Tables

Table 1 Anticipated Effects of Dredging

Title and character of activity	Anticipated effect
Active Dredge Zone (ADZ) – in the process of being dredged at the time or immediately preceding the survey period. This is a subset of the Primary Impact Zone (PIZ) as it will not be static over time, but will always remain within the PIZ.	Complete or almost complete loss of fauna, both epifauna and infauna in the immediate vicinity of the dredging activity. Defined as highly significant detectable differences from baseline and reference areas.
Primary Impact Zone (PIZ) – comprising the area that may be actively dredged during the lifetime of the licence and hence subject to relatively severe direct impacts at times.	Partial lost of both epifauna and infauna due to direct and indirect effects. Partial recovery may occur in this area due to the cessation of dredging in part so of the zone, however, continued effects may be felt from indirect sediment deposition and seabed sediment mobilisation. Defined as significant detectable differences from baseline and reference areas.
Secondary Impact Zone (SIZ) – This area falls outside of the area that will be actively dredged, although it may be subject to peripheral and indirect impacts.	Partial loss of fauna, primarily the epifauna, due to deposition and or mobilisation of the seabed sediments. Impacts will be on a gradient from the immediate boundary of the PIZ to the outer edge of the SIZ at which point no impacts are anticipated. Defined as marginal detectable differences from baseline and reference areas.
No impact and reference areas.	No anticipated loss of fauna due to any activity related to dredging. No detectable difference from baseline.

Table 2 Matrix of Potential Thresholds related to Ecological Monitoring

	Thresholds will be available for discussion in the:	
Relating to:	**Short-term (3 years)**	**Long-term (6 years)**
Regional Monitoring	Benthic species numbers. Benthic community Evenness values. Benthic community Shannon Weiner Diversity index. Corresponding impact zones and benthic (Hamon grab samples) clusters derived from PRIMER.	Corresponding impact zones and benthic (Epibenthic 2m beam trawl samples) clusters derived from PRIMER. Clustering of benthic sites (Hamon Grab and Epibenthic Trawl) related to dredging factors. Biotope or habitat area or boundary. Changes to the principal species of biotopes. Biomass of Herring larvae.
Licence Specific	Benthic species numbers.. Benthic community Evenness values. Benthic community Shannon Weiner Diversity index. Corresponding impact zones and benthic (Hamon grab samples) clusters derived from PRIMER.	Clustering of benthic sites (Hamon Grab) related to dredging factors. Biotope or habitat area or boundary. Changes to the principal species of biotopes. Scallop populations change.

