDING SUBSEA INFRASTRUCTURE
(Note: Pipe laying and accommodation vessels are considered a "FACILITY" under Australian Regs).

LOCATION	LEVEL	CONTROL AGENCY	INCIDENT CONTROLLER
COMMONWEALTH WATERS	1	Woodside	Person In Charge (PIC) with support from Onshore Team Leader (OTL)
	2/3	Woodside	Corporate Incident Coordination Centre (CICC) DUTY MANAGER
STATE WATERS	1	Woodside	CICC Duty Manager
	2/3	Department of Transport (DoT)	DoT Incident Controller
WITHIN PORT LIMITS	1	Woodside	CICC Duty Manager
	2/3	Department of Transport (DoT)	DoT Incident Controller

SPILL FROM VESSEL
(Note: SOPEP should be implemented in conjunction with this document)

LOCATION	LEVEL	CONTROL AGENCY	INCIDENT CONTROLLER
COMMONWEALTH WATERS	1	Australian Marine Safety Authority (AMSA)	Vessel Master
	2/3	AMSA	AMSA (with response assistance from Woodside)
STATE WATERS	1	DoT	DoT Incident Controller
	2/3	DoT	DoT Incident Controller
WITHIN PORT LIMITS	1	Port Authority	Port Harbour Master
	2/3	Port Authority/ DoT	Port Harbour Master/ DoT Incident Controller

[1]See **Table A** for a guidance to incident characteristics of Levels 1 to 3

Guidance to Oil Spill Incident Levels

The most significant characteristic of the below guidance should be considered when determining level or escalation potential.

Table A: Guidance to the characteristics of incident Levels 1 to 3

Characteristic	Level 1 Indicators	Level 2 Indicators	Level 3 Indicators
General Description	Generally able to be resolved within 24-48 hours.	Generally a response is required beyond 48 hours.	Response may extend beyond weeks.
Woodside Emergency Management (EM) Crisis Management Team (CMT) Activation	Onsite Incident Controller (IC) e.g. vessel master activated. Use of ICC support may be required.	Handover of Control from Onsite IC to Corporate Incident Management Team (CIMT)Duty Manager (DM) in Peth.	Includes Perth based CMT activation.
Number of Agencies	First-response agency and Incident Management Team (IMT).	Multi-agency response.	Agencies from across government and industry.
Environment	Isolated impacts or with natural recovery expected within weeks.	Significant impacts and recovery may take months.	Significant area and recovery may take months to years. Remediation required.
Economy	Business level disruption (i.e. Woodside).	Business failure or 'Channel' impacts.	Disruption to a sector.
Public Affairs	Local and regional media coverage (WA).	National media coverage.	International media coverage.

For guidance on credible spill scenarios and hydrocarbon characteristics refer to APPENDIX A.

For Spills Entering State Waters

In the event of a spill where Woodside is the responsible party and the spill may impact State waters/shorelines, Woodside will notify the Western Australian Department of Transport (DoT). The Director General of DoT is the Hazard Management Agency (HMA) for Western Australian waters. If a Level 1 vessel spill arises with port limits, Woodside will notify the Port Authority who will become the Control Agency. In the event of a Level 2/3 spill arising from a vessel within port limits, the Control Agency will be agreed between the Port Authority and DoT.

If the spill impacts State waters/shorelines and is a Level 1, Woodside will remain the Control Agency. If the spill is a Level 2/3 then DoT will become the Control Agency/HMA for the response in State waters/shorelines only. DoT will appoint an Incident Controller and form a separate Incident Management Team to manage the State waters/shorelines response only. The coordination structure for a concurrent hydrocarbon spill in both Commonwealth and State waters/shorelines is shown in APPENDIX E – Coordination structure for a concurrent hydrocarbon spill in both Commonwealth and State Waters/shorelines.

Initially Woodside will be required to make available an appropriate number of suitably qualified persons to work in the DoT IMT (see APPENDIX G). DoT's role as the Controlling Agency/HMA for Level 2 and 3 spills in State waters/shorelines does not negate the requirement for Woodside to have appropriate plans and resources in place to adequately respond to a Marine Hydrocarbon Spill incident in State waters/shorelines or to commence the initial response actions to a spill prior to DoT establishing incident control in line with DoT Offshore Petroleum Industry Guidance Note - Marine Oil Pollution: Response and Consultation Arrangements (July 2020). Cost recovery arrangements for offshore marine pollution incidents (MOP) are in accordance with Section 9 of the Guidance Note:

https://www.transport.wa.gov.au/mediaFiles/marine/MAC_P_Westplan_MOP_OffshorePetroleumIndGuidance.pdf

Woodside's Incident Management Structure for a Hydrocarbon Spill, including Woodside Liaison Officer's command structure within DoT can be seen at APPENDIX F.

Response Process Overview

<table>
<tr><th colspan="3">Use the below to determine actions required and which parts of this plan are relevant to the incident.</th></tr>
<tr><th colspan="3">For guidance on credible scenarios and hydrocarbon characteristics, refer to Appendix A.</th></tr>
<tr><td rowspan="2">ALL INCIDENTS</td><td colspan="2">Notify the Woodside Communication Centre (WCC) on:
[redacted]</td></tr>
<tr><td colspan="2">Incident Controller or delegate to make relevant notifications in Table 1-1 of this Oil Pollution First Strike Plan.</td></tr>
<tr><td rowspan="3">LEVEL 1</td><th>FACILITY INCIDENT</th><th>VESSEL INCIDENT</th></tr>
<tr><td>Coordinate pre-identified tactics in Table 2-1 of this Oil Pollution First Strike Plan.
Remember to download each Operational Plan.</td><td>Notify AMSA or Port Authority (if within port limits) and coordinate pre-identified tactics in Table 2-1 of this Oil Pollution First Strike Plan
Remember to download each Operational Plan.</td></tr>
<tr><td colspan="2">If the spill escalates such that the site cannot manage the incident, inform the WCC on [redacted] and escalate to a level 2/3 incident.</td></tr>
<tr><td rowspan="4">LEVEL 2/3</td><th>FACILITY INCIDENT</th><th>VESSEL INCIDENT</th></tr>
<tr><td>Handover control to CIMT and notify DoT or Port Authority (if within port limits)</td><td>Handover control to AMSA or Port Authority (if within port limits) and stand up CIMT to assist.</td></tr>
<tr><td>Commence quick revalidation of the recommended strategies on Table 3-1 taking into consideration seasonal sensitivities and current situational awareness.
Commence validated strategies.</td><td>If requested by AMSA/Port Authority:
Commence quick revalidation of the recommended strategies on Table 3-1 taking into consideration seasonal sensitivities and current situational awareness.
Commence validated strategies.</td></tr>
<tr><td>Create an Incident Action Plan (IAP) for all ongoing operational periods
The content of the IAP should reflect the selected response strategies based on current situational awareness.
For the full detailed pre-operational Net Environmental Benefit Analysis (NEBA) see the OSPRMA Appendix A</td><td>If requested by AMSA/Port Authority:
Create an IAP for all ongoing operational periods
The content of the IAP should reflect the selected response strategies based on current situational awareness.
For the full detailed pre-operational NEBA see the OSPRMA Appendix A</td></tr>
</table>

1. NOTIFICATIONS (ALL LEVELS)

The Incident Controller or delegate must ensure the below notifications **(Table 1-1)** are completed within the designated timeframes.

Table 1-1: Immediate notifications

Notification timing	Responsibility	Authority/ Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
Notifications to be made for ALL LEVELS of spill *(For spills from a vessel the following notifications must be undertaken by a WEL representative).*							
In the event of an incident between campaign vessels, activate relevant vessel Emergency Response Plans and/or Bridging Documents							
In the event of an incident impacting Scarborough live well infrastructure, also activate Scarborough Drilling and Completions Oil Pollution First Strike Plan							
Immediately	Offshore Installation Manager (OIM) or Vessel Master	Woodside Communication Centre (WCC)	Duty Manager	[redacted]	Verbally notify WCC of event and estimated volume and hydrocarbon type.	Verbal	
Within 2 hours	Woodside Site Rep (WSR)	National Offshore Petroleum Safety Environmental Management Authority (NOPSEMA[1])	Incident notification office	[redacted]	Verbally notify NOPSEMA for spills >80L. Record notification using Initial Verbal Notification Form or equivalent and send to NOPSEMA as soon as practicable (cc to NOPTA and DMIRS).	[redacted]	
Within 3 days	WSR				Provide a written NOPSEMA Incident Report Form as soon as practicable (no later than 3 days after notification) (cc to NOPTA and DMIRS) NOPSEMA: [redacted] NOPTA: [redacted] DMIRS: [redacted]	[redacted]	

[1] Notification to NOPSEMA must be from a Woodside Representative.

Notification timing	Responsibility	Authority/ Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
As soon as practicable	CIMT DM or Delegate	Woodside	Environment Duty Manager	As per roster	Verbally notify Duty Environment of event and seek advice on relevant performance standards from EP	Verbal	
As soon as practicable if spill arises in or is likely to extend into port limits.	CIMT DM or Delegate	Pilbara Ports Authority (PPA)	PPA Dampier Vessel Traffic Services (VTS)	[redacted]	Any spill within or close to the Dampier Port boundary should be reported immediately to the PPA Dampier VTS	Verbal	
Within 2 hours of becoming aware of a marine oil pollution incident (MOP) that occurs in or may impact State waters	CIMT DM or Delegate	WA Department of Transport	DoT Maritime Environmental Emergency Response Unit (MEER) Duty Officer	[redacted]	Verbally notify DoT MEER Duty Officer that a spill has occurred and, if required, request use of equipment stored in Karratha. Follow up with a written POLREP as soon as practicable following verbal notification. Additionally, DoT to be notified if spill is likely to extend into WA State waters. Request DoT to provide Liaison to WEL IMT.	[redacted]	
As soon as practicable	CIMT DM or Delegate	Department of Climate Change, Energy, the Environment and Water (DCCEEW) (Director of National Parks)	Marine Park Compliance Duty Officer	[redacted]	The Marine Park Compliance Duty Officer is notified in the event of oil pollution within a marine park, or where an oil spill response action must be taken within a marine park, so far as reasonably practicable, prior to response action being taken. This notification should include: • titleholder details • time and location of the incident • proposed response arrangements and locations as per the OPEP • contact details for the response coordinator	Verbal	

