6 FURTHER CHARACTERISATION METHODOLOGY & OUTCOMES

6.1 Introduction

Following the further characterisation of pressures on the morphology of TraC water bodies (as described in Chapter 3), further characterisation of the risk to TraC waters resulting from these pressure types was then required.

With the approval from the Marine Morphology Steering Group, TraC-MImAS was selected as an appropriate tool to further characterise the risk of TraC water bodies failing to meet the WFD objectives by 2015. TraC-MImAS version M2f (final) was used for the assessment of Irish TraC water bodies.

Prior to the final application of this version of TraC-MImAS, earlier versions were trialled to facilitate the development of the tool. TraC-MImAS version M2d was trialled in five Irish water bodies:

- Cork Harbour
- Castlemaine Harbour
- Cromane
- Inner Bantry Bay
- Outer Dingle Bay

The results of these trials, outlined in Appendix 6-1, were submitted to SEPA in September 2007 for inclusion with those of Scotland and Northern Ireland to assist with further development/refinement of the tool.

Also, at the request of the Heavily Modified and Artificial Water Body PoMS team, TraC-MImAS versions M2(d) and (f) were applied to two provisionally HMWBs; the Cashen and Upper Feale Estuaries. The results of both assessments are outlined in Appendix 6-2.

TraC-MImAS expresses the risk of a water body failing WFD objectives by indicating the potential ecological status class that may be achieved based on the water body type and pressure extents identified. As noted in Section 5.2 of this report, TraC-MImAS is based on the assumption that an assessment of impacts on ecologically relevant features and processes can be used to protect morphology and ecology. A result of 'Good' for example, indicates that this water body is potentially at risk of failing to achieve high morphological status and in turn high ecological status. It is important to note that the results outlined within this chapter are wholly based on the detailed risk assessment undertaken for the purpose of further characterising TraC waters, and any reference to status class boundaries are wholly based on this risk assessment and have not been verified by field assessments or reference to biological classification. At the time of writing biological classification results were incomplete.

The formal classification of morphological status for TraC water bodies in Ireland is outside the scope of the Marine Morphology Study. However, in the absence of monitoring results and a formal classification system it is likely that the classification of TraC water bodies for the first RBMP will incorporate the outputs of this study, particularly the application of TraC-MImAS. This study has received a formal request from the EPA to apply TraC-MImAS to 23 water bodies that may be potentially classed as HES following the application of draft classification tools; a proportion of which were already identified for assessment as part of this study. The results of TraC-MImAS assessment of the remaining water bodies are detailed in Appendix 6-3.

Member States are only required to report on morphology for those water bodies designated as 'High' status. For these water bodies it is assumed the EC will require information on the normative definitions, for example the structure of the water body's intertidal zone indicates little or no human impacts. TraC-MImAS can only indicate the likely risk to these quality elements; monitoring results are required to quantify these risks.

The Marine Morphology Study relates to the ***morphology*** of TraC water bodies and does not give significant focus to ***hydrology***. Hydrology was assessed separately by the initial risk assessments and is given limited consideration within TraC-MImAS. It is considered that the EPA will lead the development of a hydrology classification tool within their Marine Group and that this tool will use the Q95 data which will potentially act as a 'bolt-on' to TraC-MImAS to help support classification of transitional water bodies. Q95 is the average river flow for any 1 day expected to be greater for 95 days in any 100 days, i.e. the flow that would be exceed 95% of the time, and generally expressed as m^3 per second. It is a flow which generally only occurs in summer when rainfall is reduced.

The UK-Ireland Marine Task Team recently (Nov 2007) endorsed TraC-MImAS as a regulatory ***support*** tool and also agreed that, in the absence of other assessment tools, TraC-MImAS is suitable as a ***support*** tool for classification. In line with this endorsement, the further development of the typology module of TraC-MImAS was a key recommendation of this group. As noted in Section 5.2.2 of this report, the impact assessment within TraC-MImAS is largely based on the water body type, therefore refinement of the typology module would prove very beneficial to the future use of this tool for both regulation and classification.

As described in Chapter 1 of this report, the initial risk assessments assigned risk categories (risk of not achieving Good Status) to each TraC water body based on the proportion of the water body altered by human activities. However, as the initial risk assessments were based on screening or semi-quantitative assessments, results adopted the four-category risk scheme:

1a – at risk

1b – probably at risk

2a – probably not at risk

2b – not at risk

Where information was either lacking or of low confidence, the water body was assigned to either a 'probably at risk' or 'probably not a risk' category.

6.2 Methodology – Further Characterisation

There are 309 TraC waters in Ireland, and at the time of writing 13 were provisionally designated as Heavily Modified Water Bodies (pHMWB). TraC-MImAS was not applied to pHMWBs as designation indicates the failure of these water bodies to achieve GES due to the water body's 'specified use'. On formal designation of HMWBs, specific PoMs will be developed for each with the aim of achieving GEP.

6.2.1 Assumptions

Classification systems for morphology are incomplete and therefore formal results are unavailable at present. Consequently the impact of morphology on ecology has yet to be formally defined for Irish TraC waters. In the absence of these systems the following has been assumed to allow the PoMs to be informed by the Marine Morphology Study:

i. The Initial Risk Assessment risk category '1a' (at risk) indicates that the morphological status of a water body is less than Good.
ii. The Initial Risk Assessment risk category '2b' (not at risk) indicates that the morphological status of a water body is Good or High.
iii. PoMs for water bodies characterised as 'at risk' from 'other factors' such as pollution or marine direct impacts (nutrients and hazardous substances) in addition to morphology factors, will be focused on the 'other factors' for the first RBMP in order to achieve GES; morphology will then only be required for the achievement of HES. Therefore, TraC-MImAS was not applied to water bodies characterised in the initial risk assessments as 'at risk' (1a) from other factors. The hierarchy relating to the achievement of GES and HES is illustrated in Figure 1.1 earlier in this report.

6.2.2 Water Body Typology

As noted in section 5.2.2 previously, further characterisation of TraC water body types, defined by System B for the WFD, to be bodies of "similar physical character that respond to pressures in predictable ways" is required to facilitate their assessment with TraC-MImAS. It is intended that these TraC-MImAS water body types reflect the presence and character of the attributes identified in the Attribute Module of TraC-MImAS.

Table 6.1 below shows how the MImAS water body types can be assigned to the WFD water body codes (those prominent in Ireland are shown in bold text). The conversion of water body types between the two systems is unique except for water bodies CW1 to CW9 where there is a choice of two possibilities.

Table 6.1: WFD and TraC-MImAS water body types

WFD Type	TraC-MImAS Water Body Types	
TW1 **TW2** TW3 TW4	Transtional Meso to Macrotidal	
CW1 **CW2** CW3 CW4 **CW5** **CW6**	Moderately to Exposed Coastal - Sedimentary	Coastal Bedrock
CW7 **CW8** CW9	Sheltered Coastal – Sedimentary	Coastal Bedrock
TW6 **CW10**	TraC Lagoons	
TW5 CW11 CW12	TraC Sea Lochs	

The following resources were used to define TraC-MImAS water body types for all 309 water bodies:

- WFD and TraC-MImAS water body conversion table (Table 6.1)
- WFD water body typology elements
- Orthophotos
- Oblique images
- Professional judgement (Marine Morphology Steering Group)

Advice from the Steering Group was sought for the water bodies trialled using the earlier TraC-MImAS (vers M2d) and various coastal water bodies for which two different TraC-MImAS water body types could be identified. On assigning TraC-MImAS water body types a conservative approach was taken. For example, if a water body, such as the North Atlantic Seaboard, or Clonakilty Bay could be classed as 'Coastal Bedrock' in some areas and 'Moderately exposed to exposed coast, sedimentary' in a large proportion of other areas, the more sensitive code, i.e. the latter, was assigned.

6.2.3 TraC-MImAS Application (Steps 1 – 3)

Using the method outlined below, 122 TraC water bodies were identified for assessment (and further characterisation) using TraC-MImAS. Tables 6.2 and 6.3 below tabulate these water bodies as identified by each of the three steps below, and summarise the risk categories assigned to each by the initial risk assessments.

Step 1

Aim: To further characterise those water bodies identified as 'probably at risk' and 'probably not at risk' from morphology by providing an indication of risk to status class.

MImAS was applied to all water bodies identified as 'probably at risk' (1b) and 'probably not at risk' (2a) from morphology, with the exception of those that have been characterised as 'at risk' (1a) from other factors such as pollution or marine direct impacts. This exclusion of 'at risk' (1a) water bodies is based on the assumption made in section 6.2.1(iii).

On completion of Step 1; 77 water bodies (53 transitional, and 24 coastal) were identified for assessment.

Step 2

Aim: Further characterise those water bodies that could potentially achieve GES or HES if morphology was restored or mitigated.

MImAS was applied to those remaining 'at risk' water bodies where morphology is the only factor contributing to an 'at risk' (1a) characterisation.

On completion of Step 2, 27 water bodies (22 transitional, and 5 coastal) were identified for assessment.

Step 3

Aim: To identify those water bodies unlikely to be at risk of failing HES based on the assumption that the morphological attributes assessed support ecological function.

On prioritising water bodies for assessment using TraC-MImAS, it was assumed that those water bodies initially characterised as ‘not at risk’ (2b) were likely to be subject to little or no morphological pressures, and therefore excluded from assessment. However, before it can be assumed these water bodies are unlikely to be at risk of failing to achieve HES, further characterisation was required to confirm if this assumption was correct.

The estimated pressure footprints for all 309 TraC water bodies were reviewed within ArcGIS to determine the presence and extents of any pressures identified for those water bodies initially characterised as ‘not at risk’ (2b). Water bodies for which no pressures footprints were identified should retain the characterisation of ‘not at risk’, and may be assumed as likely to achieve high morphological status, and therefore have the potential to achieve HES. A similar approach has been applied by SEPA on classifying Scottish TraC waters; assigning any water bodies with no or minimal pressure footprints to High Status.

Whilst undertaking this assessment it was identified that 84 water bodies initially characterised as ‘not at risk’ (2b) contained pressure footprints. From these 84 (2b) water bodies, 54 were identified as potentially subject to extensive pressures, i.e. the footprint of a particular pressure extended over 5% of the water body’s area or shoreline length. The further assessment of potential risk of these water bodies failing to meet WFD objectives was then required.

Of these 54 water bodies, the pressure ‘Other Disturbances to Seabed’ was identified as the primary footprint extending over 5% of the water body area in 39 water bodies. As this pressure type is largely associated with the estimated locations of shellfish dredging (detailed assessment of which is outside the scope of this study) these water bodies were not reviewed further. The remaining 18 (2b) water bodies potentially subject to extensive pressures were identified for assessment with TraC-MImAS.

An exception to the rule relating to ‘Other Disturbances to Seabed’ footprints was made for the water bodies Outer Kenmare River, Inner Kenmare River, and Outer Dingle Bay, all of which are associated with shellfish dredging. These water bodies were assessed during the initial trials for TraC-MImAS, and it was therefore considered appropriate to further characterise these water bodies using the most recent version of the assessment tool.

On completion of Step 3, 18 water bodies (4 transitional, and 14 coastal) were identified for assessment.

The total number of water bodies identified by Steps 1 – 3 for further characterisation was ***122***.

Table 6.2: Coastal Water Bodies identified for assessment with TraC-MImAS (42 No.)

Water Body Code	Water Body Name	Water Body Type	TraC-MImAS Water Body Type	Marine Direct Impacts	Pollution	Point Source Discharges	Morphology Risk	Overall Risk	MImAS Application Step
GBNIIE6NB030	Carlingford Lough (NB_030_0000)	CW8	Sheltered coast, sedimentary	1b	1b	1b	**1b**	1b	**1**
IE_NB_040_0000	Outer Dundalk Bay	CW5	Moderately exposed to exposed coast, sedimentary		1b		**1b**	1b	**1**
IE_SW_240_0000	Dingle Harbour	CW5	Moderately exposed to exposed coast, sedimentary				**1b**	1b	**1**
IE_WE_100_0000	Outer Galway Bay	CW2	Moderately exposed to exposed coast, sedimentary		2a	2a	**1b**	1b	**1**
GBNIIE6NW250	Lough Foyle (NW_250_0000)	CW8	Sheltered coast, sedimentary	1b	1b	1b	**1b**	1b	**1**
IE_EA_140_0000	Southwestern Irish Sea - Brittas Bay (HA 10)	CW6	Moderately exposed to exposed coast, sedimentary		2b	2b	**1b**	1b	**1**
IE_SE_010_0000	Southwestern Irish Sea (Has 11;12)	CW5	Moderately exposed to exposed coast, sedimentary				**1b**	1b	**1**
IE_SE_040_0000	Wexford Harbour	CW8	Sheltered coast, sedimentary	1b	1b		**1b**	1b	**1**
IE_SE_110_0000	Tramore Bay	CW5	Moderately exposed to exposed coast, sedimentary				**1b**	1b	**1**
IE_SE_140_0000	Dungarvan Harbour	CW5	Moderately exposed to exposed coast, sedimentary	1b	1b		**1b**	1b	**1**
IE_SW_040_0000	Ballycotton Bay	CW5	Moderately exposed to exposed coast, sedimentary				**1b**	1b	**1**
IE_SE_120_0000	Tramore Back Strand	CW8	Sheltered coast, sedimentary				**1b**	1b	**1**
IE_EA_070_0000	Irish Sea Dublin (HA 09)	CW5	Moderately exposed to exposed coast, sedimentary		2b	2b	**2a**	2a	**1**
IE_WE_170_0000	Inner Galway Bay North	CW5	Moderately exposed to exposed coast, sedimentary		2a	2a	**2a**	2a	**1**
IE_EA_020_0000	Northwestern Irish Sea (HA 08)	CW5	Moderately exposed to exposed coast, sedimentary		2b	2b	**2a**	2a	**1**
IE_NW_170_0000	Ballyness Bay	CW5	Moderately exposed to exposed coast, sedimentary		2a		**2a**	2a	**1**
IE_NW_190_0000	Sheephaven Bay	CW5	Moderately exposed to exposed coast, sedimentary		2a		**2a**	2a	**1**
IE_SE_050_0000	Eastern Celtic Sea (HAs 13;17)	CW2	Moderately exposed to exposed coast, sedimentary				**2a**	2a	**1**
IE_SE_090_0000	Bannow Bay	CW8	Sheltered coast, sedimentary				**2a**	2a	**1**
IE_SE_100_0000	Waterford Harbour	CW2	Moderately exposed to exposed coast, sedimentary				**2a**	2a	**1**
IE_SH_060_0000	Mouth of the Shannon (HAs 23;27)	CW2	Moderately exposed to exposed coast, sedimentary		2a		**2a**	2a	**1**
IE_SH_100_0000	Liscannor Bay	CW2	Moderately exposed to exposed coast, sedimentary		2b		**2a**	2a	**1**
IE_SW_110_0000	Rosscarbery Bay	CW5	Coastal bedrock				**2a**	2a	**1**
IE_WE_360_0000	Blacksod Bay	CW5	Moderately exposed to exposed coast, sedimentary		2a	2a	**2a**	2a	**1**
IE_WE_470_0000	Sligo Harbour	CW8	Sheltered coast, sedimentary		2a	2a	**1a**	1a	**2**
IE_EA_010_0000	Boyne Estuary Plume Zone	CW5	Moderately exposed to exposed coast, sedimentary	1b	1b	2b	**1a**	1a	**2**
IE_EA_100_0000	Southwestern Irish Sea - Killiney Bay (HA10)	CW5	Moderately exposed to exposed coast, sedimentary		2b	2b	**1a**	1a	**2**
IE_WE_190_0000	Casla Bay	CW5	Coastal bedrock		2b	2b	**1a**	1a	**2**
IE_SH_050_0000	Inner Tralee Bay	CW8	Sheltered coast, sedimentary		2b		**1a**	1a	**2**
IE_SH_040_0000	Outer Tralee Bay	CW5	Moderately exposed to exposed coast, sedimentary		2b		**2b**	2b	**3**
IE_SW_100_0300	White's Marsh	CW10	TraC lagoons			2b	**2b**	2a	**3**
IE_SW_170_0000	Outer Bantry Bay	CW2	Coastal bedrock	2b	2b		**2b**	2b	**3**
IE_SW_190_0000	Outer Kenmare River	CW2	Coastal bedrock	1b	1b		**2b**	1b	**3**
IE_WE_420_0000	Killala Bay	CW5	Moderately exposed to exposed coast, sedimentary		2a	2a	**2b**	2a	**3**
IE_NW_070_0000	Donegal Bay Northern	CW2	Coastal bedrock		2b		**2b**	2b	**3**
IE_NW_220_0000	Lough Swilly	CW5	Moderately exposed to exposed coast, sedimentary		2b		**2b**	2b	**3**
IE_SH_010_0000	Southwestern Atlantic Seaboard (HA 23)	CW2	Coastal bedrock		2b		**2b**	2b	**3**
IE_SW_050_0000	Outer Cork Harbour	CW5	Moderately exposed to exposed coast, sedimentary				**2b**	2b	**3**
IE_SW_230_0000	Outer Dingle Bay	CW2	Coastal bedrock				**2b**	2b	**3**
IE_WE_430_0000	Donegal Bay Southern	CW2	Moderately exposed to exposed coast, sedimentary		2a	2a	**2b**	2a	**3**
IE_WE_450_0000	Sligo Bay	CW5	Moderately exposed to exposed coast, sedimentary		2a	2a	**2b**	2a	**3**
IE_SW_180_0000	Berehaven	CW5	Moderately exposed to exposed coast, sedimentary				**2b**	2b	**3**