Table 3 Hypothesis summary table

Item		Hypothesis	Comments
Biological Monitoring Impact Hypothesis 1		Biological changes, occurring as a consequence of physical changes to the sediment, attributable to the extraction of marine aggregate in the ECR, will be limited to the vicinity of dredging activity.	
Biological Monitoring Impact Hypothesis 2		The benthic fauna within areas of intensive dredging activity in the ECR will be adversely affected but will recolonise relatively rapidly (i.e. within months) after cessation of dredging activity and will be structurally comparable to adjacent assemblages within 5 years.	
Physical Monitoring Impact Hypothesis 1	Ho	The composition, deposition, distribution and transport of fine sediment liberated by the dredging process differs from that predicted in the REA model and will result in seabed sediment bedforms that differ from the REA model.	
	Ha	The composition, deposition, distribution and transport of fine sediment liberated by the dredging process is as predicted in the REA model.	
Physical Monitoring Impact Hypothesis 2	Ho	There is no significant difference between the composition of the screened sediment compared to overspilled sediment.	
	Ha	Sediment returned to the seabed from the screening process is composed of particles with a significantly different particle size distribution (less silt and clay particles) than the sediment returned to the seabed via the dredger spillways, as predicted in the REA.	
Physical Monitoring Impact Hypothesis 3	Ho	There is no significant difference between the volume of the screened sediment compared to overspilled sediment.	
	Ha	Higher volumes of sediment are returned to the seabed from the screening process than are returned to the seabed via the dredger spillways, as predicted in the REA.	
Physical Monitoring Impact Hypothesis 4	Ho	The nature (depth averaged concentrations of suspended sediment) and spatial extent of the plume generated by dredging is different from that predicted in the REA model and subsequent studies.	
	Ha	The nature and extent of the plume generated by dredging is as predicted in the REA model.	
Physical Monitoring Impact Hypothesis 5	Ho	Deposition and resupsension of plume sediments is different from that predicted in the REA model.	
	Ha	Deposition and resuspension of plume sediments is as predicted in the REA model.	
Physical Monitoring Impact Hypothesis 6	Ho	Measured tracer particle transport at the seabed does not occur in a direction as predicted in the REA seabed sediment model.	Tracer study may subsequently not employ specific hyptheses
	Ha	Measured tracer particle transport at the seabed occurs in a direction as predicted in the REA seabed sediment model.	
Physical Monitoring Impact Hypothesis 7	Ho	Tracer particle transport at the seabed will result in a distribution and range of seabed sediment bedforms different to those predicted in the REA seabed sediment model.	Tracer study may subsequently not employ specific hyptheses
	Ha	Tracer particle transport at the seabed will result in a distribution and range of seabed sediment bedforms as predicted in the REA seabed sediment model.	
Physical Monitoring Impact Hypothesis 8	Ho	The rate of transport of tracer particles of a range of grain sizes is different to that predicted in the REA seabed sediment model.	Tracer study may subsequently not employ specific hyptheses
	Ha	The rate of transport of tracer particles of a range of grain sizes is as predicted in the REA seabed sediment model.	

Table 4 (Part 1) Numbers of sampling sites related to impact zones (yellow indicates combination of sites for analysis purposes)

ADZ = Active Dredge zone PIZ = Primary Impact Zone SIZ = Secondary Impact Zone

Areas	PIZ sites	No. replicate grabs within PIZ	Single PIZ grabs inc. ADZ sites	No of PIZ 2m Beam	No PIZ 4m beam	No PIZ Scallop	No PIZ Video sites
464-2	10	5	9	1	1	1	14
458	12	5	11	1	1	1	16
473- E	12	5	11	1	1	1	16
473-w	10	5	9	1	1	1	14
474 north	9	5	8	1	1	1	13
474 east	9	5	8	1	1	1	13
474 west	11	5	10	1	1	1	15
478	16	5	15	1	1	1	20
475	16	5	15	1	1	1	20
461	16	5	15	1	1	1	20
477 north	7	5	6	1	1	1	11
477 south	11	5	10	1	1	1	15
Total	**139**	**60**	**127**	**12**	**12**	**12**	**187**
Areas	**SIZ sites**	**No Reps within SIZ**	**Single SIZ grabs**	**SIZ 2m Beam**	**SIZ 4m beam**	**SIZ Scallop**	**SIZ Video sites**
464-2	7	5	6	1	1	1	12
458	7	5	6	1	3	3	12
473- E	6	5	5	1	2	2	11
473-w	6	5	5	1	2	2	11
474 north	7	5	6	1	2	2	14
474 east	6	5	5	1	3	3	12
474 west	5	5	4	1	2	2	10
478	15	5	14	2	3	3	20
475	13	5	12	2	3	3	21
461	14	5	13	1	2	2	68
477 north	6	5	5	1	2	2	10
477 south	7	5	6	1	2	2	11
Total	**99**	**60**	**87**	**14**	**27**	**27**	**212**

Reference sites	Sites	Rep grabs	single grabs	2m beam	4m beam	Scallop	Video sites
	90	**30**	**84**	**18**	**6**	**6**	**164**

Table 4 (Part 2) Total number of sampling sites (yellow indicates combination of sites for analysis purposes)

	Totals				
Areas	Grabs	2m beam	4m beam	Scallop	Video
	per area	per area	per area	per area	per area
464-2	25	2	2	2	26
458	27	2	4	4	28
473- E	26	2	3	3	27
473-w	24	2	3	3	25
474 north	24	2	3	3	27
474 east	23	2	4	4	25
474 west	24	2	3	3	25
478	39	3	4	4	40
475	37	3	4	4	41
461	38	2	3	3	88
477 north	21	2	3	3	21
477 south	26	2	3	3	26
Total	334	26	39	39	399