Notification timing	Responsibility	Authority/ Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
					• confirmation of access to relevant monitoring and evaluation reports when available.		
Without delay as per protection of the Sea Act, part II, section 11(1)	Vessel Master	Australian Maritime Safety Authority (AMSA)	Response Coordination Centre (RCC)	[redacted]	Verbally notify AMSA RCC of the hydrocarbon spill. Follow up with a written Marine Pollution Report (POLREP) as soon as practicable following verbal notification.	[redacted]	
IN THE EVENT OF AN INCIDENT IMPACTING ANOTHER TITLEHOLDERS' LIVE INFRASTRUCTURE, NOTIFY RELEVANT PARTY							
Immediately	WCC	Chevron Australia Pty Ltd (CAPL)	Chevron Perth Security Operations Centre	[redacted]	Verbally notify CAPL Security Operations Centre of event and estimated volume and hydrocarbon lost. Establish which party will be IC for spill incident.	Verbal	
Immediately	WCC	Santos Health, Safety & Security	Santos Crisis, Emergency Response & Security Manager	[redacted]	Verbally notify Santos of event and estimated volume and hydrocarbon lost. Establish which party will be IC for spill incident.	Verbal	
			Emergency Response Coordinator (Oil Spill Response)	[redacted]			
		Santos WA: Upstream Health, Safety & Environment Division	Senior Crisis & Emergency Response Adviser	[redacted]			
ADDITIONAL LEVEL 2/3 NOTIFICATIONS							
As soon as practicable	CIMT DM or Delegate	AMOSC	AMOSC Duty Manager	[redacted]	Notify AMOSC that a spill has occurred and follow-up with an email from the **CIMT Leader/ CIMT Deputy Leader/ IMT IC/ CMT Adviser/ CMT Leader** to formally activate AMOSC.	[redacted]	

Notification timing	Responsibility	Authority/ Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
					Determine what resources are required consistent with the AMOS Plan and detail in a Service Contract that will be sent to Woodside from AMOSC upon activation.		
As soon as practicable	CIMT DM or Delegate	Oil Spill Response Limited (OSRL)	OSRL Duty Manager	[redacted]	Contact OSRL duty manager and request assistance from technical advisor in Perth. Send the completed notification form to OSRL as soon as practicable. For mobilisation of resources, send the Mobilisation Form to OSRL as soon as practicable. The mobilisation form must be signed by a nominated callout authority from Woodside. OSRL can advise the names on the call out authority list, if required	Notification: [redacted] Mobilisation: [redacted]	
As soon as practicable if there is potential for oiled wildlife or the spill is expected to contact land or waters managed by WA Department of Biodiversity, Conservation and Attractions	CIMT DM or Delegate	WA Department of Biodiversity, Conservation and Attractions (DBCA)	Duty Officer	[redacted]	Phone call notification	Verbal	
As soon as practicable	Public Information	Relevant persons and organisations	To be determined	To be determined	Should it be identified that additional persons such as, but not limited to, commercial fishers, tourism operators or relevant cultural authorities may be affected, Woodside would, at the relevant time, engage with these parties as appropriate and in alignment with the Oil Spill Preparedness and Response Mitigation Assessment (OSPRMA) for	Verbal initially	

Notification timing	Responsibility	Authority/ Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
					Scarborough Seabed Intervention and Trunkline Installation. Relevant persons and organisations will be re-assessed throughout the response period.		
As soon as practicable	Public Information	Murujuga Aboriginal Corporation (MAC)	MAC CEO	[redacted]	Woodside will engage MAC and seek input to spill response planning as the relevant cultural authority as soon as practicable after becoming aware of a marine pollution incident from Scarborough trunkline activities that may impact cultural heritage values.	Verbal	
As soon as practicable if extra personnel are required for incident support	CIMT DM or Delegate	Marine Spill Response Corporation (MSRC)	MSRC Response Manager	[redacted]	Activate the contract with MSRC (in full) for the provision of up to 30 personnel depending on what skills are required. Please note that provision of these personnel from MSRC are on a best endeavours basis and are not guaranteed.	Verbal	

2. LEVEL 1 RESPONSE

2.1 Mobilisation of response techniques

For the relevant hydrocarbon type, undertake quick revalidation of the recommended techniques and pre-identified tactics indicated with a ‘Yes’ in Table 2-1**.** Undertake all validated pre-identified tactics immediately. These tactics should be carried out using the associated plan identified under Table 2-1 Operational Plan column.

All response techniques and pre-identified tactics have been identified from the pre-operational Net Environmental Benefits Analysis (NEBA) presented in the Scarborough Seabed Intervention and Trunkline Installation Environment Plan Appendix D (Woodside’s Oil Spill Preparedness and Response Mitigation Assessment).

Table 2-1: Level 1 response summary

Response Techniques	Hydrocarbon Type Marine Diesel Oil	Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
Please consider instructing the CIMT DM to activate or implement any of the following Pre-Identified tactics. The following tactics will assist in answering the '7 Questions of Spill Assessment' identified in Appendix C to increase situational awareness.						
Monitor and Evaluate (Operational Monitoring, OM02)	Yes	If a vessel is on location, consider the need to deploy the oil spill tracking buoy. If no vessel is on location, consider the need to mobilise oil spill tracking buoys from the King Bay Supply Base (KBSB) Stockpile. If a surface sheen is visible from the facility, deploy the satellite tracking buoy within two hours.	Operations	**DAY 1:** Tracking buoy deployed within two hours.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02 of The Operational Monitoring Operational Plan). Deploy tracking buoy in accordance with APPENDIX D.
Monitor and evaluate – predictive modelling (OM01)	Yes	Undertake initial modelling using the Rapid assessment oil spill tool and weathering fate analysis using ADIOS (or refer to the hydrocarbon information in Appendix A).	Intelligence or Environment	**DAY 1:** Initial modelling within six hours using the Rapid Assessment Tool.		Predictive Modelling of Hydrocarbons to Assess Resources at Risk (OM01 of The Operational Monitoring Operational Plan). *Planning to download immediately and follow steps*
	Yes	Send Oil Spill Trajectory Modelling (OSTM) form (Appendix B Form 7) to RPS Response team (email: [redacted]	Intelligence	**DAY 1:** Detailed modelling within four hours of RPS Response receiving information from Woodside.		
Monitor and evaluate – aerial surveillance (OM02)	Yes	Instruct Aviation Duty Manager to commence aerial observations in daylight hours. Aerial surveillance observer to complete log in Appendix B Form 8.	Logistics - Aviation	**DAY 1:** Two trained aerial observers. One aircraft available.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02 of The Operational Monitoring Operational Plan). *Planning to download immediately and follow steps*
Monitor and evaluate – satellite tracking (OM02)	Yes	The Intelligence duty manager should be instructed to stand up KSAT to provide satellite imagery of the spill (email [redacted]).	Intelligence	**DAY 1:** Service provider will confirm availability of an initial acquisition within two hours.		

				Data received to be uploaded into Woodside Common Operating Picture.		
Monitor and evaluate – monitoring hydrocarbons in water (OM03)	Yes	Consider the need to mobilise resources to undertake water quality monitoring (OM03).	Planning or Environment	**DAY 3:** Water quality assessments access and capability.		Detecting and Monitoring for the Presence and Properties of Hydrocarbons in the Marine Environment (OM03 of The Operational Monitoring Operational Plan).
Monitor and evaluate – pre-emptive assessment of receptors at risk (OM04)	Yes	Consider the need to mobilise resources to undertake pre-emptive assessment of sensitive receptors at risk (OM04).	Planning or Environment	**DAY 2:** In agreement with WA DoT, deployment of two specialists to reach of the Response Protection Areas (RPA) with predicted impacts.		Pre-emptive Assessment of Sensitive Receptors (OM04 of The Operational Monitoring Operational Plan).
Monitor and evaluate – shoreline assessment (OM05)	Yes	Consider the need to mobilise resources to undertake shoreline assessment surveys (OM05).	Planning or Environment	**DAY 2:** In agreement with WA DoT, deployment of two specialists in shoreline clean-up assessment (SCAT) for each of the RPAs with predicted impacts.		Shoreline Assessment (OM05 of The Operational Monitoring Operational Plan).
Shoreline Protection and Deflection	Potentially	Equipment from Woodside and/or PPA (if within port limits) mobilised. If required additional equipment mobilised from AMOSC and AMSA Western Australian stockpiles.	Logistics and Planning	**DAY 1:** In agreement with WA DoT and/or PPA (if within port limits), activate relevant Tactical Response Plans (TRPs) within 12 hours. In agreement with WA DoT and/or PPA (if within port limits), mobilise teams to RPAs within 12 hours of operational monitoring predicting impacts. In agreement with WA DoT and/or PPA (if within port limits), equipment mobilised from closest stockpile within 12hours. Supplementary equipment mobilised from AMOSC, AMSA stockpiles within 24 hours		Protection and Deflection Operational Plan *Logistics to download immediately and follow steps*

3. LEVEL 2/3 RESPONSE

3.1 Mobilisation of response techniques

For the relevant hydrocarbon type, undertake quick revalidation of the recommended techniques and pre-identified tactics indicated with a 'Yes' in Table 3-1**.** Undertake all validated pre-identified tactics immediately. These tactics should be carried out using the associated plan identified under Table 3-1 Operational Plan column.

All response techniques and pre-identified tactics have been identified from the pre-operational Net Environmental Benefits Analysis (NEBA) presented in the Scarborough Seabed Intervention and Trunkline Installation Environment Plan Appendix D (Woodside's Oil Spill Preparedness and Response Mitigation Assessment).

Table 3-1: Level 2/3 response summary

Response Techniques	Hydrocarbon Type Marine Diesel Oil	Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
Monitor and evaluate – tracking buoy (OM02)	Yes	If a vessel is on location, consider the need to deploy the oil spill tracking buoy. If no vessel is on location, consider the need to mobilise oil spill tracking buoys from the King Bay Supply Base (KBSB) Stockpile. If a surface sheen is visible from the facility, deploy the satellite tracking buoy within two hours.	Operations	**DAY 1:** Tracking buoy deployed within two hours.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02) of The Operational Monitoring Operational Plan. Deploy tracking buoy in accordance with APPENDIX D.
Please consider instructing the CIMT DM to activate or implement any of the following Pre-Identified tactics. The following tactics will assist in answering the '7 Questions of Spill Assessment' identified in Appendix C to increase situational awareness.						
Monitor and evaluate – predictive modelling (OM01)	Yes	Undertake initial modelling using the Rapid assessment oil spill tool and weathering fate analysis using ADIOS (or refer to the hydrocarbon information in Appendix A).	Intelligence or Environment	**DAY 1:** Initial modelling within six hours using the Rapid Assessment Tool.		Predictive Modelling of Hydrocarbons to Assess Resources at Risk (OM01 of The Operational Monitoring Operational Plan). *Planning to download immediately and follow steps*
	Yes	Send Oil Spill Trajectory Modelling (OSTM) form [redacted] to RPS Response team (email: [redacted]	Intelligence	**DAY 1:** Detailed modelling within 4 hours of RPS Response receiving information from Woodside.		
Monitor and evaluate – aerial surveillance (OM02)	Yes	Instruct Aviation Duty Manager to commence aerial observations in daylight hours. Aerial surveillance observer to complete log in [redacted]	Logistics - Aviation	**DAY 1:** Two trained aerial observers. One aircraft available. Report made available to the IMT within two hours of landing after each sortie.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02 of The Operational Monitoring Operational Plan). Planning to download immediately and follow steps
Monitor and evaluate – satellite tracking (OM02)	Yes	The Intelligence duty manager should be instructed to stand up Kongsberg Satellite Services (KSAT) to provide satellite imagery of the spill.	Intelligence	**DAY 1:** Service provider will confirm availability of an initial acquisition within two hours.		