Table 6.3: Transitional Water Bodies identified for assessment with TraC-MImAS (80 No.)

Water Body Code	Water Body Name	Water Body Type	TraC-MImAS Water Body Type	Abstraction	Marine Direct Impacts	Pollution	Point Source Discharges	Morphology Risk	Overall Risk	MImAS Application Step
IE_SE_020_0100	Owenavorragh Estuary	TW2	Transitional meso to macrotidal	2b		1b	1b	1b	1b	1
IE_SE_080_0100	Bridgetown Estuary	TW2	Transitional meso to macrotidal	2b		2b	2b	1b	1b	1
IE_SW_230_0200	Castlemaine Harbour	TW2	Transitional meso to macrotidal	2b		1b	1b	1b	1b	1
IE_SH_060_1200	Clonderalaw Bay	TW2	Transitional meso to macrotidal	2b		2b	2b	1b	1b	1
IE_SW_190_0500	Drongawn Lough, Sneem	TW6	TraC lagoons	2b		2b	2b	1b	1b	1
GBNIIE5NW250010	Foyle and Faughan Estuaries	TW2	Transitional meso to macrotidal	2b		1b	1b	1b	1b	1
IE_NW_220_0300	Inch Lough	TW6	TraC lagoons	2b		2a	2a	1b	1b	1
IE_SW_060_1200	Owenboy Estuary	TW2	Transitional meso to macrotidal	2b		1b	1b	1b	1b	1
IE_SW_030_0100	Womanagh Estuary	TW2	Transitional meso to macrotidal	2b		2b	2b	1b	1b	1
IE_NB_040_0300	Ballymascanlan Estuary	TW2	Transitional meso to macrotidal	2a		2b	2b	1b	1b	1
IE_WE_410_0100	Bunatrahir Bay	TW2	Transitional meso to macrotidal	2b		2b	2b	1b	1b	1
IE_NW_030_0100	Erne Estuary	TW2	Transitional meso to macrotidal	1b		1b	1b	1b	1b	1
IE_EA_080_0100	Mayne Estuary	TW2	Transitional meso to macrotidal	2b		1b	1b	1b	1b	1
IE_SE_040_0100	North Slob Channels	TW6	TraC lagoons	2b		2b	2b	1b	1b	1
IE_WE_400_0200	Sruwaddacon Bay	TW2	Transitional meso to macrotidal	2b		2a	2a	1b	1b	1
IE_SE_070_0100	Tacumshin Lake	TW6	TraC lagoons	2b		2b	2b	1b	1b	1
IE_NW_090_0100	Teelin Bay	TW2	Transitional meso to macrotidal	2b		2b	2b	1b	1b	1
IE_WE_390_0100	Tullaghan Bay	TW2	Transitional meso to macrotidal	2b		2a	2a	1b	1b	1
IE_EA_050_0100	Rogerstown Estuary	TW2	Transitional meso to macrotidal	2b		1b	1b	1b	1b	1
IE_SW_110_0200	Rosscarbery Harbour	TW6	TraC lagoons	2b		1b	1b	1b	1b	1
IE_NW_220_0100	Swilly Estuary	TW2	Transitional meso to macrotidal	2b		2a	2a	1b	1b	1
IE_SE_100_0100	Barrow Suir Nore Estuary	TW2	Transitional meso to macrotidal	2b	1b	1b	2b	2a	1b	1
IE_WE_160_0800	Dunbulcaun Bay	TW2	Transitional meso to macrotidal	2b		2a	2a	2a	2a	1
IE_SW_190_0200	Kilmakilloge Harbour	TW2	Transitional meso to macrotidal	2b		2b	2b	2a	2a	1
IE_WE_160_0100	Kinvarra Bay	TW2	Transitional meso to macrotidal	2b		1b	1b	2a	1b	1
IE_WE_350_0100	Westport Bay	TW2	Transitional meso to macrotidal	2b		1b	1b	2a	1b	1
IE_SW_170_0500	Adrigole Harbour	TW2	Transitional meso to macrotidal	2b		2b	2b	2a	2a	1
IE_SH_110_0100	Aille Clare Estuary	TW2	Transitional meso to macrotidal	2b		2b	2b	2a	2a	1
IE_SW_090_0200	Argideen Estuary	TW2	Transitional meso to macrotidal	2a		1b	1b	2a	1b	1
IE_SH_050_0200	Blennerville Lake East	TW6	TraC lagoons	2b		2b	2b	2a	2a	1
IE_SH_050_0300	Blennerville Lake West	TW6	TraC lagoons	2b		2b	2b	2a	2a	1
IE_NW_200_0200	Carrick Beg Lough (South)	TW6	TraC lagoons	2a		2a	2a	2a	2a	1
IE_SE_140_0100	Colligan Estuary	TW2	Transitional meso to macrotidal	2b		1b	1b	2a	1b	1
IE_SE_090_0100	Corock Estuary	TW2	Transitional meso to macrotidal	2b		2b	2b	2a	2a	1
IE_NW_220_0400	Crana Estuary	TW2	Transitional meso to macrotidal	2b		2b	2b	2a	2a	1
IE_SH_080_0100	Doonbeg Estuary	TW2	Transitional meso to macrotidal	2b		2b	2b	2a	2a	1
IE_NW_040_0100	Durnesh Lough	TW6	TraC lagoons	2b		2a	2a	2a	2b	1
IE_WE_440_0100	Easky Estuary	TW2	Transitional meso to macrotidal	2b		2b	2b	2a	2a	1
IE_WE_350_0300	Furnace Lough	TW6	TraC lagoons	2b		1b	1b	2a	1b	1
IE_SW_170_0400	Glengarriff Harbour	TW2	Transitional meso to macrotidal	2b		2b	2b	2a	2a	1
IE_SH_100_0100	Inagh Estuary	TW2	Transitional meso to macrotidal	2a		1b	1b	2a	1b	1
IE_EA_120_0100	Kilcoole Marsh	TW6	TraC lagoons	2b		1b	1b	2a	1b	1
IE_SE_060_0100	Lady's Island Lake	TW6	TraC lagoons	2b		1b	1b	2a	1b	1
IE_NW_160_0100	Loch Chionn Caslach (Kincas L.)	TW6	TraC lagoons	2a		2a	2a	2a	2a	1
IE_NW_180_0100	Loch O Dheas, Tory Island	TW6	TraC lagoons	2a		2a	2a	2a	2a	1
IE_SH_040_0100	Lough Gill	TW6	TraC lagoons	2a		2b	2b	2a	2a	1
IE_NW_140_0100	Maghery Lough	TW6	TraC lagoons	2a		2a	2a	2a	2a	1
IE_NW_160_0300	Moorlagh	TW6	TraC lagoons	2b		2a	2a	2a	2b	1
IE_EA_030_0100	Nanny Estuary	TW2	Transitional meso to macrotidal	2b		1b	1b	2a	1b	1
GBNIIE5NB030010	Newry Estuary (NB_030_0100)	TW2	Transitional meso to macrotidal	2b		2b	2b	2a	2a	1
IE_SW_070_0100	Oysterhaven	TW2	Transitional meso to macrotidal	2b		2b	2b	2a	2a	1
IE_SH_060_0400	Poulaweala Lough / Quayfield Lo	TW6	TraC lagoons	2b		2a	2a	2a	2a	1
IE_SW_100_0100	Clonakilty Harbour	TW2	Transitional meso to macrotidal	2b		1b	1b	2a	1b	1
IE_EA_010_0100	Boyne Estuary	TW2	Transitional meso to macrotidal	2a	1b	1b	1b	1a	1a	2
IE_EA_130_0100	Broad Lough	TW2	Transitional meso to macrotidal	2b		1b	1b	1a	1a	2
IE_WE_170_0700	Corrib Estuary	TW2	Transitional meso to macrotidal	2b		2a	2a	1a	1a	2
IE_EA_110_0100	Dargle Estuary	TW2	Transitional meso to macrotidal	2b		2b	2b	1a	1a	2
IE_SH_060_1100	Fergus Estuary	TW2	Transitional meso to macrotidal	2b		1b	1b	1a	1a	2
IE_WE_470_0100	Garavoge Estuary	TW2	Transitional meso to macrotidal	2b	1b	1b	1b	1a	1a	2
IE_NB_040_0100	Inner Dundalk Bay	TW2	Transitional meso to macrotidal	2b		1b	1b	1a	1a	2
IE_WE_160_0600	Lough Sallagh (Doorus Loughs)	TW6	TraC lagoons	2b		2b	2b	1a	1a	2
IE_SH_060_0800	Upper Shannon Estuary	TW2	Transitional meso to macrotidal	2b		1b	1b	1a	1a	2
IE_WE_170_0300	Ardfry Oyster Pool	TW6	TraC lagoons	2b		2a	2a	1a	1a	2
IE_WE_190_0100	Casla Estuary	TW2	Transitional meso to macrotidal	2b		2b	2b	1a	1a	2
IE_WE_310_0100	Erriff Estuary	TW2	Transitional meso to macrotidal	2b		2b	2b	1a	1a	2
IE_SW_170_0100	Inner Bantry Bay	TW2	Transitional meso to macrotidal	2b		1b	1b	1a	1a	2
IE_WE_170_0600	Renmore Lough, Galway City	TW6	TraC lagoons	2b		2b	2b	1a	1a	2
IE_SH_060_1000	Shannon Airport Lagoon	TW6	TraC lagoons	2b		1b	1b	1a	1a	2
IE_NB_030_0250	Shilties Lough	TW6	TraC lagoons	2b		2b	2b	1a	1a	2
IE_SE_040_0400	South Slob Channel	TW6	TraC lagoons	2b		2b	2b	1a	1a	2
IE_SE_080_0200	Ballyteige Channels	TW6	TraC lagoons	2b		2b	2b	1a	1a	2
IE_NW_220_0200	Blanket Nook Lough	TW6	TraC lagoons	2b		2a	2a	1a	1a	2
IE_NW_010_0100	Duff Estuary	TW2	Transitional meso to macrotidal	2b		2b	2b	1a	1a	2
IE_NB_040_0400	Fane Estuary	TW2	Transitional meso to macrotidal	2b		2b	2b	1a	1a	2
IE_NB_040_0500	Glyde Estuary	TW2	Transitional meso to macrotidal	2a		2b	2b	1a	1a	2
IE_SE_140_0200	Brickey Estuary	TW2	Transitional meso to macrotidal	2b		2b	2b	2b	2b	3
IE_SW_190_0300	Inner Kenmare River	TW2	Transitional meso to macrotidal	2b		2b	2b	2b	2b	3
IE_SW_230_0100	Cromane	TW2	Transitional meso to macrotidal	2b	1b	1b	1b	2b	1b	3
IE_NW_160_0500	Meenaclady	TW2	Transitional meso to macrotidal	2a		2b	2b	2b	2a	3
IE_WE_180_0100	Spiddal Estuary	TW2	Transitional meso to macrotidal	2b		2b	2b	2b	2b	3

Table 6.4 below summarises the distribution of TraC water bodies across the Initial Risk Assessment morphology risk categories, and those identified for assessment.

Table 6.4: Distribution of TraC water bodies between Initial Risk Assessment morphology risk categories & summary of those further characterised using TraC-MImAS

	No. Water Bodies	1a 'at risk'	1b 'probably at risk'	2a 'probably not at risk'	2b 'not at risk'
Total Water Bodies	309	49	42	58	160
TraC-MImAS (Steps 1 - 3)	122	27	33	44	18
Water Bodies not Assessed	187	22	9	14	142
Water Bodies with Identified Pressure Footprints	200	42	36	38	84
Water Bodies with no Identified Pressure Footprints	109	7	6	20	76
Water Bodies 'not at risk' (2b) with Identified Pressure Footprints >5%	18				18

6.3 Results – Further Characterisation

Table 6.5 and 6.6 below summarise the results for each of the water bodies assessed with TraC-MImAS (122 No.). The estimated percentage of system capacity currently used in each water body is expressed using the MCL range which each water body falls within. The overall risk for a water body was determined by the highest percentage capacity estimated for the three water body zones; hydrodynamic, intertidal, and subtidal. The MCLs discussed in Section 5.2.5 and Table 5.9 previously, are displayed next to the percentage capacity results to indicate which status class the water bodies are not likely to be at risk of failing, e.g. where pressures for all three zones of a water body are estimated to have used 7% of the water body's system capacity, this water body is considered unlikely to be at risk of failing GES as the MCLs for Good range from 5 to 14.9%. The use of these 'status' terms in further characterisation indicates **risk** to status class only, and does not represent classification results.