Total including Reference areas				
Grabs	2m beam	4m beam	Scallop	Video
448	44	45	45	578

Additional context sites

Grabs	2m beam
15	3

Additional Tracer sites

Grabs
74

Table 5 Project and Reporting Gantt (Baseline – 2010/11) for discussion

See enclosure

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Table 6 Provisional Annual Survey Programme with Field Windows – Examples based on first two years

Activities	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2006 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	2007 Jan	Feb
Dredging starts																							
Benthic grabs																							
Field survey																							
Sample analysis																							
Data analysis																							
Reporting																							
2m Epibenthic trawl																							
Field survey																							
Sample analysis																							
Data analysis																							
Reporting																							
4m Epibenthic trawl																							
Field survey																							
Sample analysis																							
Data analysis																							
Reporting																							
Scallop Dredge																							
Field survey																							
Sample analysis																							
Data analysis																							
Reporting																							
Video																							
Wide array with grabs																							
Detailed study area																							
Data analysis																							
Reporting																							

Table 7

Activity	Year 0 Baseline Active dredging starts in mid-year	Year 1 Active dredging continues	Year 2 dredging continuing	Year 3 dredging continuing	Year 4 dredging continuing	Year 5
Benthic grab surveys	All proposed sites sampled	All proposed sites sampled	Reduced array based on similar site redundancy	Reduced array based on similar site redundancy	All proposed sites sampled	Subject to 5th year review
Video Survey	All proposed sites sampled including intense survey in detailed survey areas supported by side-scan.	All proposed sites sampled including detailed survey sites supported by side-scan	Reduced survey for benthic sites plus intense survey in detailed survey sites supported by side-scan	Reduced survey for benthic sites plus intense survey in detailed survey sites supported by side-scan	All proposed sites sampled including detailed survey sites supported by side-scan	Subject to 5th year review
Epibenthic scientific 2m beam trawl	All sites identified	All sites surveyed in baseline	All sites surveyed in baseline	All sites surveyed in baseline	All sites surveyed in baseline	Subject to 5th year review
Epibenthic 4m Beam trawl	All sites identified	All sites surveyed in baseline	All sites surveyed in baseline	All sites surveyed in baseline	All sites surveyed in baseline	Subject to 5th year review
Scallop trawls	All sites identified	All sites surveyed in baseline	All sites surveyed in baseline	All sites surveyed in baseline	All sites surveyed in baseline	Subject to 5th year review

Provisos

- If a site is not actively dredged for any period after the baseline survey it is proposed that a reduced array is surveyed in the intervening years, with a full array only conducted on initiation of dredging.
- Reference sites and regional context sites should be fully sampled every year.

Table 8

Activity	Year 0 Baseline Active dredging starts in mid-year	Year 1 Active dredging continuing	Year 2 Active dredging continuing	Year 3 Active dredging continuing	Year 4 Active dredging continuing	Year 5
Screening and overspill discharge study	Measurement of screened and unscreened spillway and screening discharges	No further activity planned in first instance	No further activity planned in first instance	No further activity planned in first instance	No further activity planned in first instance	Subject to 5th year review
Seabed Sediments study	Baseline grab, sidescan, swath and seabed profile camera/video surveys	6 monthly repeat of baseline survey with intitial minipod deployment	6 monthly repeat of baseline survey	Annual repeat of baseline survey	Annual repeat of baseline survey	Subject to 5th year review
Plume study	Initial plume characterisation study and ADCP surveys	No further activity planned in first instance	No further activity planned in first instance	No further activity planned in first instance	No further activity planned in first instance	Subject to 5th year review
Tracer study	Initial tracer injection and sampling	Second tracer injection and sampling	No further activity planned in first instance	No further activity planned in first instance	No further activity planned in first instance	Subject to 5th year review