		[redacted]		Data received to be uploaded into Woodside Common Operating Picture.		
Monitor and evaluate – monitoring hydrocarbons in water (OM03)	Yes	Consider the need to mobilise resources to undertake water quality monitoring (OM03).	Planning or Environment	**DAY 3:** Water quality assessment access and capability Daily fluorometry reports will be provided to IMT.		Detecting and Monitoring for the Presence and Properties of Hydrocarbons in the Marine Environment (OM03 of The Operational Monitoring Operational Plan).
Monitor and evaluate – pre-emptive assessment of receptors at risk (OM04)	Yes	Consider the need to mobilise resources to undertake pre-emptive assessment of sensitive receptors at risk (OM04).	Planning or Environment	**DAY 2:** In agreement with WA DoT, deployment of two specialists for each of the Response Protection Areas (RPA) with predicted impacts.		Pre-emptive Assessment of Sensitive Receptors (OM04 of The Operational Monitoring Operational Plan).
Monitor and evaluate – shoreline assessment (OM05)	Yes	Consider the need to mobilise resources to undertake shoreline assessment surveys (OM05).	Planning or Environment	**DAY 2:** In agreement with WA DoT, deployment of two specialists in SCAT for each of the RPAs with predicted impacts.		Shoreline Assessment (OM05 of The Operational Monitoring Operational Plan).
Surface Dispersant	No	This response strategy is not recommended.				
Containment and Recovery	No	This response strategy is not recommended.				
Mechanical Dispersion	No	This response strategy is not recommended.				
In-situ Burning	No	This response strategy is not recommended.				
Shoreline Protection and Deflection	Yes	Equipment from Woodside, PPA (if within port limits), AMOSC and AMSA Western Australian Stockpiles mobilised. Consideration of mobilisation of interstate/international shoreline protection equipment (i.e. OSRL).	Logistics and Planning	**DAY 1:** In agreement with WA DoT and/or PPA (if within port limits), activate relevant Tactical Response Plans (TRPs) within 12 hours. In agreement with WA DoT and/or PPA (if within port limits), mobilise teams to RPAs within 12 hours of operational monitoring predicting impacts.		Protection and Deflection Operational Plan *Logistics to download immediately and follow steps*

				In agreement with WA DoT and/or PPA (if within port limits), equipment mobilised from closest stockpile within 12-hours. Supplementary equipment mobilised from AMOSC, AMSA stockpiles within 24 hours **DAY 2:** Supplementary equipment mobilised from OSRL within 48 hours (if required)		
Shoreline Clean Up	Yes	Equipment from Woodside, and/or PPA (if within port limits) AMOSC and AMSA Western Australian Stockpiles and relevant personnel mobilised. Consideration of mobilisation of interstate/international shoreline clean-up equipment and relevant personnel (i.e. OSRL).	Logistics and Planning	**DAY 1:** In agreement with WA DoT and/or PPA (if within port limits), activate relevant Tactical Response Plans (TRPs) within 12 hours. Equipment mobilised from closest stockpile within 24 hours **DAY 2:** Deployment of shoreline clean-up teams to contaminated RPAs. Supplementary equipment mobilised from State, AMOSC, AMSA stockpiles within 48 hours, if required. Access to at least 213 m^3 of solid and liquid waste storage available within 2 days upon activation of 3rd party contract.		Shoreline Clean-up Operational Plan *Logistics to download immediately and follow steps*
Oiled Wildlife Response	Yes	If oiled wildlife is a potential impact, request AMOSC to mobilise containerised oiled wildlife first strike kits and relevant personnel. Refer to relevant Tactical Response Plan for potential wildlife at risk. Mobilise AMOSC Oiled Wildlife Containers. Consider whether additional equipment is required from local suppliers.	Logistics and Planning	**DAY 5:** Contracted capability to treat up to an additional 250 individual fauna within a five-day period. Facilities for oiled wildlife rehabilitation are operational 24/7.		Oiled Wildlife Response Operational Plan

Scientific Monitoring (Type II)	Yes	Notify Woodside science team of spill event.	Environment			Oil Spill Scientific Monitoring Programme – Operational Plan

4. PRIORITY RECEPTORS

Note: DoT are the Control Agency to respond to all the sites listed below in a Level 2/3 spill into State waters/shorelines.

Action: Provide DoT with all relevant Tactical Response Plans for Priority Protection Areas.

Stochastic modelling has been completed for a worst case spill scenario of an instantaneous surface release of 2000 m^3 of marine diesel, representing loss of vessel fuel tank integrity after a collision, at three locations: outside Mermaid Sound (Credible Scenario-01 (CS-01)), within Montebello Marine Park (Credible Scenario-02 (CS-02)) and at the proposed Floating Production Unit (FPU) location in the Scarborough field (Credible Scenario-03 (CS-03)). Only CS-01 results in any impacts at response threshold and has therefore been used to plan and scale the response.

Based on hydrocarbon spill risk modelling results for the three scenarios the sensitive receptors outlined in Table 4-2 are identified as priority protection areas, as they have the potential to be contacted by hydrocarbon at or above response threshold levels within 48 hours of a spill. Please note that impact thresholds (10 g/m^2 surface hydrocarbon concentration, 100 g/m^2 shoreline accumulation, and 100 ppb entrained hydrocarbon concentration) are used to determine the environment that may be affected (EMBA) identified in the Environment Plan and are lower than response thresholds (**Table 4-1**).

Table 4-1: Response thresholds

Surface Hydrocarbon (g/m^2)	Description
>10	Predicted minimum threshold for commencing operational monitoring [2]
50	Predicted minimum floating oil threshold for containment and recovery and surface dispersant application [3]
100	Predicted optimum floating oil threshold for containment and recovery and surface dispersant application
100	Predicted minimum shoreline accumulation threshold for shoreline assessment operations
250	Predicted minimum threshold for commencing shoreline clean-up operations

Table 4-2: Receptors for priority protection with potential impact within 48 hours

Receptor	Distance and Direction from Operational Area (km)	Minimum time to shoreline contact (above 100 g/m^2) in days	Maximum shoreline accumulation (above 100 g/m^2) in m^3	Tactical Response Plans
Dampier Archipelago	13 km East	53 hours (2.2 days) *NB >48 hour criteria but included for conservatism*	3	Legendre Island – Dampier Rosemary Island - Dampier Additional TRPs available via this Link
Open Ocean – Commonwealth Waters	Overlaps	N/A	N/A	N/A

Hydrocarbon spill modelling results indicate the sensitive receptors listed below have the potential to be contacted by hydrocarbons beyond 48 hours of a spill:

- Dampier MP (surface hydrocarbon concentrations ≥10 g/m^2)
- Montebello MP (surface hydrocarbon concentrations ≥10 g/m^2)

[2] Operational monitoring will be undertaken from the outset of a spill whether or not this threshold has been reached. Monitoring is needed throughout the response to assess the nature of the spill, track its location and inform the need for any additional monitoring and/or response techniques. It also informs when the spill has entered State Waters and/or control of the incident passes to WA DoT or AMSA.

[3] At 50 g/m^2 containment and recovery and surface dispersant application operations are not expected to be particularly effective. This threshold represents a conservative approach to planning response capability and displaying the spread of surface oil.

- Gascoyne MP (surface hydrocarbon concentrations ≥10 g/m^2)

Tactical Response plans for these locations can be accessed here: Oil Spill Tactical Response Plans. Oil Spill Trajectory Modelling specific to the spill event will be required to determine the regional sensitive receptors to be contacted beyond 48 hours of a spill.

Figure 4-1 illustrates the location of regional sensitive receptors in relation to the Scarborough Seabed Intervention operational area and identifies priority protection areas.

Consideration should be given to other stakeholders (including mariners) in the vicinity of the spill location. **Table 4-3** indicates the assets within the vicinity of the Scarborough Seabed Intervention and Trunkline Installation Operational Area.

Table 4-3: Assets in the vicinity of the Scarborough Seabed Intervention and Trunkline Installation Operational Area

Asset	Distance and Direction from Operational Area	Operator
Dampier Port	0 km – from eastern end of trunkline	Pilbara Port Authority
Pluto Platform	2 km north	Woodside
Stag Platform	5 km south	Jadestone
Wheatstone Platform	10 km north	Chevron
Reindeer Platform	15 km north	Santos
Goodwyn Platform	48 km north	Woodside