Water Body Summary Sheets have been generated for all water bodies estimated to be a risk of failing GES, and are included in Appendix 6-4.

Water body results highlighted in ***red italics*** in Tables 6.5 and 6.6 indicate where specific reservations about the TraC-MImAS results were identified. These water bodies were reviewed further and are discussed in section 6.3.3 below. Section 6.3.3 firstly outlines those water bodies categorised as 'not at risk' by the initial risk assessments, but estimated as having the potential to achieve HES following assessment with TraC-MImAS. Secondly, this section addresses those water bodies categorised as 'at risk' or 'probably at risk' due to intensive land use but for which no pressure footprints were identified during further characterisation by this study.

Appendix 6-3 outlines the overall results tables for the further characterisation of TraC water bodies. For those water bodies assessed with TraC-MImAS, this table details the percentage system capacities calculated for each water body zone. The initial risk assessment categories originally assigned to each water body are included for reference, and any comments specific to a water body are detailed where necessary. Included in this table are the results for additional water bodies assessed following a request from the EPA. As with Tables 6.5 and 6.6, any water bodies for which the results have been queried are highlighted in ***red italics***. To provide an indication of the level of confidence in results, Appendix 6-3 identifies those water bodies for which orthophotos were unavailable and therefore did not undergo detailed review for pressure extents (footprints).

Within Appendix 6-3, the overall risk associated with those water bodies assessed using TraC-MImAS is expressed as potential status class as with Tables 6.5 and 6.6 below. For those water bodies not assessed with TraC-MImAS, overall risk categories have been assumed based in the initial risk assessment results, pressure footprints, and discussions with the Marine Morphology Steering Group. The overall risk assigned to these water bodies is expressed as potential ***morphological*** status class:

'***Less than Good***' – this overall risk category is assigned to water bodies which are considered unlikely to achieve GES due to the status of morphology:

- pHMWBs
- Water bodies characterised as 'at risk' (1a) from other factors such as pollution or marine direct impacts, but also as 'at risk' (1a) or 'probably at risk' (1b) from morphology.

‘***At least Good***’ – this overall risk category is assigned to water bodies which are considered unlikely to achieve HES. In the absence of monitoring / classification results, ‘at least good’ is the highest potential status class that can be estimated for the morphology of the following water bodies:

- Water bodies characterised as ‘probably not at risk’ (2a) from morphology, but ‘at risk’ (1a) from other factors such as pollution or marine direct impacts.
- Water bodies characterised as ‘not at risk’ (2b) from morphology and not assessed using TraC-MImAS

Table 6.5: Summary TraC-MImAS results for coastal water bodies (sorted by MImAS Application Step (see Section 6.2.3))

Water Body Code	Water Body Name	Initial Risk Assessment - Morphology Risk	Initial Risk Assessment - Overall Risk	MImAS Application Step	% Capacity Used	Overall Risk expressed as Status Class
IE_SE_120_0000	Tramore Back Strand	1b	1b	1	15 - 29.9	Moderate
GBNIIE6NB030	Carlingford Lough (NB_030_0000)	1b	1b	1	5 - 14.9	Good
IE_EA_070_0000	Irish Sea Dublin (HA 09)	2a	2a	1		Good
IE_NB_040_0000	Outer Dundalk Bay	1b	1b	1		Good
IE_SW_240_0000	Dingle Harbour	1b	1b	1		Good
IE_WE_100_0000	Outer Galway Bay	1b	1b	1		Good
IE_WE_170_0000	Inner Galway Bay North	2a	2a	1		Good
GBNIIE6NW250	Lough Foyle (NW_250_0000)	1b	1b	1	0 - 4.9	High
IE_EA_020_0000	Northwestern Irish Sea (HA 08)	2a	2a	1		High
IE_EA_140_0000	Southwestern Irish Sea - Brittas Bay (HA 10)	1b	1b	1		High
IE_NW_170_0000	Ballyness Bay	2a	2a	1		High
IE_NW_190_0000	Sheephaven Bay	2a	2a	1		High
IE_SE_010_0000	Southwestern Irish Sea (HAs 11;12)	1b	1b	1		High
IE_SE_040_0000	Wexford Harbour	1b	1b	1		High
IE_SE_050_0000	Eastern Celtic Sea (HAs 13;17)	2a	2a	1		High
IE_SE_090_0000	Bannow Bay	2a	2a	1		High
IE_SE_100_0000	Waterford Harbour	2a	2a	1		High
IE_SE_110_0000	Tramore Bay	1b	1b	1		High
IE_SE_140_0000	Dungarvan Harbour	1b	1b	1		High
IE_SH_060_0000	Mouth of the Shannon (HAs 23;27)	2a	2a	1		High
IE_SH_100_0000	Liscannor Bay	2a	2a	1		High
IE_SW_040_0000	Ballycotton Bay	1b	1b	1		High
IE_SW_110_0000	Rosscarbery Bay	2a	2a	1		High
IE_WE_360_0000	Blacksod Bay	2a	2a	1		High
IE_SH_050_0000	Inner Tralee Bay	1a	1a	2	15 - 29.9	Moderate
IE_WE_470_0000	Sligo Harbour	1a	1a	2	5 - 14.9	Good
IE_EA_010_0000	Boyne Estuary Plume Zone	1a	1a	2	0 - 4.9	High
IE_EA_100_0000	Southwestern Irish Sea - Killiney Bay (HA10)	1a	1a	2		High
IE_WE_190_0000	Casla Bay	1a	1a	2		High
IE_SW_180_0000	Berehaven	2b	2b	3	30 - 44.9	Poor
IE_SH_040_0000	Outer Tralee Bay	2b	2b	3	5 - 14.9	Good
IE_SW_100_0300	White's Marsh	2b	2a	3		Good
IE_SW_170_0000	Outer Bantry Bay	2b	2b	3		Good
IE_SW_190_0000	Outer Kenmare River	2b	1b	3		Good
IE_WE_420_0000	Killala Bay	2b	2a	3	0 - 4.9	High
IE_NW_070_0000	Donegal Bay Northern	2b	2b	3		High
IE_NW_220_0000	Lough Swilly	2b	2b	3		High
IE_SH_010_0000	Southwestern Atlantic Seaboard (HA 23)	2b	2b	3		High
IE_SW_050_0000	Outer Cork Harbour	2b	2b	3		High
IE_SW_230_0000	Outer Dingle Bay	2b	2b	3		High
IE_WE_430_0000	Donegal Bay Southern	2b	2a	3		High
IE_WE_450_0000	Sligo Bay	2b	2a	3		High

% Capacity Used	HIGH	GOOD	MOD	POOR	BAD
	0 - 4.9	5 - 14.9	15 - 29.9	30 - 44.9	50 +

Table 6.6: Summary TraC-MImAS results for transitional water bodies (sorted by MImAS Application Step (see Section 6.2.3))

Water Body Code	Water Body Name	Initial Risk Assessment Morphology Risk	Initial Risk Assessment Overall Risk	MImAS Application Step	% Capacity Used	Overall Risk expressed as Status Class
IE_SE_020_0100	Owenavorragh Estuary	**1b**	1b	1	50 +	Bad
IE_EA_050_0100	Rogerstown Estuary	**1b**	1b	1	15 - 29.9	Moderate
IE_NW_220_0100	Swilly Estuary	**1b**	1b	1		Moderate
IE_SW_100_0100	Clonakilty Harbour	**2a**	1b	1		Moderate
IE_SW_110_0200	Rosscarbery Harbour	**1b**	1b	1		Moderate
GBNIIE5NW250010	Foyle and Faughan Estuaries	**1b**	1b	1	5 - 14.9	Good
IE_NW_220_0300	Inch Lough	**1b**	1b	1		Good
IE_SE_080_0100	Bridgetown Estuary	**1b**	1b	1		Good
IE_SE_100_0100	Barrow Suir Nore Estuary	**2a**	1b	1		Good
IE_SH_060_1200	Clonderalaw Bay	**1b**	1b	1		Good
IE_SW_030_0100	Womanagh Estuary	**1b**	1b	1		Good
IE_SW_060_1200	Owenboy Estuary	**1b**	1b	1		Good
IE_SW_190_0200	Kilmakilloge Harbour	**2a**	2a	1		Good
IE_SW_190_0500	Drongawn Lough, Sneem	**1b**	1b	1		Good
IE_SW_230_0200	Castlemaine Harbour	**1b**	1b	1		Good
IE_WE_160_0100	Kinvarra Bay	**2a**	1b	1		Good
IE_WE_160_0800	Dunbulcaun Bay	**2a**	2a	1		Good
IE_WE_350_0100	Westport Bay	**2a**	1b	1		Good
GBNIIE5NB030010	Newry Estuary (NB_030_0100)	**2a**	2a	1	0 - 4.9	High
IE_EA_030_0100	Nanny Estuary	**2a**	1b	1		High
IE_EA_080_0100	Mayne Estuary	**1b**	1b	1		High
IE_EA_120_0100	Kilcoole Marsh	**2a**	1b	1		High
IE_NB_040_0300	*Ballymascanlan Estuary*	*1b*	*1b*	*1*		*High*
IE_NW_030_0100	Erne Estuary	**1b**	1b	1		High
IE_NW_040_0100	Durnesh Lough	**2a**	2b	1		High
IE_NW_090_0100	Teelin Bay	**1b**	1b	1		High
IE_NW_140_0100	Maghery Lough	**2a**	2a	1		High
IE_NW_160_0100	Loch Chionn Caslach	**2a**	2a	1		High
IE_NW_160_0300	Moorlagh	**2a**	2b	1		High
IE_NW_180_0100	Loch O Dheas, Tory Island	**2a**	2a	1		High
IE_NW_200_0200	Carrick Beg Lough (South)	**2a**	2a	1		High
IE_NW_220_0400	Crana Estuary	**2a**	2a	1		High
IE_SE_040_0100	*North Slob Channels*	*1b*	*1b*	*1*		*High*
IE_SE_060_0100	Lady's Island Lake	**2a**	1b	1		High
IE_SE_070_0100	*Tacumshin Lake*	*1b*	*1b*	*1*		*High*
IE_SE_090_0100	Corock Estuary	**2a**	2a	1		High
IE_SE_140_0100	Colligan Estuary	**2a**	1b	1		High
IE_SH_040_0100	Lough Gill	**2a**	2a	1		High
IE_SH_050_0200	Blennerville Lake East	**2a**	2a	1		High
IE_SH_050_0300	Blennerville Lake West	**2a**	2a	1		High
IE_SH_060_0400	Poulaweala Lough / Quayfield	**2a**	2a	1		High
IE_SH_080_0100	Doonbeg Estuary	**2a**	2a	1		High
IE_SH_100_0100	Inagh Estuary	**2a**	1b	1		High
IE_SH_110_0100	Aille Clare Estuary	**2a**	2a	1		High
IE_SW_070_0100	Oysterhaven	**2a**	2a	1		High
IE_SW_090_0200	Argideen Estuary	**2a**	1b	1		High
IE_SW_170_0400	Glengarriff Harbour	**2a**	2a	1		High
IE_SW_170_0500	Adrigole Harbour	**2a**	2a	1		High
IE_WE_350_0300	Furnace Lough	**2a**	1b	1		High
IE_WE_390_0100	*Tullaghan Bay*	*1b*	*1b*	*1*		*High*
IE_WE_400_0200	Sruwaddacon Bay	**1b**	1b	1		High
IE_WE_410_0100	Bunatrahir Bay	**1b**	1b	1		High
IE_WE_440_0100	Easky Estuary	**2a**	2a	1		High
IE_EA_010_0100	Boyne Estuary	**1a**	1a	2	50 +	Bad
IE_NB_040_0400	Fane Estuary	**1a**	1a	2	15 - 29.9	Moderate
IE_NB_040_0500	Glyde Estuary	**1a**	1a	2		Moderate
IE_NW_010_0100	Duff Estuary	**1a**	1a	2		Moderate
IE_NW_220_0200	Blanket Nook Lough	**1a**	1a	2		Moderate
IE_SE_080_0200	Ballyteige Channels	**1a**	1a	2		Moderate
IE_EA_110_0100	Dargle Estuary	**1a**	1a	2	5 - 14.9	Good
IE_EA_130_0100	Broad Lough	**1a**	1a	2		Good
IE_NB_040_0100	Inner Dundalk Bay	**1a**	1a	2		Good
IE_SH_060_0800	Upper Shannon Estuary	**1a**	1a	2		Good
IE_SH_060_1100	Fergus Estuary	**1a**	1a	2		Good
IE_WE_160_0600	Lough Sallagh (Doorus Loughs)	**1a**	1a	2		Good
IE_WE_170_0700	Corrib Estuary	**1a**	1a	2		Good
IE_WE_470_0100	Garavoge Estuary	**1a**	1a	2		Good
IE_NB_030_0250	*Shilties Lough*	*1a*	*1a*	*2*	0 - 4.9	*High*
IE_SE_040_0400	*South Slob Channel*	*1a*	*1a*	*2*		*High*
IE_SH_060_1000	*Shannon Airport Lagoon*	*1a*	*1a*	*2*		*High*
IE_SW_170_0100	Inner Bantry Bay	**1a**	1a	2		High
IE_WE_170_0300	Ardfry Oyster Pool	**1a**	1a	2		High
IE_WE_170_0600	*Renmore Lough, Galway City*	*1a*	*1a*	*2*		*High*
IE_WE_190_0100	*Casla Estuary*	*1a*	*1a*	*2*		*High*
IE_WE_310_0100	Erriff Estuary	**1a**	1a	2		High
IE_WE_180_0100	Spiddal Estuary	**2b**	2b	3	15 - 29.9	Moderate
IE_SE_140_0200	Brickey Estuary	**2b**	2b	3	5 - 14.9	Good
IE_SW_190_0300	Inner Kenmare River	**2b**	2b	3		Good
IE_NW_160_0500	Meenaclady	**2b**	2a	3	0 - 4.9	High
IE_SW_230_0100	Cromane	**2b**	1b	3		High

% Capacity Used	HIGH	GOOD	MOD	POOR	BAD
	0 - 4.9	5 - 14.9	15 - 29.9	30 - 44.9	50 +

6.3.1 Results of Step 1

The following summarises the results of TraC-MImAS for those water bodies characterised as 'probably at risk' (1b) and 'probably not at risk' (2a) from morphology in the initial risk assessments. The results of this step as given in Tables 6.5 and 6.6 above, and also in Appendix 6-3, should be regarded as indicative in the absence of field trials and monitoring / classification results (refer to Section 6.1 and 6.2.1).

a) Of the 33 'probably at risk' (1b) water bodies assessed:

- 5 water bodies were estimated to be ***at risk of failing to achieve GES:***
  - Tramore Back Strand (SERBD)
  - Clonakilty Harbour (SWRBD)
  - Rogerstown Estuary (EARBD)
  - Rosscarbery Harbour (SWRBD)
  - Swilly Estuary (NWRBD)
- 17 water bodies were estimated to be ***at risk of failing to achieve HES***

b) Of the 44 'probably not at risk' (2a) water bodies assessed:

- 1 water body was estimated to be ***at risk of not achieving GES:***
  - Owenavorragh Estuary (SERBD)
- 8 water bodies were estimated to be ***at risk of failing to achieve HES***.