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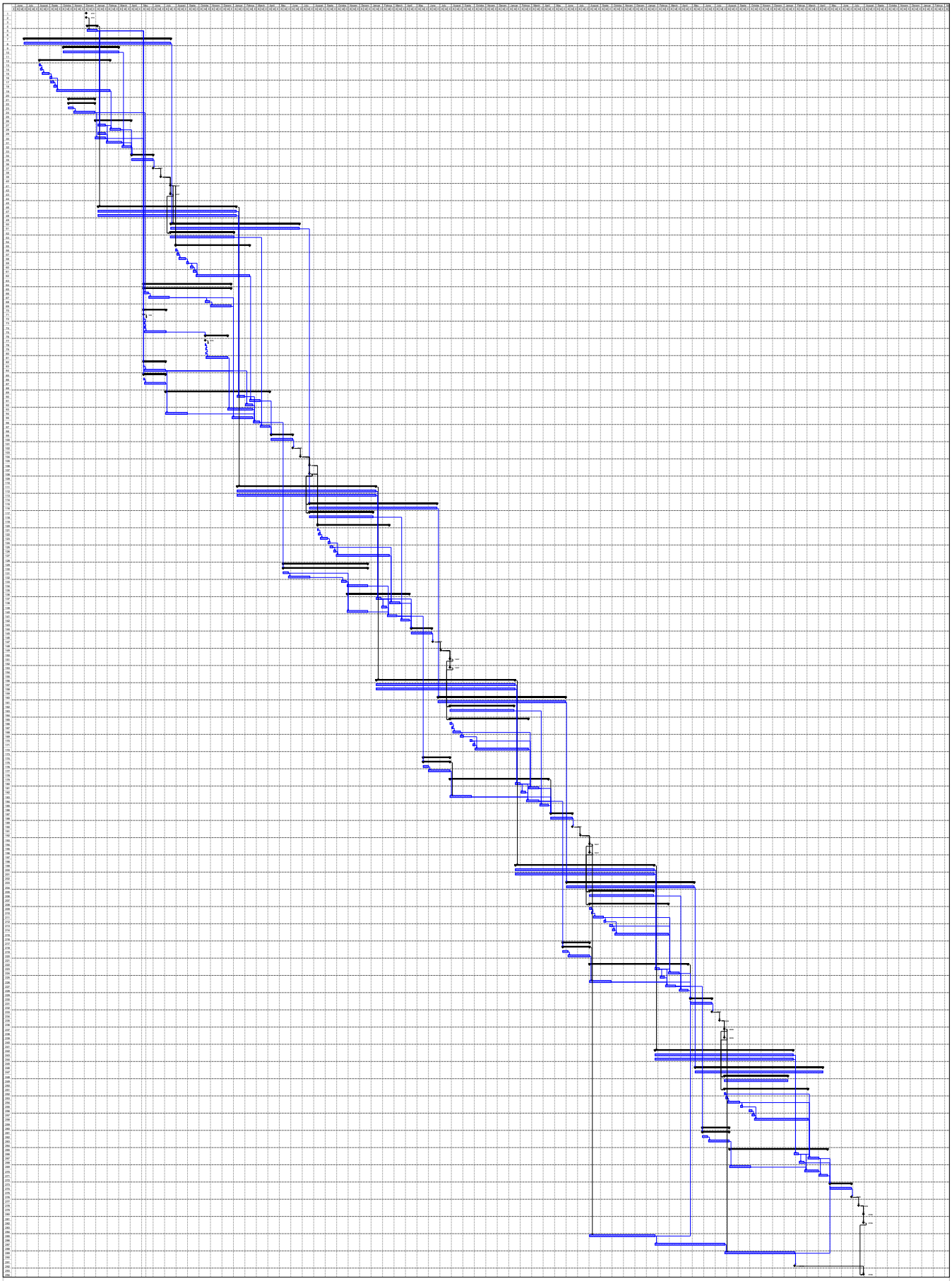