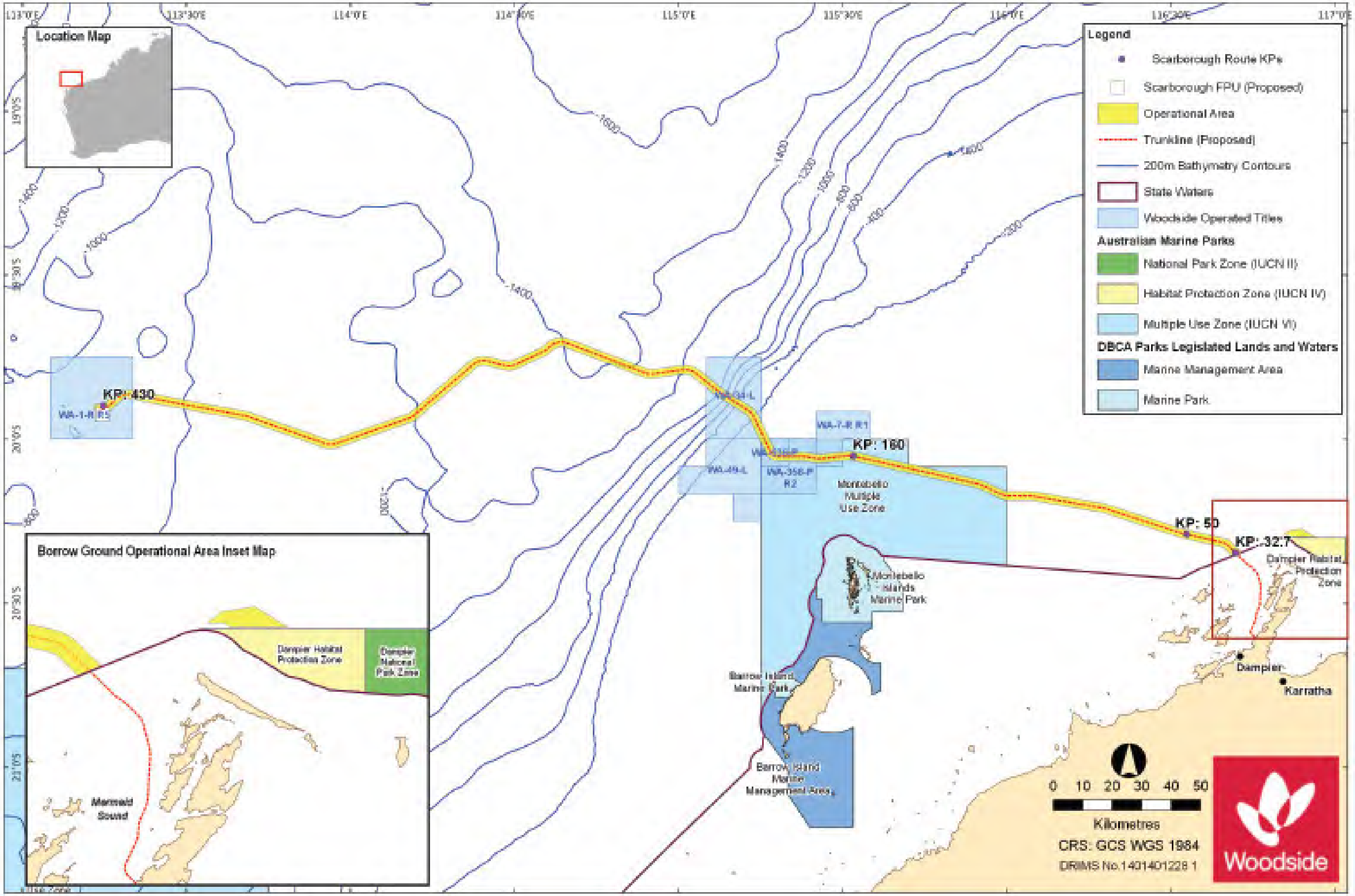


Figure 4-1 Regional Sensitive Receptors – Scarborough Seabed Intervention and Trunkline Installation

APPENDIX A – CREDIBLE SPILL SCENARIOS AND HYDROCARBON INFORMATION

For more detailed hydrocarbon information see the
[Hydrocarbon Data Directory]

Credible Spill Scenarios

Scenario	Product	Maximum Volumes	Suggested ADIOS2 Analogue*
WCCS: Instantaneous release from Vessel Collision outside Mermaid Sound (CS-01)	Marine Diesel	2000 m^3 release volume resulting in 100 m^3 residual oil on water surface	Diesel Fuel Oil (Southern USA 1) API of 37.2
Instantaneous release from Vessel Collision within Montebello Marine Park (CS-02)	Marine Diesel	2000 m^3 release volume resulting in 100 m^3 residual oil on water surface	Diesel Fuel Oil (Southern USA 1) API of 37.2
Instantaneous release from Vessel Collision at the proposed Floating Production Unit (FPU) location in the Scarborough field (CS-03)	Marine Diesel	2000 m^3 release volume resulting in 100 m^3 residual oil on water surface	Diesel Fuel Oil (Southern USA 1) API of 37.2

*Initial screening of possible ADIOS2 analogues was done by considering hydrocarbons with similar APIs. Suggested selection was based on the closest distillation cut to WEL hydrocarbon. Only hydrocarbons with distillation cuts that showed results for > 380°C were included in selection process.

Marine Diesel (Group 2 Oil)

Marine diesel is a mixture of volatile and persistent hydrocarbons, with approximately 40-50% by mass predicted to evaporate over the first day or two, depending upon the prevailing conditions, with further evaporation slowing over time. The heavier components of diesel have a strong tendency to entrain into the upper water column due to wind waves, but can refloat to the surface if wind waves abate.

The mass balance forecast for the constant calm wind case (**Figure A-1**) for marine diesel shows that approximately 45% of the oil is predicted to evaporate within 24 hours. Under these calm conditions the majority of the remaining oil on the water surface will weather at a slower rate due to being comprised of the longer-chain compounds with higher boiling points. Evaporation of the residual compounds will slow significantly, and they will then be subject to more gradual decay through biological and photochemical processes.

Under the variable-wind case (**Figure A-2)**, where the winds are of greater strength, entrainment of marine diesel into the water column is indicated to be significant. Approximately 24 hours after the spill, around 45% of the oil mass is forecast to have entrained and a further 35% is forecast to have evaporated, leaving only a small proportion of the oil floating on the water surface (<1%). The residual compounds will tend to remain entrained beneath the surface under conditions that generate wind waves (approximately >6 m/s).

The increased level of entrainment in the variable-wind case will result in a higher percentage of biological and photochemical degradation, where the decay of the floating slicks and oil droplets in the water column occurs at an approximate rate of 1.8% per day with an accumulated total of ~13% after 7 days, in comparison to a rate of ~0.2% per day and an accumulated total of 1.5% after 7 days in the constant-wind case. Given the large proportion of entrained oil and the tendency for it to remain mixed in the water column, the remaining hydrocarbons will decay and/or evaporate over time scales of several weeks to a few months. This long weathering duration will extend the area of potential effect, requiring the break-up and dispersion of the slicks and droplets to reduce concentrations below the thresholds

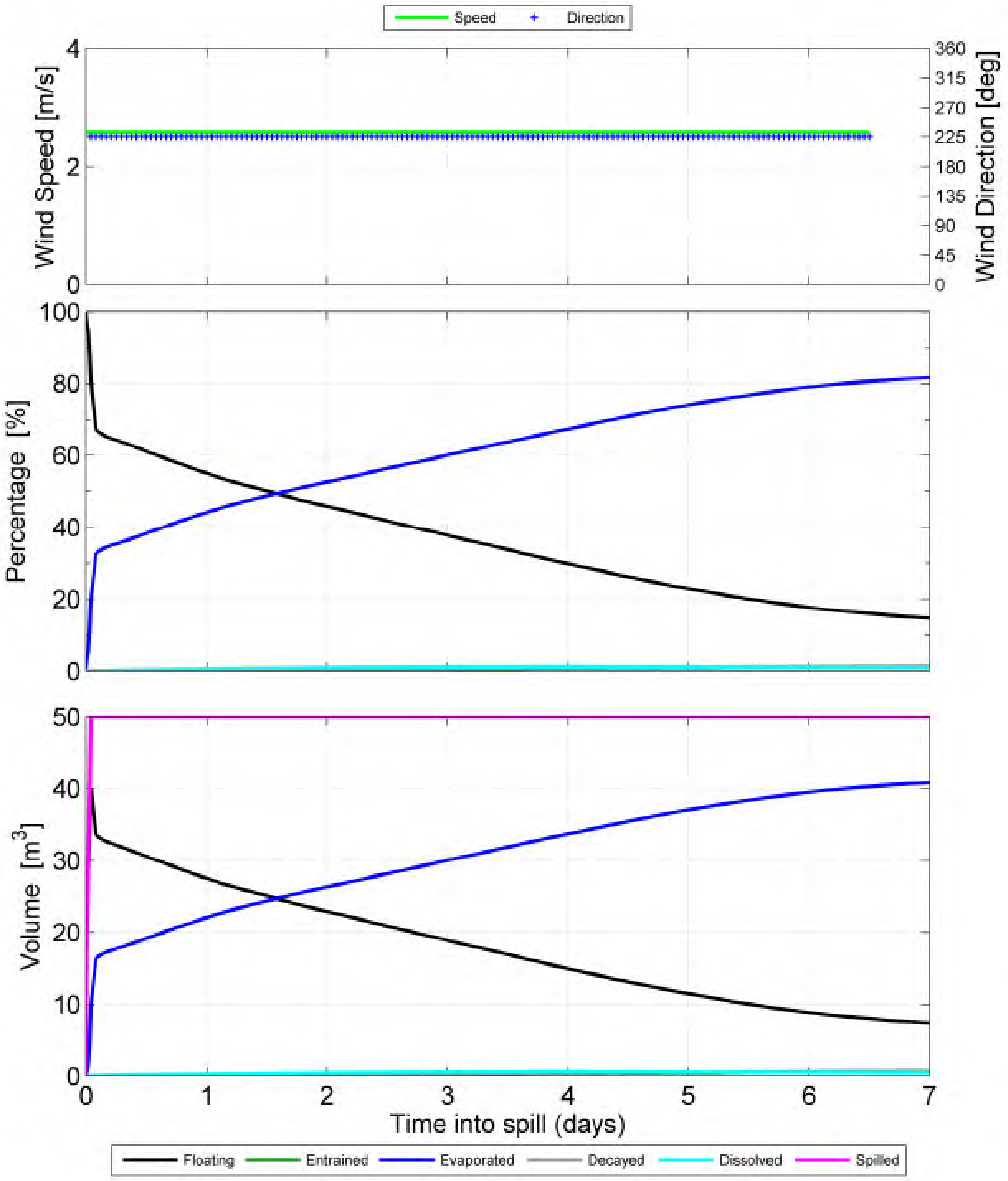


Figure A-1: Mass balance plot representing, as proportion (middle panel) and volume (bottom panel) the weathering of marine diesel spilled onto the water surface as a one-off release (50m^3 over 1 hour) and subject to a constant 5kn (2.6 m/s) wind at 27°C water temperature and 25°C air temperature.