6.3.2 Results of Step 2

The following summarises the results of TraC-MImAS for those water bodies with potential to achieve GES or HES if morphology was restored or mitigated (i.e. water bodies for which an 'at risk' (1a) category was assigned for morphology pressures only). The results of this step are outline in Tables 6.5 and 6.6 above, and also in Appendix 6-3.

TraC-MImAS was applied to 27 'at risk' (1a) water bodies:

- 7 water bodies were estimated to be ***at risk of not achieving GES***:
  - Ballyteige Channels (SERBD)
  - Blanket Nook Lough (NWRBD)
  - Boyne Estuary (ERBD)
  - Duff Estuary (NWRBD)
  - Fane Estuary (NBRBD)
  - Glyde Estuary (NBRBD)
  - Inner Tralee Bay (ShIRBD)
- 16 water bodies were estimated to be ***at risk of failing to achieve HES***.

6.3.3 Results of Step 3

The following summaries the results of the assessment of TraC water bodies unlikely to be at risk of failing HES.

The application of Steps 1 and 2 further characterised the risk to those water bodies initially characterised as 'at risk' (1a), 'probably at risk' (1b), and 'probably not at risk' (2a) from morphology. Tables 6.5 and 6.6 identify which of these water bodies may have the potential to achieve HES.

All water bodies initially characterised as 'not at risk' (2b) were then reviewed to determine which of these may have the potential to achieve HES.

6.3.3.1 Further characterisation of risk for 'not at risk' (2b) water bodies

As noted in Step 3 in section 6.2.3 above, 18 'not at risk' (2b) water bodies required further assessment following the identification of potentially extensive pressure footprints. The results of this assessment using TraC-MImAS are outlined in Tables 6.5 and 6.6 above (MImAS Application Step 3).

- Of the 18 'not at risk' (2b) water bodies assessed, only 9 indicated ***a likelihood of achieving High Status***.

- Of the remaining 9 water bodies; 7 may potentially achieve GES, but TraC-MImAS results indicate a risk to the achievement of HES due to the extensive pressures identified. Table 6.7 below tabulates the pressure footprints identified for these water bodies.

- In addition, 2 water bodies, Berehaven (SWRBD) and Spiddal Estuary (WRBD), were estimated as being at risk of failing to achieve GES. The pressures identified for Berehaven and Spiddal Estuary are provided in detail in the appended Water Body Summary Sheets (Appendix 6-4).

Table 6.7: Pressure footprints identified for those water bodies characterised as 'not at risk' (2b) by the initial risk assessments

Water Body		Area (km^2)	Perimeter (km)	Pressure Footprints							
				Dredging - Low Impact (km^2)	Other Disturbances to Seabed (km^2)	Disposal (km^2)	Flow / Sediment Manipulation Structures (km^2)	Piled Structures (km^2)	Shoreline Reinforcement - High Impact (km)	Shoreline Reinforcement - Low Impact (km)	Embankments (km)
SE_140_0200	Brickey Estuary	0.63	9.11	0.05435	0	0	0	0	0	0	2.836
SH_040_0000	Outer Tralee Bay	215.81	111.56	31.18146	215.09630	1.57732	0.00019	0.00216	2.501	0.136	0.000
SW_100_0300	White's Marsh	0.03	1.11	0.00069	0	0	0	0	0	0	1.145
SW_170_0000	Outer Bantry Bay	276.18	182.70	139.94553	79.40766	0.04339	0.00576	0.00265	0.697	0	0
SW_190_0000	Outer Kenmare River	188.76	283.76	0	188.73803	0	0.00640	0.00015	1.778	0.709	0
SW_190_0300	Inner Kenmare River	3.79	28.41	0	3.78431	0	0.00123	0.00107	0.268	0	0
WE_420_0000	Killala Bay	81.38	68.05	8.74948	0	0	0.00405	0	0	0	0

6.3.3.2 Identification of water bodies unlikely to risk the achievement of HES

Following on from the further characterisation of 'at risk' (2b) water bodies with potentially extensive pressures, a review of all pressure footprints was undertaken to identify those water bodies for which no pressure footprints were identified.

Table 6.8 below lists 109 water bodies for which no pressure footprints were identified. The absence of morphological pressures indicates that the current morphological condition of these water bodies may be considered as ***unlikely to risk the achievement of HES***.

A qualitative review was then undertaken to identify any potential risks to the achievement of HES for the 109 water bodies.

Table 6.8: TraC water bodies for which no pressure footprints were identified

Water Body	TYPE	MImAS Assessment	Dredging / Channelisation	Deposition	Coastal Defence	Built Structures - Port Tonnage	Built Structures - Urban / Industrial Shoreline	Built structures - Power / Industrial Intakes	Intensive landuse	Morphology Overall Risk
NB_030_0250_Shilties Lough	TW6	Y	2b	2b	2b	2b		2b	1a	**1a**
SE_040_0400_South Slob Channel	TW6	Y	2b	2b	2b	2b		2b	1a	**1a**
SE_100_0250_Barrow Nore Estuary Upper	TW2		2b	2b	2b	1a		2b	1b	**1a**
SH_060_1000_Shannon Airport Lagoon	TW6	Y	2b	2b	2b	2b		2b	1a	**1a**
WE_170_0300_Ardfry Oyster Pool	TW6	Y	1a	2b	2b	2b			2b	**1a**
WE_170_0600_Renmore Lough, Galway City	TW6	Y	2b	2b	2b	2b			1a	**1a**
WE_190_0100_Casla Estuary	TW2	Y	2b	2b	2b	1a			2b	**1a**
NB_040_0200_Castletown Estuary	TW2		2a	2b	1b	2b		2b	1b	**1b**
NB_040_0300_Ballymascanlan Estuary	TW2	Y	2b	2b	1b	2b		2b	2b	**1b**
SE_040_0100_North Slob Channels	TW6	Y	2b	2b	2b	2b		2b	1b	**1b**
SE_070_0100_Tacumshin Lake	TW6	Y	2b	2b	2b	2b		2b	2a	**1b**
WE_390_0100_Tullaghan Bay	TW2	Y	2b	2b	2b	2b			1b	**1b**
WE_410_0100_Bunatrahir Bay	TW2	Y	2b	2b	2b	2b			1b	**1b**
NB_030_0200_Carlingford Lagoons	TW6		2b	2b	2b	2b		2b	2a	2a
NW_040_0100_Durnesh Lough	TW6	Y	2b	2b	2b	2b		2b	2a	2a
NW_140_0100_Maghery Lough	TW6	Y	2b	2b	2b	2b		2b	2a	2a
NW_160_0100_Loch Chionn Caslach (Kincas Lough)	TW6	Y	2b	2b	2b	2b		2b	2a	2a
NW_160_0300_Moorlagh	TW6	Y	2b	2b	2b	2b		2b	2a	2a
NW_180_0100_Loch O Dheas, Tory Island	TW6	Y	2b	2b	2b	2b		2b	2a	2a
NW_200_0200_Carrick Beg Lough (South)	TW6	Y	2b	2b	2b	2b		2b	2a	2a
SE_040_0300_Upper Slaney Estuary	TW2		2b	2b	2b	2b		2b	2a	2a
SE_060_0100_Lady's Island Lake	TW6	Y	2b	2b	2b	2b		2b	2a	2a
SE_090_0100_Corock Estuary	TW2	Y	2b	2b	2a	2b		2b	2b	2a
SE_100_0300_Upper Barrow Estuary	TW2		2b	2b	2a	2b		2b	2a	2a
SH_050_0200_Blennerville Lake East	TW6	Y	2b	2a	2b	2b		2b	2b	2a
SH_050_0300_Blennerville Lake West	TW6	Y	2b	2a	2b	2b		2b	2b	2a
SH_060_0400_Poulaweala Lough / Quayfield Lough	TW6	Y	2b	2a	2b	2b		2b	2b	2a
SH_090_0100_Lough Donnell	TW6		2b	2a	2b	2b		2b	2b	2a
SH_110_0100_Aille Clare Estuary	TW2	Y	2b	2a	2b	2b		2b	2b	2a
SW_020_0500_Upper Blackwater M Estuary	TW2		2b	2b	2a	2b		2b	2b	2a
SW_060_0600_Slatty Bridge, Fota Island	TW6		2b	2b	2a	2b		2b	2b	2a
WE_350_0300_Furnace Lough	TW6	Y	2b	2b	2b	2b			2a	2a
WE_440_0100_Easky Estuary	TW2	Y	2b	2b	2b	2b			2a	2a
EA_040_0000_Rockabill	CW5		2b	2b	2b	2b	2b	2b		2b
NB_040_0600_Corstown Lagoon	TW6		2b	2b	2b	2b		2b	2b	2b
NW_020_0100_Drowes Estuary	TW2		2b	2b	2b	2b		2b	2b	2b
NW_130_0000_Trawena Bay	CW8		2b	2b	2b	2b	2b	2b	2b	2b
NW_150_0100_Sally's Lough	CW10		2b	2b	2b	2b	2b	2b	2b	2b
NW_190_0100_Lackagh Estuary	TW2		2b	2b	2b	2b		2b	2b	2b
SE_100_0400_Nore Estuary	TW2		2b	2b	2b	2b		2b	2b	2b
SE_130_0100_Mahon Estuary	TW2		2b	2b	2b	2b		2b	2b	2b
SH_060_1300_Scattery Island Lagoon	CW10		2b	2b	2b	2b	2b	2b	2b	2b
SH_060_1400_Clonconeen Pool	CW10		2b	2b	2b	2b	2b	2b	2b	2b
SW_020_0400_Lackaroe (Glendine Estuary)	TW6		2b	2b	2b	2b		2b	2b	2b
SW_060_0100_Rostellan Lake	TW6		2b	2b	2b	2b		2b	2b	2b
SW_060_0200_Cuskinny Lake	TW6		2b	2b	2b	2b		2b	2b	2b
SW_060_1000_Raffeen Lake, Shanbally	CW10		2b	2b	2b	2b	2b	2b	2a	2b
SW_060_1100_Lough Beg / Curraghbinny	TW6		2b	2b	2b	2b			2b	2b
SW_070_0200_Oysterhaven Lake, Clashroe	TW6		2b	2b	2b	2b		2b	2b	2b
SW_080_0200_Kinsale Marsh, Commoge	CW10		2b	2b	2b	2b	2b	2b	2a	2b
SW_080_0300_Upper Bandon Estuary	TW2		2b	2b	2b	2b		2b	2b	2b
SW_100_0200_Inchydoney	CW10		2b	2b	2b	2b	2b	2b	2a	2b
SW_110_0100_Kilkeran Lake	TW6		2b	2b	2b	2b		2b	2b	2b
SW_120_0000_Fastnet Waters	CW2		2b	2b	2b	2b	2b	2b		2b
SW_140_0100_Ballyrisode Bridge Lagoon	CW10		2b	2b	2b	2b	2b	2b	2a	2b
SW_150_0100_Reen Point Pool	TW6		2b	2b	2b	2b		2b	2b	2b
SW_160_0100_Farranamagh Lough	TW6		2b	2b	2b	2b		2b	2b	2b
SW_170_0200_Kilmore Lake, Whiddy Island	TW6		2b	2b	2b	2b		2b	2b	2b
SW_170_0300_Reenydonagan Lough	TW6		2b	2b	2b	2b		2b	2b	2b
WE_020_0100_Loch Mor, Inis Oirr	TW6		2b	2b	2b	2b			2b	2b
WE_030_0100_Port na Cora lochs, Inis Meain	TW6		2b	2b	2b	2b			2b	2b
WE_040_0100_Loch na gCadhan, Inis Meain	TW6		2b	2b	2b	2b			2b	2b
WE_050_0100_Loch an tSaile, Arainn	TW6		2b	2b	2b	2b			2b	2b
WE_055_0100_Baile an Duin Lagoon	TW6		2b	2b	2b	2b			2b	2b
WE_060_0100_Loch an Chara, Arainn	TW6		2b	2b	2b	2b			2b	2b
WE_070_0100_Loch Phort Chorruch, Arainn	TW6		2b	2b	2b	2b			2b	2b

Table 6.8 continued: TraC water bodies for which no pressure footprints were identified