Project: Baseline - Year 1
Date: Fri 12/5/06

Task
Split
Progress

Milestone
Summary
Project Summary

External Tasks
External Milestone
Deadline

	Task Name
1	Consents (assumption)
2	Issue of Area 473 GV
3	
4	Dredging Activity (potential)
5	Area 473 East 2005
6	
7	Blueprint Development
8	2005-2006
9	Biodiversity Action Plan Development
10	HAP and SAP Development
11	
12	Ecologcial Monitoring Studies (2005)
13	Sidescan
14	Video
15	Benthic Grab and Seabed Photography
16	2m Beam Trawl
17	4m Beam Trawl
18	Scallop Dredge
19	Analysis
20	
21	Physical Mointoring Studies (2005)
22	Seabed Sediment Study
23	Baseline Sampling
24	Analysis
25	
26	ECA Reporting (2005-2006)
27	Dredging Activity Report
28	Ecological Monitoring
29	Screening Report
30	Seabed Sediments Part 1
31	Seabed Sediments Part 2
32	ECA Bidiversity Action Plan Report
33	
34	Review Process (2006)
35	TWG Review Period
36	
37	TWG Meeting (2006)
38	
39	ECEN Annual Meeting (2006)
40	
41	Annual Interpretation and Summary Report (2006)
42	
43	Annual BAP Report (2006)
44	
45	
46	Dredging Activity (2006)
47	Any Dredging Permission Area
48	Area 473 East 2006
49	
50	Blueprint Development
51	2006-2007
52	Biodiversity Action Plan Development
53	HAP/SAP Development and Regional Mapping
54	

55	Ecologcial Monitoring Studies (2006)
56	Sidescan
57	Video
58	Benthic Grab and Seabed Photography
59	2m Beam Trawl
60	4m Beam Trawl
61	Scallop Dredge
62	Analysis
63	
64	Physical Monitoring Studies (2006)
65	Seabed Sediment Study
66	1st Repeat Sampling
67	Analysis
68	2nd Repeat Sampling
69	Analysis
70	Tracer Study 1st Injection
71	1st Injection and Sampling (estimate)
72	2nd Sampling
73	3rd Sampling
74	4th Sampling
75	Analysis
76	Tracer Study 2nd Injection
77	2nd Injection and Sampling (estimate)
78	2nd Sampling
79	3rd Sampling
80	4th Sampling
81	Analysis
82	Screening and Overspill Discharge Study
83	Field Work
84	Analysis
85	Plume Study
86	Field Work
87	Analysis
88	
89	ECA Reporting (2006-2007)
90	Dredging Activity Report
91	Ecological Monitoring
92	Screening Report
93	Tracer Report
94	Plume Study Report
95	Seabed Sediments Part 1
96	Seabed Sediments Part 2
97	ECA Biodiversity Action Plan Report
98	
99	Review Process (2007)
100	TWG Review Period
101	
102	TWG Meeting (2007)
103	
104	ECEN Annual Meeting (2007)
105	
106	Annual Interpretation and Summary Report (2007)
107	
108	Annual BAP Report (2007)
109	
110	

111	Dredging Activity (2007)
112	Any Dredging Permission Area 2007
113	Area 473 East 2007
114	
115	Blueprint Development
116	2007-2008
117	Biodiversity Action Plan Development
118	HAP/SAP Development and Regional Mapping
119	
120	Ecologcial Monitoring Studies (2007)
121	Sidescan
122	Video
123	Benthic Grab and Seabed Photography
124	2m Beam Trawl
125	4m Beam Trawl
126	Scallop Dredge
127	Analysis
128	
129	Physical Monitoring Studies (2007)
130	Seabed Sediment Study
131	3rd Repeat Sampling
132	Analysis
133	4th Repeat Sampling
134	Analysis
135	
136	ECA Reporting (2007-2008)
137	Dredging Activity Report
138	Ecological Monitoring
139	Screening Report
140	Seabed Sediments Part 1
141	Seabed Sediments Part 2
142	ECA Biodiversity Action Plan Report
143	
144	Review Process (2008)
145	TWG Review Period
146	
147	TWG Meeting (2008)
148	
149	ECEN Annual Meeting (2008)
150	
151	Annual Interpretation and Summary Report (2008)
152	
153	Annual BAP Report (2008)
154	
155	
156	Dredging Activity (2008)
157	Any Dredging Permission Area 2008
158	Area 473 East 2008
159	
160	Blueprint Development
161	2008-2009
162	Biodiversity Action Plan Development
163	HAP/SAP Development and Regional Mapping
164	
165	Ecologcial Monitoring Studies (2008)
166	Sidescan