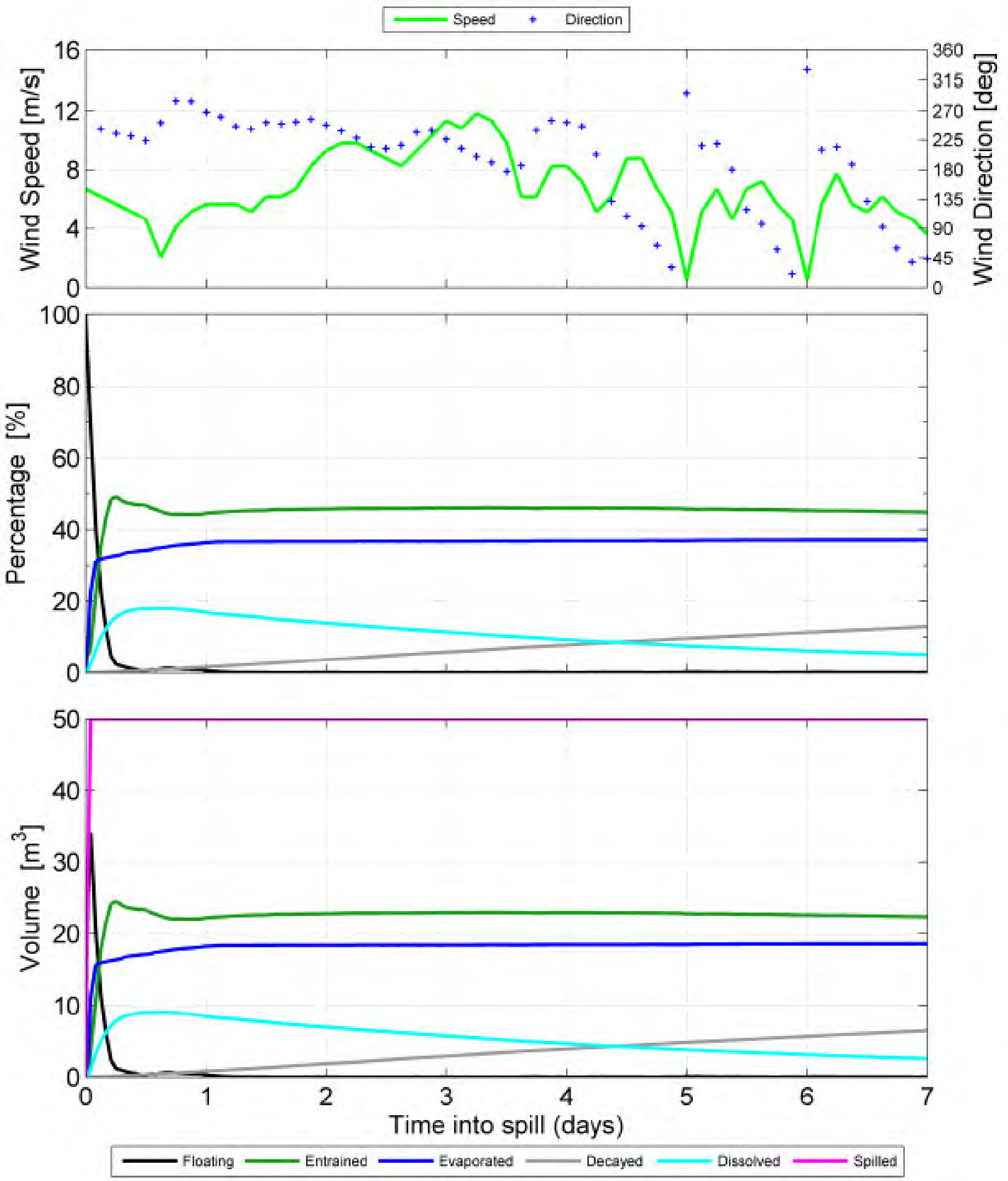


Figure A-2: Mass balance plot representing, as proportion (middle panel) and volume (bottom panel), the weathering of marine diesel spilled onto the water surface as a one-off release (50m^3 over 1 hour) and subject to variable wind at 27°C water temperature and 25°C air temperature.

APPENDIX B – FORMS

Form No.	Form Name	Link
1	Record of Initial Verbal Notification to NOPSEMA Template	[redacted]
2	NOPSEMA Incident Report Form	[redacted]
3	Marine Pollution Report (POLREP – AMSA)	[redacted]
4	AMOSC Service Contract Note	[redacted]
5	Marine Pollution Report (POLREP – DoT)	[redacted]
6a	OSRL Initial Notification Form	[redacted]
6b	OSRL Mobilisation Activation Form	[redacted]
7	RPS Response Oil Spill Trajectory Modelling Request	[redacted]
8	Aerial Surveillance Observer Log	[redacted]

FORM 1

Record of initial verbal notification to NOPSEMA

NOPSEMA phone: [redacted]

Date of call	
Time of call	
Call made by	
Call made to	

Information to be provided to NOPSEMA:

Date and Time of incident/ time caller became aware of incident	
Details of incident	**1 Location** ____ **2 Title** ____ **3 Hydrocarbon source** ____ □ **Platform** ____ □ **Pipeline** ____ □ **FPSO** ____ □ **Exploration drilling** ____ □ **Well** ____ □ **Other (please specify)** ____ **4 Hydrocarbon type** ____ **5 Estimated volume of hydrocarbon** ____ **6 Has the discharge ceased?** ____ **7 Fire, explosion or collision?** ____ **8 Environment Plan(s)** ____ **9 Other Details**
Actions taken to avoid or mitigate environmental impacts	
Corrective actions taken or proposed to stop, control or remedy the incident	

After the initial call is made to NOPSEMA, please send this record as soon as practicable to:

1. **NOPSEMA** [redacted]
2. **NOPTA** [redacted]
3. **DMIRS** [redacted]

FORM 2

[insert NOPSEMA Incident Report Form when printing]

[redacted]

FORM 3

[insert Marine Pollution Report (POLREP – AMSA) when printing]

[redacted]

FORM 4

[insert AMOSC Service Contract note when printing]

[redacted]

FORM 5

[insert Marine Pollution Report (POLREP – DoT) when printing]

[redacted]

FORM 6a

[insert OSRL Initial Notification Form when printing]

[redacted]

FORM 6b

[insert OSRL Mobilisation Activation Form [redacted] when printing]

[redacted]

FORM 7

[insert RPS Response Oil Spill Trajectory Modelling Request form when printing]

[redacted]

FORM 8

[insert Aerial Surveillance Observer Log when printing]

[redacted]

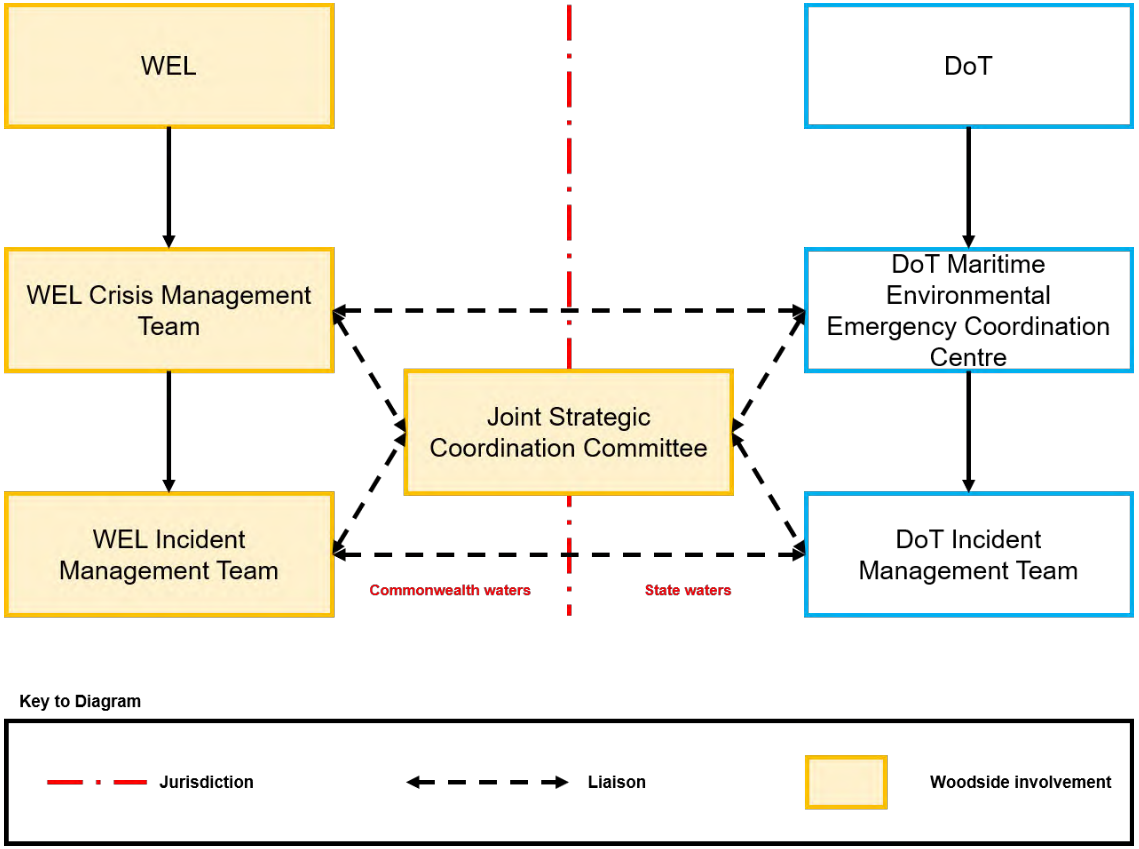
APPENDIX C – 7 QUESTIONS OF SPILL ASSESSMENT

WHAT IS IT? **Oil Type/name** **Oil properties** **Specific gravity / viscosity / pour point / asphaltenes/ wax content / boiling point**	
WHERE IS IT? Lat/Long Distance and bearing	
HOW BIG IS IT? Area Volume	
WHERE IT IS GOING? Weather conditions Currents and tides	
WHAT IS IN THE WAY? Resources at risk	
WHEN WILL IT GET THERE? Weather conditions Currents and tides	
WHAT'S HAPPENING TO IT? Weathering processes	

APPENDIX D – TRACKING BUOY DEPLOYMENT INSTRUCTIONS

(Insert [redacted] when printing)

APPENDIX E – COORDINATION STRUCTURE FOR A CONCURRENT HYDROCARBON SPILL IN BOTH COMMONWEALTH AND STATE WATERS/SHORELINES[4]