Water Body	TYPE	MImAS Assessment	Dredging / Channelisation	Deposition	Coastal Defence	Built Structures - Port Tonnage	Built Structures - Urban / Industrial Shoreline	Built structures - Power / Industrial Intakes	Intensive landuse	Morphology Overall Risk
WE_080_0100_Loch Dearg, Arainn	TW6		2b	2b	2b	2b			2b	2b
WE_090_0100_Loch Amurvy, Arainn	TW6		2b	2b	2b	2b			2b	2b
WE_110_0100_Muckinish Lough	TW6		2b	2b	2b	2b			2b	2b
WE_120_0100_Murree Lough	TW6		2b	2b	2b	2b			2b	2b
WE_140_0100_Aughinish Lagoon	TW6		2b	2b	2b	2b			2b	2b
WE_140_0200_Carrownahallia Lagoon, Aughinish	TW6		2b	2b	2b	2b			2b	2b
WE_150_0100_Rossalia Lagoon	TW6		2b	2b	2b	2b			2b	2b
WE_160_0300_Loughaungreena (Doorus Loughs)	TW6		2b	2b	2b	2b			2b	2b
WE_160_0400_Lough Fadda (Doorus Loughs)	TW6		2b	2b	2b	2b			2b	2b
WE_160_0500_Lough Namona (Doorus Loughs)	TW6		2b	2b	2b	2b			2b	2b
WE_160_0700_Rincarna Pools South	CW10		2b	2b	2b	2b	2b	2b	2b	2b
WE_160_0710_Rincarna Pools North	CW10		2b	2b	2b	2b	2b	2b	2b	2b
WE_170_0150_Mweeloon Pool North	TW6		2b	2b	2b	2b			2b	2b
WE_170_0200_Loughaunascalia, Ardfry Point	TW6		2b	2b	2b	2b			2b	2b
WE_170_0400_Turreen Lough (Rinville West)	TW6		2b	2b	2b	2b			2b	2b
WE_190_0200_Lough Faddacrussan	TW6		2b	2b	2b	2b			2b	2b
WE_200_0300_Loch Fhada Upper Pools	TW6		2b	2b	2b	2b			2b	2b
WE_200_0400_Loch an Ghadai	TW6		2b	2b	2b	2b			2b	2b
WE_200_0500_Loch Fhada	TW6		2b	2b	2b	2b			2b	2b
WE_200_0600_Loch Tanai	TW6		2b	2b	2b	2b			2b	2b
WE_200_0800_Loch Cara Fionnla	TW6		2b	2b	2b	2b			2b	2b
WE_200_1000_Loch Doire Bhanbh (Derravonniff)	TW6		2b	2b	2b	2b			2b	2b
WE_200_1100_Loch an tSaile, North of Camus Bay	TW6		2b	2b	2b	2b			2b	2b
WE_200_1200_Loch Conaortha (L. Aconeera)	TW6		2b	2b	2b	2b			2b	2b
WE_210_0100_Loch an Chaorain (L. Keeraun)	TW6		2b	2b	2b	2b			2b	2b
WE_220_0100_Lough an Mhuilinn (Mill Lough)	TW6		2b	2b	2b	2b			2b	2b
WE_240_0100_Ballyconneely Lough	TW6		2b	2b	2b	2b			2b	2b
WE_260_0100_Loch an tSaile (Lough Athola)	TW6		2b	2b	2b	2b			2b	2b
WE_280_0100_Lough B-Finne, Inishbofin	TW6		2b	2b	2b	2b		2b	2b	2b
WE_290_0100_Lough Anillaun, Cleggan Bay	TW6		2b	2b	2b	2b			2b	2b
WE_320_0100_Corragaun Lough	TW6		2b	2b	2b	2b			2b	2b
WE_330_0100_Roonagh Lough	TW6		2b	2b	2b	2b			2b	2b
WE_370_0100_Dooniver Loughs	TW6		2b	2b	2b	2b			2b	2b
WE_380_0000_Bellacragher Bay	CW8		2b	2b	2b	2b	2b	2b		2b
WE_405_0000_Belmullet Bay	CW8		2b	2b	2b	2b	2b	2b		2b
WE_420_0100_Cloonaghmore Estuary	TW2		2b	2b	2b	2b			2b	2b
WE_420_0200_Cartoon Lough, Killala Bay	CW10		2b	2b	2b	2b	2b	2b	2b	2b
WE_460_0000_Ballysadare Bay	CW8		2b	2b	2b	2b	2b	2b		2b
WE_460_0100_Portavaud West, Ballysadare Bay	TW6		2b	2b	2b	2b			2b	2b
WE_460_0200_Portavaud East, Ballysadare Bay	CW10		2b	2b	2b	2b	2b	2b	2b	2b
WE_460_0300_Ballysadare Estuary	TW2		2b	2b	2b	2b			2b	2b
WE_460_0400_Tanrego Intake	TW6		2b	2b	2b	2b			2b	2b
WE_480_0100_Drumcliff Estuary	TW2		2b	2b	2b	2b			2b	2b

6.3.3.3 Further characterisation of potential risks to the achievement of HES

Of the 109 water bodies with no identified pressure footprints, 13 were initially characterised as ‘at risk’ (1a) or ‘probably at risk’ (1b) from physical alterations. This warranted further assessment of these water bodies as the results of TraC-MImAS (applied in Steps 1 and 2) indicated that these water bodies could potentially achieve HES (Table 6.5 and 6.6). Details of these water bodies are summarised below.

It is important to note that new pressure footprints were only digitised in areas of orthophoto coverage (refer to Section 3.2.1.7 of Chapter 3). The results table in Appendix 6-3 identifies those water bodies for which orthophotos were unavailable.

i **Ardfry Oyster Pool (WRBD):** this water body was reported by the initial risk assessments as ‘at risk’ due to channelisation. However, following a review of OPW data and orthophotos no evidence of channelisation was identified. In the absence of further baseline information, it is considered ***likely that this water body can achieve GES.***

ii **Casla Estuary (WRBD):** A category of ‘at risk’ was assigned to Casla Estuary for the pressure ‘Built Structures (port tonnage)’. No port infrastructure associated with this water body was identified. Therefore, in the absence of further baseline information, it is considered ***likely that this water body can achieve GES.***

iii **Ballymascanlan Estuary (NBRBD):** The initial risk assessments predicted that this water body was ‘probably not at risk’ from coastal defence. OPW data relating to embankments did not extend to this water body and lack of orthophotos for this area prevented digitising of pressure footprints. A review of orthophotos via the EPA’s online interactive map, ENVision, indicated that the majority of this water body’s shoreline is embanked. As an estimation of risk, the full length of this water body’s shoreline (12.7 km) was assigned to intertidal embankments within TraC-MImAS. Table 6.9 below shows that Ballymascanlan Estuary is ***potentially at risk of failing to meet GES.***

Table 6.9: Percentage capacity used by flood embankments within Ballymascanlan Estuary; estimation based on embankment of the total length of intertidal shoreline

TOTAL CAPACITY USED		
Hydrodynamics	0.0%	HIGH
Intertidal Zone	16.7%	MOD
Subtidal Zone	0.0%	N/A

iv **Tacumshin Lake (SERBD):** This water body was characterised as 'probably not at risk' due to impoundment. A review of the historic maps and oblique images indicated that the impoundment of this water body is attributed to natural deposition of material which has created a barrier of dunes. Figure 6.1 below conveys where, historically, flow exchange was permitted between this water body and the Eastern Celtic Sea. Although this area is now barred with dunes the lagoon is known to breach during storm conditions (and therefore partially saline). Tacumshin Lake is designated as a SAC and bird sanctuary. The CFB notes that farmers use sluice gates to provide a minimum water level in the lake, and that this lake is an extremely poor habitat for fish (CFB/Marine Institute, 2006). This is associated with the fact that there is no breach that would allow recruitment of fish, and that "lack of tidal flushing or any significant freshwater inputs means that eutrophic conditions prevail in the summer contributing to fish kills" (CFB/Marine Institute, 2006).

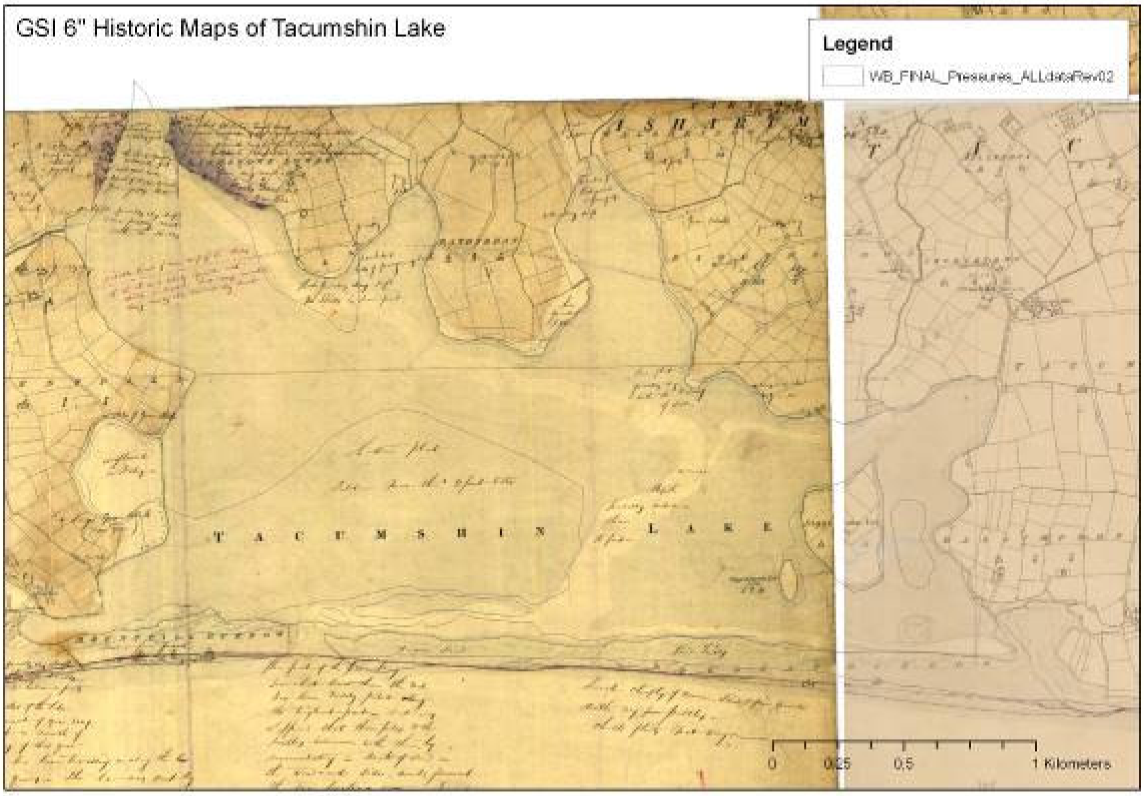


Figure 6.1: Historic bedrock geology maps of Tacumshin Lake

In the absence of further baseline information, the existing ***risk associated with morphological alterations for Tacumshin Lake cannot be concluded.***

The following sections summarise those remaining 9 water bodies identified as containing no pressure footprints. These 9 water bodies were characterised in the initial risk assessments as being ‘at risk’ or ‘probably at risk’ due to intensive land use.

An assessment of adjacent land use is not a component of TraC-MImAS, which considers for the most part engineering pressures. The WRBD is undertaking an assessment of intensive land use associated with forestry and peat lands, therefore, it is recommended that in addition to the summaries below, the results of the WRBD PoMS studies should be considered prior to classification of water bodies subject to intensive land use associated with forestry and peat lands. Table 6.10 below, summarises the proportion of TraC water body shoreline flanked with non-irrigated arable land, exploited peat bog, coniferous forest, and urban, industrial and transport related land uses. As noted in Chapters 3 and 5 of this report, the pressure of intensive land use associated with urban, industrial and transport related land uses is considered by TraC-MImAS via the assessment of pressures such as shoreline reinforcement, flow and sediment manipulation structures and land claim.

v **Castletown Estuary (NBRBD):** This water body was considered at risk from coastal defence features as well as intensive land use. Lack of orthophotos for this water body prevented digitising of pressure footprints. However, a review of the EPA's ENVision interactive map has identified that a significant proportion of this water body's shoreline is reinforced and embanked. The shoreline is flanked by industrial, urban and agricultural related land uses and the water body is crossed by 3 piled bridges. The CFB/Marine Institute (2006) have identified that the main channel is regularly dredged for navigational purposes and outside of this channel, intertidal area makes up a "substantial component of the estuary", some of which contains saltmarsh, and has a predominant bed type of mud. The lower estuary is considered by the CFB to be of importance as a "nursery ground for juvenile flatfish as well as juvenile gadoids such as cod" (CFB/Marine Institute, 2006). The pressure footprints for this water body should be identified for assessment using TraC-MImAS, as it is likely that Castletown Estuary is ***at risk of achieving HES.***

vi **Renmore Lough (WRBD):** At present this water body is not subject to significant physical alterations. However, adjacent land use associated with the harbour indicates future pressure on this water body, possibly associated with land reclamation. In the absence of further baseline information, the existing ***risk associated with morphological alterations cannot be concluded.***

vii **Shilities Lough (NBRBD):** Orthophotos indicate that this water body may be partially infilled and in close proximity to recent housing developments. The origin of this water body and source of seawater should be investigated further before the risk of this water body failing to achieve the WFD objectives can be determined. In the absence of further baseline information, the existing ***risk associated with morphological alterations cannot be concluded.***

Not far from Shilities Lough are the Carlingford Lagoons which were not considered 'at risk' in the initial risk assessments. However, these lagoons are part of the Greenore Golf Course, and considered to be artificially maintained, and therefore unlikely to of HES. In the absence of further baseline information, the existing ***risk associated with morphological alterations cannot be concluded.***

viii **South Slob Channel (SERBD):** The CMRC, using information obtained from a study titled 'Wetlands of Ireland: Distribution, Ecology and Economic Value' (Otte, 2003) digitised the location of coastal lagoons within the RoI. This water body was

identified as an artificial drainage channel which received seawater via percolation (and possibly an inlet). Therefore, it is considered likely that this water body is ***at risk of failing to achieve HES.***

ix **North Slobs Channels (SERBD):** As with the South Slob Channel, these channels were identified as artificial drainage lagoons, again questioning the ability of these channels to achieve HES. Therefore, it is considered likely that this water body is ***at risk of failing to achieve HES.***

x **Shannon Airport Lagoon (ShIRBD):** Figure 6.2 below indicates that this lagoon has been created by reclamation at Shannon Airport. However, the definition of an artificial water body in the WFD does not permit water bodies such as this to be classed as such. The estuary surrounding the lagoon is an SPA (Site Code 004077), and the lagoon is part of an SAC (Site Code: 002165).

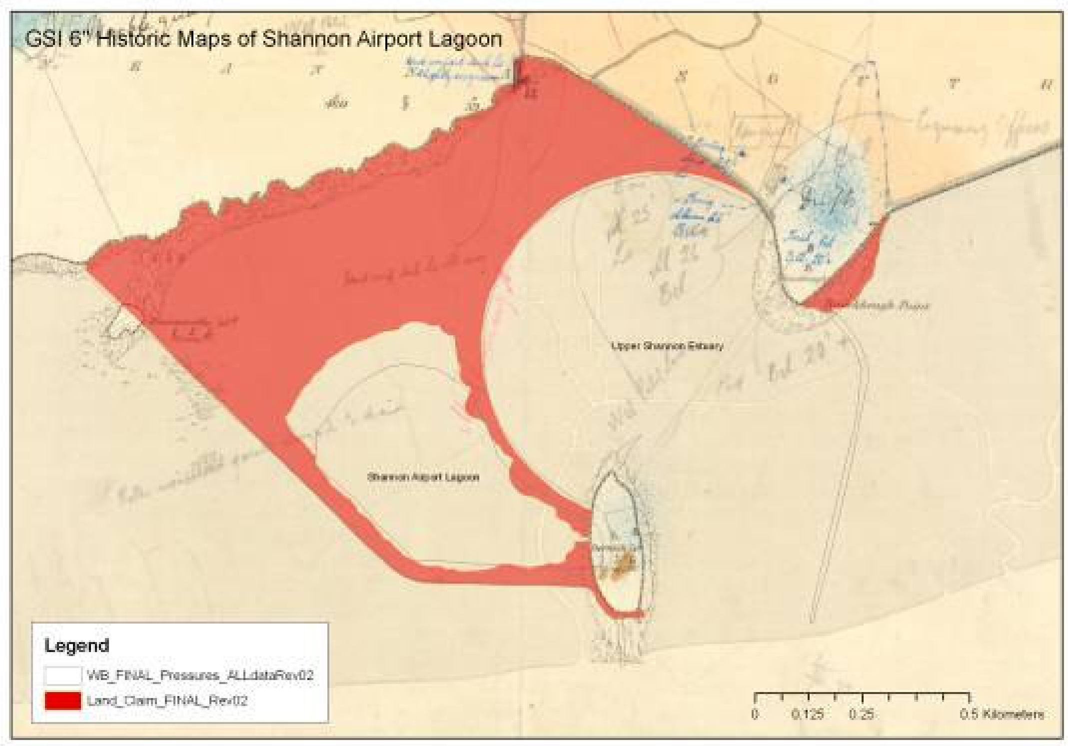


Figure 6.2: Historic bedrock geology maps of Upper Shannon Estuary and estimated are of reclamation surrounding the existing Shannon Airport Lagoon.