167	Video
168	Benthic Grab and Seabed Photography
169	2m Beam Trawl
170	4m Beam Trawl
171	Scallop Dredge
172	Analysis
173	
174	Physical Monitoring Studies (2008)
175	Seabed Sediment Study
176	5th Repeat Sampling
177	Analysis
178	
179	ECA Reporting (2008-2009)
180	Dredging Activity Report
181	Ecological Monitoring
182	Screening Report
183	Seabed Sediments Part 1
184	Seabed Sediments Part 2
185	ECA Biodiversity Action Plan Report
186	
187	Review Process (2009)
188	TWG Review Period
189	
190	TWG Meeting (2009)
191	
192	ECEN Annual Meeting (2009)
193	
194	Annual Interpretation and Summary Report (2009)
195	
196	Annual BAP Report (2009)
197	
198	
199	Dredging Activity (2009)
200	Any Dredging Permission Area 2009
201	Area 473 East 2009
202	
203	Blueprint Development
204	2009-2010
205	Biodiversity Action Plan Development
206	HAP/SAP Development and Regional Mapping
207	
208	Ecologcial Monitoring Studies (2009)
209	Sidescan
210	Video
211	Benthic Grab and Seabed Photography
212	2m Beam Trawl
213	4m Beam Trawl
214	Scallop Dredge
215	Analysis
216	
217	Physical Monitoring Studies (2009)
218	Seabed Sediment Study
219	6th Repeat Sampling
220	Analysis
221	
222	ECA Reporting (2009-2010)

223	Dredging Activity Report
224	Ecological Monitoring
225	Screening Report
226	Seabed Sediments Part 1
227	Seabed Sediments Part 2
228	ECA Biodiversity Action Plan Report
229	
230	Review Process (2010)
231	TWG Review Period
232	
233	TWG Meeting (2010)
234	
235	ECEN Annual Meeting (2010)
236	
237	Annual Interpretation and Summary Report (2010)
238	
239	Annual BAP Report (2010)
240	
241	
242	Dredging Activity (2010)
243	Any Dredging Permission Area 2010
244	Area 473 East 2010
245	
246	Blueprint Development
247	2010-2011
248	Biodiversity Action Plan Development
249	HAP/SAP Development and Regional Mapping
250	
251	Ecologcial Monitoring Studies (2010)
252	Sidescan
253	Video
254	Benthic Grab and Seabed Photography
255	2m Beam Trawl
256	4m Beam Trawl
257	Scallop Dredge
258	Analysis
259	
260	Physical Monitoring Studies (2010)
261	Seabed Sediment Study
262	7th Repeat Sampling
263	Analysis
264	
265	ECA Reporting (2010-2011)
266	Dredging Activity Report
267	Ecological Monitoring
268	Screening Report
269	Seabed Sediments Part 1
270	Seabed Sediments Part 2
271	ECA Biodiversity Action Plan Report
272	
273	Review Process (2011)
274	TWG Review Period
275	
276	TWG Meeting (2011)
277	
278	ECEN Annual Meeting (2011)

279	
280	Annual Interpretation and Summary Report (2011)
281	
282	Annual BAP Report (2011)
283	
284	
285	REA II Process (Year 4 - 2009)
286	
287	REA II Process (Year 5 - 2010 Jan to Jun)
288	
289	REA II Process (Year 5 - 2010 Jan to Jun)
290	
291	
292	Recommendations for Dredging Activity (Years 6-15)
293	
294	Revised Monitoring and Management Proposals