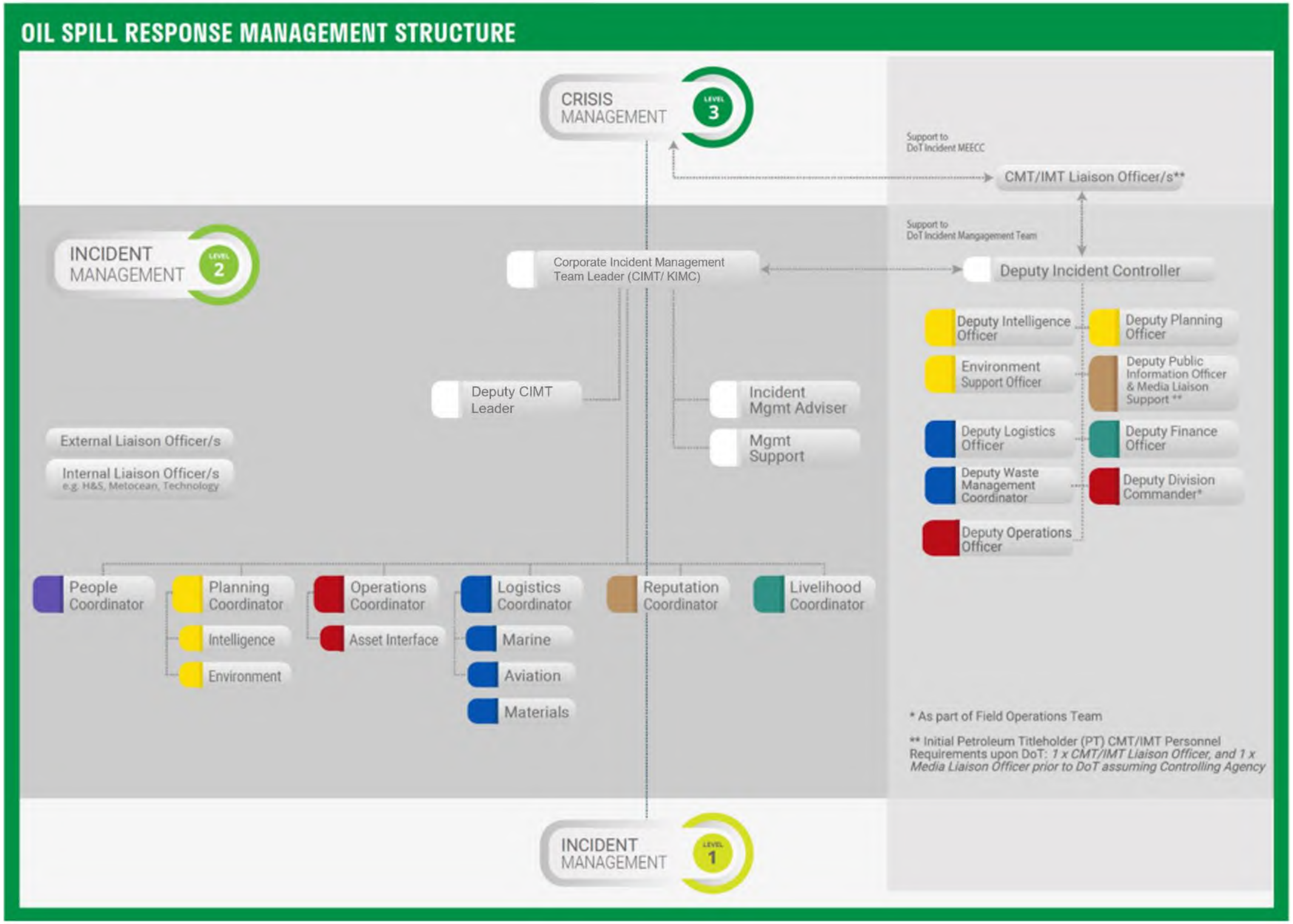


The Control Agency for a hydrocarbon spill in Commonwealth waters resulting from an offshore petroleum activity is Woodside (the Petroleum Titleholder). The Control Agency for a hydrocarbon spill in State waters/shorelines resulting from an offshore petroleum activity is DoT. DoT will appoint an Incident Controller and form a separate IMT to only manage the spill within State waters/shorelines.

[4] Adapted from DoT Offshore Petroleum Industry Guidance Note, Marine Oil Pollution: Response and Consultation Arrangements July 2020. Note: For full structure up to Commonwealth Cabinet/Minister refer to Marine Oil Pollution: Response and Consultation Arrangements Section 6.5, Figure 3.

APPENDIX F – WOODSIDE INCIDENT MANAGEMENT STRUCTURE

Woodside Incident Management Structure for Hydrocarbon Spill (including Woodside Liaison Officers Command Structure within DoT IMT if required).



APPENDIX G – WOODSIDE LIASON OFFICER RESOURCES TO DOT

Once DoT activates a State waters/shorelines IMT, Woodside will make available the following roles to DoT.

Area	WEL Liaison Role	Personnel Sourced from[5]:	Key Duties	#
DoT MEECC	CMT Liaison Officer	CIMT Leader Roster	• Provide a direct liaison between the CMT and the MEECC. • Facilitate effective communications and coordination between the CMT Leader and State Marine Pollution Coordinator (SMPC). • Offer advice to SMPC on matters pertaining to PT crisis management policies and procedures.	1
DoT IMT Incident Control	WEL Deputy Incident Controller	CIMT Leader Roster	• Provide a direct liaison between the PT IMT and DoT IMT. • Facilitate effective communications and coordination between the PT IC and the DoT IC. • Offer advice to the DoT IC on matters pertaining to PT incident response policies and procedures. • Offer advice to the Safety Coordinator on matters pertaining to PT safety policies and procedures, particularly as they relate to PT employees or contractors operating under the control of the DoT IMT.	1
DoT IMT Intelligence	Intelligence Support Officer/ Deputy Intelligence Officer	Intelligence Coordinator Roster	• As part of the Intelligence Team, assist the Intelligence Officer in the performance of their duties in relation to situation and awareness. • Facilitate the provision of relevant modelling and predications from the PT IMT. • Assist in the interpretation of modelling and predictions originating from the PT IMT. • Facilitate the provision of relevant situation and awareness information originating from the DoT IMT to the PT IMT. • Facilitate the provision of relevant mapping from the PT IMT. • Assist in the interpretation of mapping originating from the PT IMT. • Facilitate the provision of relevant mapping originating from the DoT IMT to the PT IMT.	1
DoT IMT Intelligence – Environment	Environment Support Officer	Environment Coordinator Roster	• As part of the Intelligence Team, assist the Environment Coordinator in the performance of their duties in relation to the provision of environmental support into the planning process. • Assist in the interpretation of the PT OPEP and relevant TRP plans. • Facilitate in requesting, obtaining and interpreting environmental monitoring data originating from the PT IMT. • Facilitate the provision of relevant environmental information and advice originating from the DoT IMT to the PT IMT.	1
DoT IMT	Deputy Planning Officer	Planning Coordinator Roster	• As part of the Planning Team, assist the Planning Officer in the performance of their duties in relation to the interpretation of existing response plans and the development of incident action plans and related sub plans. • Facilitate the provision of relevant IAP and sub plans from the PT IMT.	1

[5] *These positions would be mobilised, in consultation with DoT, to align to the actual spill scenario. The selected roles and/or individual personnel would be subject to continued evaluation to ensure continued 'best fit'. For CIMT/ KIMC roster arrangements, contact the WCC. During a prolonged response, additional personnel may be sourced through AMOSC Core Group via* [redacted]

Area	WEL Liaison Role	Personnel Sourced from[5]:	Key Duties	#
Planning-Plans/ Resources			• Assist in the interpretation of the PT OPEP from the PT. • Assist in the interpretation of the PT IAP and sub plans from the PT IMT. • Facilitate the provision of relevant IAP and sub plans originating from the DoT IMT to the PT IMT. • Assist in the interpretation of the PT existing resource plans. • Facilitate the provision of relevant components of the resource sub plan originating from the DoT IMT to the PT IMT. **(Note this individual must have intimate knowledge of the relevant PT OPEP and planning processes)**	
DoT IMT Public Information-Media/ Community Engagement	Public Information Support and Media Liaison Officer/ Deputy Public Information Officer	Reputation Coordinator Roster	• As part of the Public Information Team, provide a direct liaison between the PT Media team and DoT IMT Media team. • Facilitate effective communications and coordination between the PT and DoT media teams. • Assist in the release of joint media statements and conduct of joint media briefings. • Assist in the release of joint information and warnings through the DoT Information and Warnings team. • Offer advice to the DoT Media Coordinator on matters pertaining to PT media policies and procedures. • Facilitate effective communications and coordination between the PT and DoT Community Liaison teams. • Assist in the conduct of joint community briefings and events. • Offer advice to the DoT Community Liaison Coordinator on matters pertaining to the PT community liaison policies and procedures. • Facilitate the effective transfer of relevant information obtained from through the Contact Centre to the PT IMT.	1
DoT IMT Logistics	Deputy Logistic Officer	Logistics Coordinator Roster	• As part of the Logistics Team, assist the Logistics Officer in the performance of their duties in relation to the provision of supplies to sustain the response effort. • Facilitate the acquisition of appropriate supplies through the PTs existing OSRL, AMOSC and private contract arrangements. • Collects Request Forms from DoT to action via PT IMT. **(Note this individual must have intimate knowledge of the relevant PT logistics processes and contracts)**	1
DoT IMT Finance-Accounts/ Financial Monitoring	Deputy Finance Officer	Livelihood Coordinator Roster	• As part of the Finance Team, assist the Finance Officer in the performance of their duties in relation to the setting up and payment of accounts for those services acquired through the PTs existing OSRL, AMOSC and private contract arrangements. • Facilitate the communication of financial monitoring information to the PT to allow them to track the overall cost of the response. • Assist the Finance Officer in the tracking of financial commitments through the response, including the supply contracts commissioned directly by DoT and to be charged back to the PT.	1

Area	WEL Liaison Role	Personnel Sourced from[5]:	Key Duties	#
DoT IMT Operations	Deputy Operations Officer	Operations Coordinator Roster	• As part of the Operations Team, assist the Operations Officer in the performance of their duties in relation to the implementation and management of operational activities undertaken to resolve an incident. • Facilitate effective communications and coordination between the PT Operations Section and the DoT Operations Section. • Offer advice to the DoT Operations Officer on matters pertaining to PT incident response procedures and requirements. • Identify efficiencies and assist to resolve potential conflicts around resource allocation and simultaneous operations of PT and DoT response efforts.	1
DoT IMT Operations – Waste Management	Facilities Support Officer/ Deputy Waste Management Coordinator	Logistics Materials Coordinator Roster	• As part of the Operations Team, assist the Waste Management Coordinator in the performance of their duties in relation to the provision of the management and disposal of waste collected in State waters. • Facilitate the disposal of waste through the PT's existing private contract arrangements related to waste management and in line with legislative and regulatory requirements. • Collects Request Forms from DoT to action via PT IMT.	1
DoT FOB Operations Command	Deputy On-Scene Commander/ Deputy Division Commander	CIMT Leader Roster	• As part of the Field Operations Team, assist the Division Commander in the performance of their duties in relation to the oversight and coordination of field operational activities undertaken in line with the IMT Operations Section's direction. • Provide a direct liaison between the PT FOB and DoT FOB. • Facilitate effective communications and coordination between the PT Division Commander and the DoT Division Commander. • Offer advice to the DoT Division Commander on matters pertaining to PT incident response policies and procedures. • Assist the Safety Coordinator deployed in the FOB in the performance of their duties, particularly as they relate to PT employees or contractors. • Offer advice to the Safety Coordinator deployed in the FOB on matters pertaining to PT safety policies and procedures.	1
			Total Woodside personnel initially required in DoT IMT	11

DoT Liaison Officer Resources to Woodside

Once DoT activates a State waters/shorelines IMT, DoT will make available the following roles to Woodside.