In the absence of further baseline information, the existing ***risk associated with morphological alterations cannot be concluded.***

xi **Barrow Nore Estuary Upper (SERBD):** orthophotos were unavailable to digitise pressures within this water body. Using the EPA ENVision online interactive map, a limited amount of shoreline reinforcement is evident in the downstream reaches of the estuary as well as piled structures. The surrounding land use consists of arable land; however, much of this is buffered by narrow areas of woodland. Detailed assessment of pressure footprints within this water body is required before a risk category can be assigned. In the absence of further baseline information, the existing ***risk associated with morphological alterations cannot be concluded.***

xii **Tullaghan Bay (WRBD):** The exploitation of peat adjacent to this water body triggered its characterisation as 'probably at risk'. It is considered that this activity, which is estimated to have extended over 6% of the bay's shoreline has now ceased. The majority of this bay is unvegetated bare sand and is considered to be 'pristine with only limited agricultural activity and a few houses around the estuary' (CFB, 2006). In the absence of further baseline information, the existing ***risk associated with morphological alterations cannot be concluded.***

xiii **Bunatrahir Bay (WRBD):** Areas identified as exploited peat bog appear to be concentrated near to the rocky shores of this bay. Some arable land lies adjacent to the sandy shore at the estuary's inlet. However, there is no indication of extensive pressures associated with this land. In the absence of further baseline information, the existing ***risk associated with morphological alterations cannot be concluded.***

Table 6.10: Summary of percentage shoreline of TraC water bodies flanked with intensive land use

Waterbody Name and Code	Waterbody Perimeter (Km)	Intensive Land Use					
		Arable (%)	Coniferous (%)	Peat Bog (%)	Industrial (%)	Transport (%)	Urban (%)
EA_010_0100_Boyne Estuary	43.47	2.87	0.00	0.00	0.00	0.00	19.74
EA_020_0000_Northwestern Irish Sea (HA 08)	47.58	32.76	0.00	0.00	0.00	0.00	15.24
EA_030_0100_Nanny Estuary	8.96	15.72	0.00	0.00	0.00	0.00	10.49
EA_050_0100_Rogerstown Estuary	19.31	38.73	0.00	0.00	0.00	0.00	6.01
EA_060_0000_Malahide Bay	10.56	12.30	0.00	0.00	0.00	0.00	3.89
EA_060_0100_Broadmeadow Water	11.34	31.62	0.00	0.00	3.55	0.00	17.71
EA_070_0000_Irish Sea Dublin (HA 09)	19.80	5.51	0.00	0.00	0.00	15.94	18.35
EA_080_0100_Mayne Estuary	9.13	7.19	0.00	0.00	0.00	0.00	12.37
EA_090_0000_Dublin Bay	39.80	0.00	0.00	0.00	0.25	24.61	44.34
EA_090_0100_North Bull Island	8.38	0.00	0.00	0.00	0.00	0.00	46.14
EA_090_0200_Tolka Estuary	16.44	0.00	0.00	0.00	17.22	0.00	43.53
EA_090_0300_Liffey Estuary Lower	20.23	0.00	0.00	0.00	3.79	66.88	9.21
EA_090_0400_Liffey Estuary Upper	9.09	0.00	0.00	0.00	0.00	0.00	100.00
EA_100_0000_Southwestern Irish Sea - Killiney Bay (HA10)	50.86	2.27	0.00	5.04	0.00	1.70	14.15
EA_110_0100_Dargle Estuary	0.75	0.00	0.00	0.00	0.00	0.00	54.90
EA_120_0100_Kilcoole Marsh	19.57	0.00	0.00	0.00	0.00	0.00	0.00
EA_130_0100_Broad Lough	14.64	0.00	0.00	0.00	0.00	17.69	10.47
EA_140_0000_Southwestern Irish Sea - Brittas Bay (HA 10)	26.29	5.23	0.00	0.00	0.00	1.64	2.71
EA_150_0100_Avoca Estuary	5.60	0.00	0.00	0.00	0.00	41.95	39.92
GBNIIE6NB020_Mourne Coast	25.95	5.60	0.00	0.00	0.00	0.00	0.00
NB_010_0000_Portstewart Bay	36.33	0.00	0.00	0.00	0.00	0.00	2.55
NB_025_0000_Louth Coast (HA 06)	19.59	44.97	0.00	0.00	0.00	0.00	0.00
NB_030_0000_Carlingford Lough	42.41	1.17	0.83	0.00	0.00	0.00	26.11
NB_030_0100_Newry Estuary	24.62	0.00	0.00	0.00	10.68	0.00	8.04
NB_030_0250_Shilties Lough	0.30	100.00	0.00	0.00	0.00	0.00	0.00
NB_040_0000_Outer Dundalk Bay	23.19	40.65	0.00	0.00	0.00	0.00	0.00
NB_040_0100_Inner Dundalk Bay	20.92	1.64	0.00	0.00	0.00	0.00	25.68
NB_040_0200_Castletown Estuary	13.68	0.00	0.00	0.00	0.00	0.00	53.15
NB_040_0300_Ballymascanlan Estuary	12.39	6.33	0.00	0.00	0.00	0.00	0.00
NB_040_0400_Fane Estuary	8.37	70.50	0.00	0.00	0.00	0.00	11.29
NB_040_0500_Glyde Estuary	9.28	77.78	0.00	0.00	0.00	0.00	0.00
NW_010_0000_Donegal Bay (Erne)	64.42	0.00	0.14	0.00	0.00	0.00	1.94
NW_020_0000_Bundoran Bay	5.58	0.00	0.00	0.00	0.00	0.00	50.71
NW_020_0100_Drowes Estuary	1.03	0.00	0.00	0.00	0.00	0.00	33.02
NW_030_0100_Erne Estuary	11.83	0.00	0.00	0.00	0.00	0.00	12.52
NW_050_0100_Inner Donegal Bay	41.55	0.00	5.02	0.00	0.00	0.00	5.68
NW_060_0000_Inver Bay	13.41	0.00	0.00	5.90	0.00	0.00	0.00
NW_085_0000_Killybegs Harbour	14.14	0.00	0.00	0.00	0.00	0.00	25.85
NW_110_0100_Owenea Estuary	29.19	0.00	0.00	6.90	0.00	0.00	0.00
NW_120_0100_Gweebarra Estuary	44.09	0.00	5.45	0.00	0.00	0.00	0.00
NW_130_0000_Trawena Bay	24.87	0.00	0.00	3.13	0.00	0.00	0.00
NW_140_0000_Dungloe Bay	27.46	0.00	0.00	0.00	0.00	0.00	2.93
NW_170_0000_Ballyness Bay	23.63	0.00	0.00	0.00	0.00	0.00	5.11
NW_190_0000_Sheephaven Bay	65.45	1.42	1.00	1.07	0.00	0.00	2.80
NW_190_0100_Lackagh Estuary	9.23	38.20	0.00	0.00	0.00	0.00	0.00
NW_200_0000_Mulroy Bay Broadwater	88.11	1.92	3.34	2.34	0.00	0.00	0.00
NW_210_0000_Mulroy Bay Northwater	25.70	8.12	0.00	15.17	0.00	0.00	0.00
NW_220_0000_Lough Swilly	77.99	0.00	0.00	5.70	0.00	0.00	0.00
NW_220_0100_Swilly Estuary	96.12	9.83	0.00	0.00	0.00	0.00	7.85
NW_220_0200_Blanket Nook Lough	4.68	0.57	0.00	0.00	0.00	0.00	0.00
NW_220_0300_Inch Lough	10.56	22.54	0.00	0.00	0.00	0.00	0.00
NW_220_0400_Crana Estuary	4.55	0.00	0.00	0.00	0.00	0.00	57.05
NW_230_0000_Northern Atlantic Seaboard (HAs 40;02)	99.95	0.48	0.00	22.21	0.00	0.00	0.56
NW_250_0000_Lough Foyle	54.31	0.00	0.00	0.00	0.00	0.00	0.96
NW_250_0100_Foyle and Faughan Estuaries	115.12	12.33	0.00	0.00	0.00	0.00	1.25
SE_010_0000_Southwestern Irish Sea (HAs 11;12)	64.30	4.64	1.22	0.00	0.00	3.39	9.24
SE_020_0100_Owenavorragh Estuary	4.07	0.00	0.00	0.00	0.00	0.00	31.57
SE_040_0000_Wexford Harbour	16.61	40.81	9.02	0.00	0.00	0.00	0.00
SE_040_0100_North Slob Channels	11.22	45.36	0.00	0.00	0.00	0.00	0.00
SE_040_0200_Lower Slaney Estuary	54.47	16.23	0.00	0.00	0.00	0.00	8.67
SE_040_0300_Upper Slaney Estuary	17.91	5.63	0.00	0.00	0.00	0.00	14.72
SE_040_0400_South Slob Channel	5.58	92.00	0.00	0.00	0.00	0.00	0.00
SE_045_0000_Rosslare Harbour	1.48	0.00	0.00	0.00	0.00	75.48	24.52
SE_050_0000_Eastern Celtic Sea (HAs 13;17)	142.36	15.68	0.00	0.00	0.00	0.00	0.94
SE_060_0100_Lady's Island Lake	15.49	18.63	0.00	0.00	0.00	0.00	0.00
SE_070_0100_Tacumshin Lake	17.27	13.47	0.00	0.00	0.00	0.00	0.00
SE_080_0100_Bridgetown Estuary	17.70	30.96	0.00	0.00	0.00	0.00	0.00
SE_080_0200_Ballyteige Channels	10.58	51.20	0.00	0.00	0.00	0.00	0.00
SE_090_0000_Bannow Bay	27.93	46.47	0.00	0.00	0.00	0.00	0.00
SE_090_0100_Corock Estuary	9.98	8.12	0.00	0.00	0.00	0.00	0.00
SE_100_0000_Waterford Harbour	22.05	36.18	0.00	0.00	0.00	0.00	10.31
SE_100_0100_Barrow Suir Nore Estuary	40.26	20.69	0.00	0.00	0.00	0.00	6.29

Table 6.10 continued: Summary of percentage shoreline of TraC water bodies flanked with intensive land use

Waterbody Name and Code	Waterbody Perimeter (Km)	Intensive Land Use					
		Arable (%)	Coniferous (%)	Peat Bog (%)	Industrial (%)	Transport (%)	Urban (%)
SE_100_0200_New Ross Port	39.21	10.05	0.00	0.00	7.36	0.00	4.16
SE_100_0250_Barrow Nore Estuary Upper	8.65	0.00	0.00	0.00	0.00	0.00	31.41
SE_100_0300_Upper Barrow Estuary	33.89	7.97	5.04	0.00	0.00	0.00	0.00
SE_100_0400_Nore Estuary	31.88	0.92	0.92	0.00	0.00	0.00	0.00
SE_100_0500_Lower Suir Estuary	22.02	13.54	0.58	0.00	3.21	0.00	22.01
SE_100_0550_Middle Suir Estuary	63.49	10.58	0.00	0.00	0.00	0.00	12.60
SE_100_0600_Upper Suir Estuary	24.43	0.00	1.07	0.00	0.00	0.00	20.19
SE_110_0000_Tramore Bay	12.40	0.00	0.00	0.00	0.00	0.00	23.92
SE_120_0000_Tramore Back Strand	21.29	15.16	0.00	0.00	0.00	0.00	1.34
SE_140_0000_Dungarvan Harbour	15.56	5.00	0.00	0.00	0.00	0.00	0.00
SE_140_0100_Colligan Estuary	30.82	7.75	0.00	0.00	0.00	0.00	14.67
SE_140_0200_Brickey Estuary	8.60	7.78	0.00	0.00	0.00	0.00	0.00
SH_010_0000_Southwestern Atlantic Seaboard (HA 23)	54.42	0.00	0.00	0.67	0.00	0.00	0.00
SH_020_0000_Smerwick Harbour	23.58	0.00	0.00	0.00	0.00	0.00	2.08
SH_030_0000_Brandon Bay	30.80	3.83	0.00	0.00	0.00	0.00	0.00
SH_040_0000_Outer Tralee Bay	82.71	7.90	0.00	1.06	0.00	0.00	1.91
SH_050_0000_Inner Tralee Bay	21.24	0.00	0.00	0.00	0.00	0.00	9.84
SH_060_0000_Mouth of the Shannon (HAs 23;27)	151.25	1.03	0.00	2.31	0.00	0.00	3.48
SH_060_0300_Lower Shannon Estuary	132.08	1.30	0.00	0.00	5.41	1.15	1.16
SH_060_0350_Foynes Harbour	2.24	0.00	0.00	0.00	81.86	0.00	0.00
SH_060_0600_Deel Estuary	16.72	14.64	0.00	0.00	9.60	0.00	6.78
SH_060_0700_Maigue Estuary	42.23	11.55	0.00	0.00	0.00	0.00	0.30
SH_060_0800_Upper Shannon Estuary	67.15	5.69	0.00	0.00	3.44	2.14	1.19
SH_060_0900_Limerick Dock	37.51	0.00	0.00	0.00	6.62	0.00	45.14
SH_060_1000_Shannon Airport Lagoon	1.82	0.00	0.00	0.00	12.26	87.74	0.00
SH_060_1100_Fergus Estuary	98.45	0.44	0.00	0.00	0.00	0.00	0.98
SH_070_0000_Shannon Plume (HAs 27;28)	138.32	0.00	0.00	4.84	0.00	0.00	1.86
SH_100_0000_Liscannor Bay	22.30	0.00	0.00	0.00	0.00	0.00	15.70
SH_100_0100_Inagh Estuary	18.90	2.77	0.00	0.00	0.00	0.00	7.36
SW_010_0000_Western Celtic Sea (HAs 18;19;20)	99.18	21.51	0.00	0.00	0.00	0.00	0.33
SW_020_0000_Youghal Bay	26.15	37.89	0.00	0.00	0.00	0.04	5.16
SW_020_0100_Lower Blackwater M Estuary / Youghal Harbour	92.10	7.51	1.34	0.00	0.00	1.63	1.83
SW_020_0500_Upper Blackwater M Estuary	15.81	3.61	0.00	0.00	0.00	0.00	4.80
SW_030_0100_Womanagh Estuary	20.23	12.31	0.00	0.00	0.00	0.00	0.00
SW_040_0000_Ballycotton Bay	21.37	27.77	0.00	0.00	0.00	0.00	7.47
SW_050_0000_Outer Cork Harbour	31.63	34.00	0.00	0.00	1.93	0.00	0.00
SW_060_0000_Cork Harbour	48.98	8.51	0.00	0.00	11.56	11.80	22.31
SW_060_0100_Rostellan Lake	2.13	0.00	0.00	0.00	0.00	0.00	11.41
SW_060_0300_North Channel Great Island	36.60	15.91	0.00	0.00	0.00	0.00	0.00
SW_060_0400_Owenacurra Estuary	12.98	17.52	0.00	0.00	0.00	0.00	32.38
SW_060_0700_Lough Mahon (Harper's Island)	15.83	12.44	0.00	0.00	0.00	0.00	7.51
SW_060_0750_Lough Mahon	48.84	1.81	0.00	0.00	6.48	5.30	33.98
SW_060_0800_Glashaboy Estuary	4.45	0.00	0.00	0.00	0.00	5.97	55.52
SW_060_0900_Lee (Cork) Estuary Lower	10.35	0.00	0.00	0.00	0.00	33.75	66.25
SW_060_0950_Lee (Cork) Estuary Upper	14.17	0.00	0.00	0.00	0.00	0.00	97.71
SW_060_1200_Owenboy Estuary	18.85	12.81	0.00	0.00	0.00	0.00	32.53
SW_070_0100_Oysterhaven	28.42	26.16	0.00	0.00	0.00	0.00	0.00
SW_070_0200_Oysterhaven Lake, Clashroe	1.21	0.00	0.00	0.00	0.00	0.00	0.00
SW_080_0000_Kinsale Harbour	20.63	32.64	0.00	0.00	0.00	0.00	0.00
SW_080_0100_Lower Bandon Estuary	47.67	15.59	0.00	0.00	0.00	3.79	3.84
SW_080_0200_Kinsale Marsh, Commoge	0.92	0.00	0.00	0.00	0.00	0.00	0.00
SW_080_0300_Upper Bandon Estuary	8.08	2.17	0.00	0.00	0.00	0.00	6.26
SW_090_0000_Courtmacsherry Bay	39.55	12.88	0.00	0.00	0.00	0.00	0.00
SW_090_0200_Argideen Estuary	24.03	9.57	0.00	0.00	0.00	0.00	9.24
SW_100_0000_Clonakilty Bay	32.99	9.58	0.00	0.00	0.00	0.00	0.00
SW_100_0100_Clonakilty Harbour	10.13	5.90	0.00	0.00	0.00	0.00	14.63
SW_110_0000_Rosscarbery Bay	66.44	0.00	0.00	0.00	0.00	0.00	0.87
SW_110_0200_Rosscarbery Harbour	2.00	0.00	0.00	0.00	0.00	0.00	60.82
SW_110_0300_Glandore Harbour	19.33	4.66	0.00	0.00	0.00	0.00	0.00
SW_130_0100_Ilen Estuary	42.04	0.25	0.00	0.00	0.00	0.00	12.67
SW_140_0000_Roaring Water Bay	125.95	0.00	0.00	0.00	0.00	0.00	1.51
SW_150_0000_South Western Atlantic Seaboard (HAs 21;22)	138.87	0.00	0.00	0.72	0.00	0.00	0.00
SW_170_0000_Outer Bantry Bay	122.68	0.00	0.00	6.47	0.00	2.98	0.00
SW_170_0100_Inner Bantry Bay	30.36	0.00	0.00	0.00	0.00	0.00	2.17
SW_180_0000_Berehaven	29.80	0.00	4.30	0.00	0.00	0.00	18.24
SW_190_0000_Outer Kenmare River	178.97	0.00	0.00	2.72	0.00	0.00	0.00
SW_190_0100_Ardgroom	16.69	0.00	0.00	0.00	0.00	0.00	0.00
SW_190_0200_Kilmakilloge Harbour	31.99	0.00	0.00	4.17	0.00	0.00	0.00
SW_190_0300_Inner Kenmare River	23.75	0.00	0.00	12.19	0.00	0.00	5.42
SW_190_0500_Drongawn Lough, Sneem	2.35	0.00	0.00	43.53	0.00	0.00	0.00
SW_200_0000_Ballinskelligs Bay	45.67	0.00	0.00	0.00	0.00	0.00	1.69
SW_210_0000_Portmagee Channel	24.16	0.00	0.00	6.66	0.00	0.00	0.00
SW_220_0100_Ferta	17.51	0.00	0.00	2.27	0.00	0.00	6.49
SW_230_0000_Outer Dingle Bay	122.72	0.00	0.00	6.75	0.00	0.00	0.00
SW_230_0200_Castlemaine Harbour	61.46	0.00	0.00	0.42	0.00	0.00	2.44
SW_240_0000_Dingle Harbour	14.69	0.00	0.00	0.00	0.00	0.00	19.81

Table 6.10 continued: Summary of percentage shoreline of TraC water bodies flanked with intensive land use

Waterbody Name and Code	Waterbody Perimeter (Km)	Intensive Land Use					
		Arable (%)	Coniferous (%)	Peat Bog (%)	Industrial (%)	Transport (%)	Urban (%)
WE_010_0000_Aran Islands, Galway Bay, Connemara (HAs 29;31)	101.74	0.00	0.00	2.65	0.00	0.00	0.23
WE_110_0000_Ballyvaghan Bay	28.77	13.29	0.00	0.00	0.00	0.00	0.00
WE_130_0000_Aughinish Bay	30.30	16.21	0.00	0.00	0.00	0.00	0.00
WE_160_0800_Dunbulcaun Bay	16.71	8.69	0.00	0.00	0.00	0.00	0.00
WE_170_0000_Inner Galway Bay North	40.15	0.00	0.00	0.00	0.00	0.00	11.67
WE_170_0600_Renmore Lough, Galway City	0.79	0.00	0.00	0.00	0.00	0.00	100.00
WE_170_0700_Corrib Estuary	16.28	0.00	0.00	0.00	0.00	0.00	59.15
WE_190_0000_Casla Bay	32.42	0.00	0.00	13.75	0.00	0.00	0.00
WE_200_0000_Kilkieran Bay	121.13	0.00	0.00	6.81	0.00	0.00	0.00
WE_200_0200_Camus Bay	66.10	0.00	0.00	9.61	0.00	0.00	0.00
WE_250_0000_Western Atlantic Seaboard (HAs 32;33;34)	346.96	0.39	0.00	11.93	0.00	0.00	0.23
WE_260_0000_Mannin Bay	21.62	0.00	0.00	0.00	0.00	0.00	0.00
WE_260_0100_Loch an tSaile (Lough Athola), Mannin Bay	3.20	0.00	0.00	0.00	0.00	0.00	0.00
WE_270_0100_Clifden Bay	28.68	0.00	0.00	2.18	0.00	0.00	2.26
WE_290_0100_Lough Anillaun, Cleggan Bay	2.35	0.00	0.00	0.00	0.00	0.00	0.00
WE_300_0000_Ballynakill Bay	48.21	3.32	3.00	0.00	0.00	0.00	0.00
WE_310_0000_Killary Harbour	44.51	0.00	0.00	21.15	0.00	0.00	0.00
WE_310_0100_Erriff Estuary	4.72	0.00	0.00	75.91	0.00	0.00	0.00
WE_320_0100_Corragaun Lough	3.58	0.00	0.00	0.00	0.00	0.00	0.00
WE_330_0100_Roonagh Lough	3.93	0.00	0.00	0.00	0.00	0.00	0.00
WE_340_0000_Clew Bay	40.42	0.00	0.00	22.32	0.00	0.00	0.10
WE_350_0000_Inner Clew Bay	75.53	0.15	0.00	0.00	0.00	0.00	0.00
WE_350_0100_Westport Bay	49.69	0.00	0.00	2.08	0.00	0.00	0.93
WE_350_0200_Newport Bay	39.88	0.00	0.00	0.00	0.00	0.00	3.41
WE_360_0000_Blacksod Bay	152.77	2.06	0.00	9.24	0.00	0.00	1.47
WE_370_0000_Blacksod Bay SW / Achill Sound	81.95	0.00	0.00	15.66	0.00	0.00	2.13
WE_380_0000_Bellacragher Bay	39.86	0.00	0.00	12.53	0.00	0.00	0.00
WE_390_0100_Tullaghan Bay	63.36	2.35	0.00	6.25	0.00	0.00	0.00
WE_400_0000_Broadhaven	61.66	0.00	0.00	6.76	0.00	0.00	0.00
WE_400_0200_Sruwaddacon Bay	40.59	0.00	6.09	27.89	0.00	0.00	0.00
WE_405_0000_Belmullet Bay	26.66	0.00	0.00	10.05	0.00	0.00	3.46
WE_410_0100_Bunatrahir Bay	3.84	15.18	0.00	16.21	0.00	0.00	0.00
WE_420_0000_Killala Bay	43.75	4.35	0.00	0.00	0.00	0.00	2.15
WE_420_0300_Moy Estuary	31.94	0.00	0.00	0.00	0.00	0.00	13.46
WE_430_0000_Donegal Bay Southern	78.39	0.45	0.00	0.00	0.00	0.00	0.00
WE_440_0100_Easky Estuary	0.83	18.23	0.00	0.00	0.00	0.00	0.00
WE_450_0000_Sligo Bay	43.23	7.98	0.00	0.00	0.00	0.00	0.45
WE_460_0000_Ballysadare Bay	18.84	4.67	0.00	0.00	0.00	0.00	0.00
WE_470_0000_Sligo Harbour	9.87	0.00	0.00	0.00	0.00	0.00	16.79
WE_470_0100_Garavoge Estuary	18.68	7.46	0.00	0.00	0.00	0.00	37.19

6.3.4 Water bodies further characterised as at risk of failing to achieve Good Ecological Status

On completion of the application of TraC-MImAS, fourteen water bodies (of the 122 assessed) indicated that over 15% (Good – Moderate boundary) of their system capacity is used by the impacts associated with existing anthropogenic physical alterations, with Fane Estuary only just exceeding this MCL (15.1%). Appendix 6-4 contains Water Body Summary Sheets which outline, where possible, the physical and ecological characteristics of each of these water bodies as well as details of the pressures identified for each.

6.3.5 Results Summary

Appendix 6-3 tabulates the results for both the initial risk assessment and further characterisation for all 309 TraC water bodies. On reviewing these results for each water body, it is important to note where orthophotos were available for digitising pressure footprints. The availability of orthophotos is identified in this appendix as an indicator of higher level of confidence in the assessment.

Table 6.11 below summarises how morphological pressures are distributed across the RBDs by indicating the percentage coverage of each pressure type within each RBD and summing this for the whole RBD. Tables 6.12 – 6.18 detail for each RBD the pressure footprints identified, and express these as a proportion of the RBD TraC water body area. The ‘percentage coverage’ referred to in this section is associated with the extent of the pressure footprints and does not reflect the percentage of system capacity used (as calculated using TraC-MImAS).

The NWRBD and WRBD contain the least percentage coverage of morphological pressures footprints identified. Both of these RBDs have a higher proportion of coastal bedrock water bodies, and are more characteristic of rocky shorelines than the other RBDs which tend to be dominated by sedimentary coasts. The low percentage coverage of shoreline reinforcement within these RBDs reflects these characteristics.

Generally, with the exception of ‘low impact dredging’ (maintenance) and ‘other disturbances to seabed’, morphological pressures are most extensive within transitional water bodies. This was an expected result as many of Ireland’s urban/industrial areas as well as sensitive coastlines are concentrated within the transitional water bodies.

Low impact dredging and other disturbances to seabed are significant pressures within all RBDs. Low impact dredging is of most significance within the Shannon and South Western RBDs, where this pressure is associated with the maintenance of both shipping navigation channels and drainage channels. The pressure 'other disturbances to seabed' combines the footprints of shellfish dredging, ferry channels, marine cables and pipelines, and areas zoned for wind farm development. Areas designated for shellfish dredging are the primary footprints within this pressure, with only 5% of the total footprint of 'other disturbances to seabed' associated with the other pressure types such as ferry channels, marine cables etc.

Shannon International River Basin District (ShIRBD)

The ShIRBD exhibits the most extensive shoreline and areal pressure footprints. However, the areal pressures are primarily associated with low impact dredging and other disturbances to seabed; the latter requires further assessment of aquaculture areas to confirm pressure extents. Nearly 14% of this river basin district's shoreline is embanked, which is 11% greater than any other RBD. This extensive network of embankments within the ShIRBD is heavily concentrated on the following water bodies:

- Cashen
- Fergus Estuary
- Maigue Estuary
- Upper Shannon Estuary

Eastern River Basin District (ERBD)

The ERBD is also subject to extensive shoreline pressure footprints, with nearly 13% of its entire shoreline reinforced. Also, approximately 38% of the ERBD TraC water body area is subject to pressures such as low impact dredging (maintenance dredging), land claim and other disturbances to seabed. The latter pressure consists of footprints for shellfish dredging, vessel movements, and marine cables and pipelines; shellfish dredging was identified as the most significant of the three. Over 1% of this RBD's coast has been reclaimed, a significant proportion of which is in the Dublin area.

Neagh-Bann River Basin District (NBRBD)

The most significant pressures footprints identified for the NBRBD TraC water bodies are those associated with other disturbances to seabed, low impact dredging and embankments. Of those embankments identified all features were concentrated within the Glyde Estuary (7.7km). However, as noted in section 6.3.3 (iii) above, approximately 12.7 km of embankments were also identified for Ballymascanlan Estuary.

South Western River Basin District (SWRBD)

A significant proportion of the SWRBD's TraC water body area has been identified as impacted by shellfish dredging, which is a component of the pressure 'other disturbances to seabed'. Second only to the ShIRBD, over 6% of this RBD's total water body area is subject to low impact dredging. The majority of the high impact shoreline reinforcement identified is concentrated on the transitional water bodies.

South Eastern River Basin District (SERBD)

Second only to the ERBD, a significant portion of the SERBD's shoreline is subject to high impact shoreline reinforcement. The other significant pressures identified for this RBD are low impact dredging and other disturbances to seabed. The latter pressure type is associated with ferry movements, marine cables and pipelines, as well as shellfish dredging areas (which still require confirmation of extents).

Western River Basin District (WRBD)

The most significant pressure on the WRBD TraC water bodies is that associated with shellfish dredging, with over 25% of its area designated as the pressure 'other disturbances to seabed'. Low impact dredging also contributes to the morphological pressures within this district, whereas footprints for all other pressures are minimal.