Area	DoT Liaison Role	Personnel Sourced from:	Key Duties	#
WEL CMT	DoT Liaison Officer (prior to DoT assuming Controlling Agency) / Deputy Incident Controller – State waters (after DoT assumes Controlling Agency)	DoT	• Facilitate effective communications between DoT's SMPC/ Incident Controller and the Petroleum Titleholder's appointed CMT Leader / Incident Controller. • Provide enhanced situational awareness to DoT of the incident and the potential impact on State waters. • Assist in the provision of support from DoT to the Petroleum Titleholder. • Facilitate the provision technical advice from DoT to the Petroleum Titleholder Incident Controller as required.	1
WEL Reputation FST (Media Room)/ Public Information – Media	DoT Media Liaison Officer	DoT	• Provide a direct liaison between the PT Media team and DoT IMT Media team. • Facilitate effective communications and coordination between the PT and DoT media teams. • Assist in the release of joint media statements and conduct of joint media briefings. • Assist in the release of joint information and warnings through the DoT Information & Warnings team. • Offer advice to the PT Media Coordinator on matters pertaining to DoT and wider Government media policies and procedures.	1
			Total DoT Personnel Initial Requirement to Woodside	2

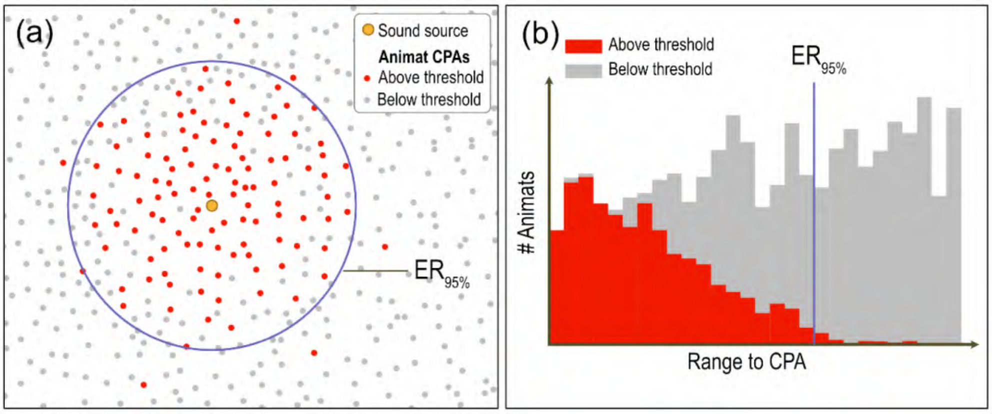
APPENDIX K JASCO MODELLING SUMMARY

SUMMARY OF THE JASCO Animal Simulation Model Including Noise Exposure (JASMINE)

The JASCO Animal Simulation Model Including Noise Exposure (JASMINE) was used to predict the exposure of animats (pygmy blue whales) to sound arising from the vessel operations. JASMINE integrates the predicted sound field with biologically meaningful movement rules for pygmy blue whales that results in an exposure history for each animat in the model. In JASMINE, the sound received by the animats is determined by the proposed vessel operations, and animats are programmed to behave like pygmy blue whales that may be present in an area. The parameters used for forecasting realistic behaviours (e.g., diving and foraging depth, swim speed, surface times) are determined and interpreted from marine mammal studies (e.g., tagging studies) where available, or reasonably extrapolated from related or comparable species. An individual animat's sound exposure levels are summed over a 24-hour duration to determine its total received energy, and then compared to the relevant threshold criteria—which in this case for PTS is 199 dB re 1 μPa^2·s and for TTS is 179 dB re 1 μPa^2·s (both LF-weighted SEL_{24h} for continuous noise sources). These sound exposure criteria are based on the best data available published in peer-reviewed literature, and represents a conservative, internationally accepted and applied impact evaluation threshold.

In the animat modelling study, a seeding density of two animats per km^2 was determined to provide sufficient sampling of the model space and statistically reliable exposure range estimates. The simulation was run for a representative period of 24-hours to coincide with the acoustic modelling effort. The modelling results are not related to real-world density estimates for pygmy blue whales within the migration BIA and the number of animals potentially exposed was not calculated. To evaluate PTS, TTS, and behavioural response, exposure results were obtained using detailed behavioural information for migrating pygmy blue whales. The spatial distribution of animats was restricted to the BIA for all assessed scenarios.

The results from the animat modelling provided a way to estimate radial distances to effect thresholds. The distance to the closest point of approach (CPA) for each of the animats was recorded. The $ER_{95\%}$ (95% Exposure Range) is the horizontal distance that includes 95% of the animat CPAs that exceeded a given effect threshold (see Figure below). Within the $ER_{95\%}$, there is generally some proportion of animats that do not exceed threshold criteria.



This Figure shows an example distribution of animat closest points of approach (CPAs). Panel (a) shows the horizontal distribution of animats near a sound source. Panel (b) shows the distribution of distances to animat CPAs. The 95% exposure range ($ER_{95\%}$) is indicated in both panels.

The results of the animal movement modelling predicted that between 11 and 88% of animats within $ER_{95\%}$ would be exposed above threshold. The maximum $ER_{95\%}$ to SEL_{24h} thresholds was 30 m for TTS (88% probability of exposure) and 10 m for PTS (11% probability of exposure).

The SEL_{24h} criterion is a cumulative metric that reflects the dosimetric impact of sound energy accumulated over a 24-hour period and assumes that an animal is consistently exposed to such noise levels. The radii that correspond to SEL_{24h} therefore represent an unlikely worst-case scenario for SEL-based exposure since, more realistically, marine fauna would not stay in the same location or at the same range for 24-hours. It is highly unlikely that PTS and TTS thresholds for low-frequency (LF) cetaceans would be exceeded given the small onset PTS and TTS range (10 m and 30 m, respectively). Furthermore, it is not credible given the known movement behaviour of cetaceans including key migrating LF whale species such as pygmy blue whales transiting through the Operational Area.

APPENDIX L PROGRAM OF ONGOING ENGAGEMENT WITH TRADITIONAL CUSTODIANS

Proposed Program of Ongoing Engagement with Traditional Custodians

This Program of Ongoing Engagement with Traditional Custodians (“Program”) has been developed to demonstrate Woodside’s commitment to ongoing engagement and support of Traditional Custodians’ capacity to care for and manage Country, including Sea Country, and has been directly informed by Traditional Custodians' feedback regarding their capacity to engage and consult on Environment Plans.

It is a living document designed to evolve with ongoing consultation and feedback from Traditional Custodians and, at a minimum, will be subject to annual review. In addition to this Program, Woodside will continue to participate in, and support collective industry engagement with Traditional Owners on the development of a future, sustainable, industry wide Program. Through the Program, Woodside actively supports Traditional Custodians’ capacity for, and involvement in, ongoing engagement and feedback on environment plans.

The Program has been developed so that Traditional Custodians can, on an ongoing basis, provide Woodside with feedback relating to the possible consequences of an activity to be carried out under an environment plan on their functions, interests and activities as they relate to cultural values. This feedback will be evaluated in conjunction with Traditional Custodians and, where necessary, avoidance or mitigation strategies in will be developed in collaboration with Traditional Custodians. How the Program is implemented with specific Traditional Custodians will depend on their stated needs and priorities

The Program is underpinned by Woodside’s First Nations Communities Policy (woodside.com), the objective of which is to ensure Woodside partners and engages with First Nations communities to create positive economic, social and cultural outcomes that leave a lasting legacy. Woodside does this through building respectful relationships and partnerships with First Nations communities where we are active, in the areas where they are most interested in. We acknowledge the unique connection that First Nations communities have to land, waters and the environment. .

The Program will include, as agreed with relevant communities, reasonable commitment to:

1. **Support for ongoing dialogue and engagement**

Woodside will support the capacity of Traditional Custodians to participate in ongoing dialogue and engagement about the environment plans and to enable the ongoing and future identification of cultural values potentially impacted by Woodside’s activities. Woodside further commits to agreeing consultation protocols with individual Traditional Custodians to ensure the material provided is appropriate in level of detail such that the potential for cultural impact from Woodside activities can be determined and as required measures can be adopted to avoid or minimise impact.

In addition, Woodside will receive feedback on cultural values from an individual person or organisation that identifies as a Traditional Custodian, at any stage during the development and implementation of activities. This feedback will be evaluated, in conjunction with the Traditional Custodian individual or group and if required, control measures will put in place to avoid impacts to cultural values, or where avoidance is not possible, to minimise and mitigate the impacts to an acceptable level.

Where cultural values are identified post activity completion, any controls relevant to value management will be implemented during the next relevant activity.

2. **Support for the identification and recording of cultural features**

Woodside will support Traditional Custodians to record and articulate their Sea Country values and will invest in cultural assessments codesigned with Traditional Custodians, where required, to inform potential risks to cultural values from our petroleum activities.

This may include supporting cultural mapping by Traditional Custodians to identify and map significant cultural features including archaeological sites and other cultural values. The scoping of the mapping process will be codesigned with Traditional Custodians.

Woodside understands that cultural knowledge remains the intellectual property of Traditional Custodians and will agree with Traditional Custodians at the outset how that information from surveys will be used to feedback into and inform the environment plan's design and implementation.

In addition, Woodside applies the Cultural Heritage Management Procedure 2019, updated in 2023, to the Program which*:*

- provides a process for the identification, protection, and management of Cultural Heritage taking into account relevant standards, in particular, the United Nations Declaration on the Rights of Indigenous Peoples, the Charter for the Protection and Management of the Archaeological Heritage, the Convention for the Safeguarding of the Intangible Cultural Heritage, and the Convention on the Protection of the Underwater Cultural Heritage;
- applies to underwater cultural heritage and, consistent with current practice, provides for the commissioning of (where appropriate) both archaeological and ethnographic assessments of cultural values over the submerged landscape; and
- the process includes the following:
    - early engagement with relevant Traditional Custodians
    - identification of potential heritage, this could include desktop and field surveys undertaken with the Traditional Custodians.
- the development of cultural management strategies; and, where it is determined cultural heritage may be impacted, the development of Cultural Heritage Management Plans codesigned with Traditional Custodians and implemented by Woodside's First Nations team which:
    - focus on avoidance or minimisation of impacts; and
    - provide regular reviews and for inclusion of new information and further development of the Cultural Heritage Management Plan.

Woodside is committed to continue to receive feedback on cultural values for the life of an environment plan, the inclusion of new information and the development of avoidance or mitigation strategies in collaboration with Traditional Custodians. This information will be recorded via the Woodside Management of Knowledge Process and any potential impacts to the accepted Environment Plan evaluated via the Woodside Management of Change Process.

3. **Building capacity for the ongoing protection of country**

Woodside will support measures to increase the capability and capacity of the Traditional Custodian groups. This is guided by Woodside's Indigenous Affairs Strategy 2019 ("Strategy"), which is designed to enable the building and maintaining of relationships with Traditional Custodians to leave a lasting legacy, including strengthening of Traditional Custodians' capacity to care for and manage Country, including Sea Country. The Strategy was developed with inputs from Traditional Custodians and contains four pillars that direct Woodside's social investment, policies relating to economic development, procurement and employment, and Woodside's agreement making and implementation of agreements. The pillars are:

1. Culture and Heritage Management: support social outcomes through protection, recognition and respect for culture and heritage;
2. Economic Participation: provide training, jobs, and business opportunities;

3. Capability and capacity: ensure strong corporate governance, leadership development and education initiatives to support self-determination; and
4. Safer and Healthier Communities: partner with Aboriginal people and service providers to maximise safer and healthier community outcomes.

Woodside is committed to an ongoing relationship between Woodside and the Traditional Custodian groups. Through consultation with Traditional Custodians Woodside will continue to:

- establish support for Indigenous ranger programs via social investment;
- establish support for Indigenous oil spill response capability via investigating training models;
- establish support for identification and recording of cultural values and the management of that information by Traditional Custodians;
- establish support for programs identified by the Traditional Custodians as important to them and as agreed by Woodside.

4. Support for capacity and capability in relation to governance

Pillar 3 of the Indigenous Affairs Strategy 2019 focuses on ensuring strong corporate governance, leadership development and education initiatives to support self-determination. To enable this, Woodside will support measures to increase the capability and capacity of the Traditional Custodian groups, including in relation to governance and management systems.

The nature of this support will be informed by the individual needs of Traditional Custodian groups, but may include:

- funding or other support for community meetings, particularly where consultation with representative bodies lies outside of that body's core business and cultural authority or mandate needs to be secured,
- resourcing internal expertise so that information is managed consistently and internally, including ensuring appropriate record keeping of consultation to provide stakeholders with a lasting record of discussions, and
- development or upgrade of IT systems to manage information.

5. Program Reporting and Review of Effectiveness

Woodside will undertake an annual review of the Program to assess its effectiveness and adapt the Program accordingly. The annual review will also include an assessment of appropriateness of the methods used to undertake ongoing consultation with Traditional Custodians.
Progress of the Program will be reported annually in line with annual sustainability reporting via the Woodside website.

A commitment to the Program will be included in all new and revised Environment Plans in the format below:

Environmental Performance Outcome	Environmental Performance standards	Measurement Criteria
EPO 1 Woodside will actively support Traditional Custodians' capacity for ongoing engagement and consultation on environment plans for the purpose of avoiding impacts to cultural heritage values	**Applicable to all EPs:** **EPS 1.1** Implement a program, which is compliant with Corporate Woodside Policies Strategies and procedures, to undertake ongoing consultation with Traditional Custodians whose functions, interests and activities may be affected by the Petroleum Activities Program. The Program will include, where agreed with relevant Traditional Custodians: • Social investment to support Indigenous ranger programs • Support for Indigenous oil spill response capabilities • Support for recording Sea Country values • Support to Traditional Custodian groups to build capabilities and capacity with respect to ability to engage with Woodside and the broader O&G industry on activities • Development of ongoing relationships with Traditional Custodian groups • Any other initiatives proposed for the purpose of protecting country including cultural values • Consideration of new cultural values / new information, through the life of the EP, and the development of avoidance or mitigation strategies in collaboration with Traditional Custodians if impacts to cultural values are identified. Where avoidance is not possible, impact minimisation will be prioritised and demonstrated through a written options analysis / ALARP to ensure an acceptable level of impact. This will be documented through Woodside's Management of Change and Management of Knowledge processes.	**MC1.1** Records demonstrate discussions with relevant Traditional Custodian Groups on proposed partnerships and/or initiatives initiated by Woodside, and responses to feedback provided by Woodside within 4 weeks **MC 1.2** Progress of the Program will be reported in line with annual sustainability reporting via the Woodside website. **MC 1.3** Records demonstrate Change Management and Management of Knowledge processes have been followed where new controls or management measures identified
	EPS 1.2 Undertake an annual review of the program to determine its effectiveness and adapt the program accordingly. The annual review will also include an assessment of appropriateness of the methods used to undertake ongoing consultation with Traditional Custodians.	**MC 1.4** Records demonstrate an annual review of the Program has been undertaken

6. Current Status

Following distribution of this proposed Program, Woodside is now participating in a number of specific ongoing consultation activities with Traditional Custodian Relevant Persons. Specific ongoing activities are tabulated below:

Traditional Custodian Relevant Person	Ongoing Consultation Description	Forward Plan	Estimated Timeframes
Buurabalayji Thalanyji Aboriginal Corporation (BTAC)	Refer to EP Section 7.5 – Thalanyji Sea Country Management. BTAC proposed a Collaboration Agreement in May 2023, Woodside agreed in principle, and exchanged correspondence to understand details of the proposal. The Collaboration Agreement would enable support for BTAC to undertake an ethnographic assessment to articulate values, and ensure appropriate cost recovery	Refer to EP Section 7.5 – Thalanyji Sea Country Management Woodside and BTAC have executed a Costs Acceptance Letter. Woodside has developed a Collaboration Agreement which is currently under internal Woodside review. Once settled internally it will be put to BBTAC for their consideration.	Refer to EP Section 7.5 – Thalanyji Sea Country Management. The draft Collaboration Agreement will be provided to BTAC for consideration in October 2023. Woodside will follow up on a monthly basis for at least six months with BTAC once they are in receipt of the draft proposed Collaboration Agreement from Woodside, or until the Agreement is in place.
Yamatji Marlpa Aboriginal Corporation (YMAC)	In June 2023, YMAC provided Woodside a proposed draft Framework Agreement, and a proposal to fund in-house expertise to support consultation and implement the Collaboration Framework. In July 2023, Woodside agreed in principle to the proposed Collaboration Framework and the funding proposal and requested a meeting to work together on details. Woodside provided the Proposed Program of Ongoing Consultation to complement the proposed Collaboration Framework.	Woodside will continue to communicate with YMAC, seeking to collaborate and reach agreement on the proposed Collaboration Framework and funding agreement. At the point of EP submission, Woodside is seeking a meeting with YMAC at YMAC's earliest convenience.	Woodside will follow up with YMAC on a monthly basis for at least six months, seeking to progress the Collaboration Framework and funding agreement.
Wirrawandi Aboriginal Corporations (WAC)	In August 2023, WAC proposed a Framework Agreement with Woodside to provide a streamlined, formalised approach to consultation between WAC and Woodside. Woodside has confirmed receipt of the proposed framework from WAC.	Woodside is in contact with the WAC CEO and is currently developing a response to the proposed Framework Agreement put forward by WAC. WAC do not object to Woodside progressing environmental plans on the proviso that both parties enter into an Agreement suitable to each party. WAC have suggested a timeframe to settle the Agreement over the next 2-3 months. Woodside will be aiming to reach agreement within a shorter timeframe.	Ongoing Framework Agreement settled in 2023.
Ngarluma Aboriginal Corporation (NAC)	In September 2023, NAC proposed a Joint Working Group to practically manage consultation processes. It was proposed that the group would meet monthly for 2023 and quarterly thereafter, meetings would include NAC CEO and NAC Directors and potentially independent SME/s, the proposal was that Woodside draft a Framework Agreement, and included a request for funding for this approach. Woodside provided in-principle support for the proposal.	Woodside has provided in-principle support for NAC's proposal and is currently developing a draft Framework Agreement which once settled internally will be sent to NAC for their response.	In accordance with NAC's proposed timeframe, Woodside aims to prepare a draft Framework Agreement, settle internally and then meet to discuss in 2023.

Nganhurra Thanardi Garrbu Aboriginal Corporation (NTGAC)	In a meeting during August 2023, NTGAC proposed a Framework Agreement. This included terms for ongoing engagement such as frequency of consultation, participation, and content. NTGAC has also requested Woodside provide funding for an in-house environmental scientist to review material. Woodside agreed in principle to this approach, and has requested a first draft of the Framework Agreement for consideration. Woodside have agreed to pay for YMAC's in-house scientist to attend NTGAC meetings to advise NTGAC.	Woodside and NTGAC/YMAC have agreed in writing to develop a Framework Agreement. Woodside have been responding to queries from NTGAC who have passed information provided by Woodside onto their Environmental Scientist. Woodside are awaiting a proposed draft of a Framework Agreement and general report. YMAC's preference is to prepare the drafts, Woodside have offered to assist with drafting and remain ready to respond on receipt of documents.	Woodside will follow up with NTGAC on a monthly basis for at least six months, seeking to progress the Framework Agreement and General report.
Yinggarda Aboriginal Corporation (YAC)	In August 2023, YAC requested Woodside provide a draft Framework Agreement for their consideration. Woodside has provided a draft Framework Agreement to YAC for review.	Woodside's Proposal suggests meeting with YAC every 3 months to progress matters. The Proposal suggests committing to work continuing between meetings with each party nominating focal points. A Scope of Work and schedule of rates is included to re-imburse the cost of ongoing consultation. Woodside's Proposal includes timeframes for anticipated milestones and has suggested the Proposal be in place for an initial 2-year period. Woodside has provided the draft Framework Agreement to YAC; they have advised that they will seek direction from the YAC Board on the proposal.	Woodside will continue following up with YAC on a monthly basis for at least six months, seeking to progress the Framework Agreement.
Robe River Kuruma Aboriginal Corporation (RRKAC)	RRKAC have noted that they are insufficiently resourced to engage further and respond to Woodside regarding EPs. Woodside assesses that a Framework Agreement could address this.	Woodside has on several occasions written to RRKAC offering to fund consultation meetings. Woodside will offer RRKAC a Framework Agreement which will propose funding, scope of work and timeframes to assist with consultation and ongoing consultation. If RRKAC are open to the proposal, it is intended to put forward a draft Framework Agreement to RRKAC within the next 2 months.	Woodside will follow up with RRKAC monthly for at least six months, seeking to progress a Framework Agreement.
Ngarluma Yindjibarndi Foundation Limited (NYFL)	NYFL and Woodside have an existing Agreement in place which enables quarterly communication about Woodside activities. NYFL has said they are working with other First Nations organisation and representative Bodies developing a Framework Agreement.	Woodside has not yet seen a draft of the Framework Agreement. Woodside's expectation is that it will outline principles of engagement, details of resourcing, timeframes to meet agreed outcomes etc. Woodside look forward to receiving a draft Agreement and will engage with NYFL to settle on the details of any proposal.	Woodside will continue to follow up monthly with NYFL for at least six months, seeking to progress a Framework Agreement.
Karajarri Traditional Lands Association (KTLA)	KTLA indicated a desire for ongoing engagement and an interest in ranger training for emergency spills, noting they required funding for engagement.	Woodside has indicated in writing and in person their support to fund the reasonable costs of meetings to engage with KTLA. Woodside proposed the suggestion of ranger training to enable them to respond to emergency response to spills. Woodside will develop and forward a draft Framework Agreement for KTLA's consideration within the next 2 months. The Framework Agreement is an effective mechanism for funding to enable ongoing consultation, to set out a scope of work and outline	Woodside will continue to follow up monthly with KTLA for at least six months, seeking to progress a Framework Agreement.

		social investment opportunities such as ranger training.	
Kariyarra Aboriginal Corporation (KAC)	In September 2023 KAC proposed an agreement which would include meeting arrangements, ongoing consultations, specialist advice and contact protocols.	Woodside support funding request that are reasonable and will seek to reach agreement on a funding proposal put forward by KAC. Woodside agrees that a Framework Agreement is a sound tool to set out ongoing consultation with KAC, funding arrangements and social investment opportunities that KAC would want explored. Woodside will propose a first draft of an agreement and put to KAC in the first instance. Woodside will prepare a draft agreement within the next two months to for KAC's consideration.	Woodside will continue to follow up monthly with KAC for at least six months, seeking to progress a Framework Agreement.