North Western River Basin District (NWRBD)

Limited pressure footprints were identified for this RBD as a whole, with the most extensive pressures of low impact dredging and 'other disturbances to seabed' present in approximately 5% and 10% of the TraC water body area respectively. Although the results indicate that pressure footprints are limited for the RBD overall, the concentration of embankments within the following water bodies has significant impact on their potential to achieve GES:

- Blanket Nook Lough
- Foyle and Faughan Estuaries
- Inch Lough
- Swilly Estuary

Table 6.11: Distribution of pressure footprints across each River Basin District, expressed as total area/length and percentage coverage

			Areal Pressure Footprints (km2)								Linear Pressure Footprints (km)			
	Total Water Body Area & % Pressure Coverage per RBD	Total Water Body Perimeter & % Pressure Coverage per RBD	Land Claim - High Impact	Land Claim - Low Impact	Dredging - High Impact	Dredging - Low Impact	Other Disturbances to Seabed	Disposal at Sea	Flow and Sediment Manipulation Structures	Piled Structures	Shoreline Reinforcement - High Impact	Shoreline Reinforcement - Low Impact	Embankments	Causeways
ERBD														
Total Area (km^2) & Length (km)	383.06	639.12	4.262	0.523	0	10.953	129.971	2.715	0.283	0.020	45.448	33.854	4.033	0
Proportion (%) of total Water Body with Pressure Footprints	38.83	13.04	1.11	0.14	0	2.86	33.93	0.71	0.07	0.01	7.11	5.30	0.63	0
NBRBD														
Total Area (km^2) & Length (km)	310.99	343.27	0	0	0	8.924	84.136	1.142	0.002	0.000	3.093	0.197	7.730	0
Proportion (%) of total Water Body with Pressure Footprints	30.29	3.21	0	0	0	2.87	27.05	0.37	0.00	0.00	0.90	0.06	2.25	0
NWRBD														
Total Area (km^2) & Length (km)	2361.42	2215.81	0.249	0.151	0	119.143	232.489	0.845	0.162	0.017	16.627	3.772	58.089	1.985
Proportion (%) of total Water Body with Pressure Footprints	14.95	3.63	0.01	0.01	0	5.05	9.85	0.04	0.01	0.00	0.75	0.17	2.62	0.09
SERBD														
Total Area (km^2) & Length (km)	1114.27	1107.59	1.042	0.014	0.661	57.827	158.587	1.409	0.108	0.010	28.592	9.371	16.748	0.571
Proportion (%) of total Water Body with Pressure Footprints	19.71	4.99	0.09	0.00	0.06	5.19	14.23	0.13	0.01	0.00	2.58	0.85	1.51	0.05
ShIRBD														
Total Area (km^2) & Length (km)	1470.23	1529.91	3.139	0.049	0.077	178.131	419.030	2.832	0.092	0.039	21.446	1.345	213.792	0
Proportion (%) of total Water Body with Pressure Footprints	41.04	15.46	0.21	0.00	0.01	12.12	28.50	0.19	0.01	0.00	1.40	0.09	13.97	0
SWRBD														
Total Area (km^2) & Length (km)	3241.63	3091.91	2.538	0.491	0.047	203.758	436.681	7.487	0.313	0.112	77.545	14.144	76.620	1.779
Proportion (%) of total Water Body with Pressure Footprints	20.10	5.50	0.08	0.02	0.00	6.29	13.47	0.23	0.01	0.00	2.51	0.46	2.48	0.06
WRBD														
Total Area (km^2) & Length (km)	4707.56	3944.52	0.252	0.010	0	200.984	1189.881	0.637	0.166	0.011	18.080	1.2230	0	2.688
Proportion (%) of total Water Body with Pressure Footprints	29.57	0.56	0.01	0.00	0	4.27	25.28	0.01	0.00	0.00	0.46	0.03	0	0.07

Table 6.12: Summary of pressure footprints identified for TraC water bodies within the ERBD. Expressed as a proportion of the total RBD TraC water body area

Water Body Code	Water Body Name	Water Body Type	Area (km^2)	Perimeter (km^2)	Land claim - High Impact	Land claim - Low Impact	Dredging - High Impact	Dredging - Low Impact	Other Disturbances to Seabed	Disposal at Sea	Flow and Sediment Manipulation Structures	Piled Structures	Shoreline Reinforcement - High Impact	Shoreline Reinforcement - Low Impact	Embankments	Causeways
EA_010_0000	Boyne Estuary Plume Zone	CW5	4.5551	9.7400	0	0	0	0.0018	1.9999	0.2016	0	0	0	0	0	0
EA_090_0000	Dublin Bay	CW5	48.0508	63.4550	1.2971	0.0381	0	5.5014	8.5465	0	0.1104	0.0016	2.821	6.750	0	0
EA_070_0000	Irish Sea Dublin (HA 09)	CW5	43.4760	59.1960	0.1115	0.0680	0	0.0026	13.6521	0	0.0627	0	0.303	0.547	0	0
EA_060_0000	Malahide Bay	CW8	2.3371	10.9400	0.0650	0	0	0	0	0	0.0239	0.0033	0.052	0	0	0
EA_020_0000	Northwestern Irish Sea (HA 08)	CW5	115.0393	121.0510	0	0	0	0.0031	84.9859	1.2580	0.0102	0.0002	3.080	2.256	0	0
EA_040_0000	Rockabill	CW5	11.8275	12.8170	0	0	0	0	0	0	0	0	0	0	0	0
EA_140_0000	Southwestern Irish Sea - Brittas Bay (HA 10)	CW6	46.9472	54.9240	0	0.1165	0	0	1.7275	0.7508	0.0158	0.0018	0.993	3.150	0	0
EA_100_0000	Southwestern Irish Sea - Killiney Bay (HA10)	CW5	87.2831	102.4150	0.1139	0	0	0.7432	16.1005	0.5047	0.0054	0	1.568	6.980	0	0
Total area / length of coastal water bodies and pressure footprints			***359.52***	***434.54***	***1.59***	***0.22***	***0.00***	***6.25***	***127.01***	***2.72***	***0.23***	***0.01***	***8.82***	***19.68***	***0.00***	***0.00***
Coverage of pressure footprints per coastal water body area / length (%)					***0.442***	***0.062***	***0.000***	***1.739***	***35.329***	***0.755***	***0.064***	***0.002***	***2.029***	***4.530***	***0.000***	***0.000***
EA_150_0100	Avoca Estuary	TW2	0.1745	5.6900	0.2093	0.0315	0	0	0	0	0.0049	0.0026	1.635	1.314	0	0
EA_010_0100	Boyne Estuary	TW2	3.1636	48.9430	0.2385	0.1894	0	1.3839	0.1694	0	0.0091	0.0040	7.183	11.370	2.307	0
EA_130_0100	Broad Lough	TW2	0.8009	14.7880	0.0689	0.0037	0	0	0	0	0.0042	0.0009	0.898	0	0	0
EA_060_0100	Broadmeadow Water	TW6	3.3345	11.7810	0	0	0	0.0050	0	0	0.0002	0	3.697	0.277	0	0
EA_110_0100	Dargle Estuary	TW2	0.0313	0.7870	0	0	0	0	0	0	0.0063	0.0007	0	0	0	0
EA_120_0100	Kilcoole Marsh	TW6	0.2341	20.7410	0	0	0	0	0	0	0	0.0003	0	0	0	0
EA_090_0300	Liffey Estuary Lower	TW2	4.8046	25.7510	0	0	0	3.0201	2.7579	0	0.0235	0.0002	15.379	0	0	0
EA_090_0400	Liffey Estuary Upper	TW2	0.1952	9.1580	0	0	0	0.1861	0	0	0	0	0	0	0	0
EA_080_0100	Mayne Estuary	TW2	1.8393	9.6250	0	0.0127	0	0	0.0311	0	0.0001	0.0002	1.188	0.514	0	0
EA_030_0100	Nanny Estuary	TW2	0.2149	10.8570	0	0	0	0	0	0	0	0.0007	0	0.522	0	0
EA_090_0100	North Bull Island	TW6	2.1259	8.6680	0.0049	0.0420	0	0.1056	0	0	0.0002	0	3.196	0	0	0
EA_050_0100	Rogerstown Estuary	TW2	3.0464	19.5370	0.3542	0.0207	0	0	0	0	0.0041	0.0006	0.538	0.174	0	0
EA_090_0200	Tolka Estuary	TW2	3.5782	18.2510	1.7991	0	0	0	0	0	0.0025	0.0029	2.917	0	1.726	0
Total area / length of coastal water bodies and pressure footprints			***23.54***	***204.58***	***2.67***	***0.30***	***0.00***	***4.70***	***2.96***	***0.00***	***0.06***	***0.01***	***36.63***	***14.17***	***4.03***	***0.00***
Coverage of pressure footprints per coastal water body area / length (%)					***11.361***	***1.274***	***0.000***	***19.966***	***12.566***	***0.000***	***0.234***	***0.057***	***17.906***	***6.927***	***1.971***	***0.000***
Total RBD area / length			***383.06***	***639.12***	***4.262***	***0.523***	***0.000***	***10.953***	***129.971***	***2.715***	***0.283***	***0.020***	***45.448***	***33.854***	***4.033***	***0.000***
Coverage of pressure footprints per RBD area / length (%)					***1.113***	***0.136***	***0.000***	***2.859***	***33.930***	***0.709***	***0.074***	***0.005***	***7.111***	***5.297***	***0.631***	***0.000***

Table 6.13: Summary of pressure footprints identified for TraC water bodies within the NBRBD. Expressed as a proportion of the total RBD TraC water body area

Water Body Code	Water Body Name	Water Body Type	Area (km^2)	Perimeter (km^2)	Land claim - High Impact	Land claim - Low Impact	Dredging - High Impact	Dredging - Low Impact	Other Disturbances to Seabed	Disposal at Sea	Flow and Sediment Manipulation Structures	Piled Structures	Shoreline Reinforcement - High Impact	Shoreline Reinforcement - Low Impact	Embankments	Causeways
NB_030_0000	Carlingford Lough	CW8	44.6729	49.0920	0	0	0	3.2074	8.1308	0	0	0	0.779	0	0	0
NB_025_0000	Louth Coast (HA 06)	CW5	38.4497	43.6120	0	0	0	0	18.6110	1.1423	0.0015	0	0.757	0.047	0	0
NB_040_0000	Outer Dundalk Bay	CW5	63.7207	60.7050	0	0	0	0.4346	35.6075	0	0	0	1.344	0	0	0
NB_010_0000	Portstewart Bay	CW2	122.4223	55.7890	0	0	0	2.9833	0	0	0.0002	0	0.113	0.150	0	0
Total area / length of coastal water bodies and pressure footprints			***269.27***	***209.20***	***0.00***	***0.00***	***0.00***	***6.63***	***62.35***	***1.14***	***0.00***	***0.00***	***2.99***	***0.20***	***0.00***	***0.00***
Coverage of pressure footprints per coastal water body area / length (%)					***0.000***	***0.000***	***0.000***	***2.461***	***23.155***	***0.424***	***0.001***	***0.000***	***1.431***	***0.094***	***0.000***	***0.000***
NB_040_0300	Ballymascanlan Estuary	TW2	0.8903	12.6510	0	0	0	0	0	0	0	0	0	0	0	0
NB_010_0100	Bann Estuary	TW2	2.4981	28.2740	0	0	0	0	0	0	0	0	0	0.000	0	0
NB_030_0200	Carlingford Lagoons	TW6	0.0160	1.8550	0	0	0	0	0	0	0	0	0	0	0	0
NB_040_0200	Castletown Estuary	TW2	1.8761	15.4250	0	0	0	0	0	0	0	0	0	0	0	0
NB_040_0600	Corstown Lagoon	TW6	0.0012	0.1320	0	0	0	0	0	0	0	0	0	0	0	0
NB_040_0400	Fane Estuary	TW2	0.0934	8.4470	0	0	0	0.0750	0	0	0	0	0	0	0	0
NB_040_0500	Glyde Estuary	TW2	0.1186	9.3960	0	0	0	0.1186	0	0	0	0	0	0	7.730	0
NB_040_0100	Inner Dundalk Bay	TW2	33.3460	31.8740	0	0	0	1.8661	21.7862	0	0	0	0.100	0	0	0
NB_030_0100	Newry Estuary	TW2	2.8778	25.7150	0	0	0	0.2392	0	0	0	0	0	0	0	0
NB_030_0250	Shilties Lough	TW6	0.0031	0.3010	0	0	0	0	0	0	0	0	0	0	0	0
Total area / length of coastal water bodies and pressure footprints			***41.72***	***134.07***	***0.00***	***0.00***	***0.00***	***2.30***	***21.79***	***0.00***	***0.00***	***0.00***	***0.10***	***0.00***	***7.73***	***0.00***
Coverage of pressure footprints per coastal water body area / length (%)					***0.000***	***0.000***	***0.000***	***5.510***	***52.219***	***0.000***	***0.000***	***0.000***	***0.075***	***0.000***	***5.766***	***0.000***
Total RBD area / length			***310.99***	***343.27***	***0.000***	***0.000***	***0.000***	***8.924***	***84.136***	***1.142***	***0.002***	***0.000***	***3.093***	***0.197***	***7.730***	***0.000***
Coverage of pressure footprints per RBD area / length (%)					***0.000***	***0.000***	***0.000***	***2.870***	***27.054***	***0.367***	***0.001***	***0.000***	***0.901***	***0.057***	***2.252***	***0.000***

Table 6.14: Summary of pressure footprints identified for TraC water bodies within the NWRBD. Expressed as a proportion of the total RBD TraC water body area

Water Body Code	Water Body Name	Water Body Type	Area (km^2)	Perimeter (km^2)	Land claim - High Impact	Land claim - Low Impact	Dredging - High Impact	Dredging - Low Impact	Other Disturbances to Seabed	Disposal at Sea	Flow and Sediment Manipulation Structures	Piled Structures	Shoreline Reinforcement - High Impact	Shoreline Reinforcement - Low Impact	Embankments	Causeways
NW_170_0000	Ballyness Bay	CW5	5.9485	27.3120	0	0	0	0	0	0	0.0014	0.000	0	0	0	0
NW_020_0000	Bundoran Bay	CW5	1.9209	10.7320	0	0	0	0	0	0	0.0015	0	0	0	0	0
NW_010_0000	Donegal Bay (Erne)	CW5	226.0561	85.7420	0	0	0	0.0118	15.1235	0	0.0053	0	0	0	0	0
NW_070_0000	Donegal Bay Northern	CW2	518.2858	133.8440	0	0	0	81.0819	4.2690	0.4355	0.0020	0	0.090	0	0	0
NW_140_0000	Dungloe Bay	CW5	11.7112	58.3990	0	0	0	0	0	0.041165	0.0025	0	0.266	0	0	0
NW_120_0000	Gweebarra Bay	CW5	34.6608	32.1430	0	0	0	0	7.5664	0	0.0009	0	0	0.121	0	0
NW_160_0000	Gweedore Bay	CW5	32.8801	93.8330	0	0	0	0	0	0	0.0041	0	0	0	0	0
NW_060_0000	Inver Bay	CW5	13.3790	17.5580	0	0	0	0	6.8086	0	0.0015	0	0	0	0	0
NW_085_0000	Killybegs Harbour	CW8	2.8339	16.9780	0	0	0	0.9414	0	0	0.0441	0.013	0	0	0	0
NW_250_0000	Lough Foyle	CW8	165.7285	61.7800	0	0	0	8.2741	0	0	0.0189	0	1.662	1.389	0	0
NW_220_0000	Lough Swilly	CW5	97.7463	91.9130	0	0	0	12.8065	23.3281	0	0.0047	0.002	1.842	0	0	0
NW_110_0000	Loughros Bay	CW5	30.9434	66.4530	0	0	0	0	4.7062	0	0.0010	0	0.287	0	0	0
NW_080_0000	McSwines Bay	CW5	16.3170	26.3510	0	0	0	0.6941	0	0	0.0007	0	0	0	0	0
NW_200_0000	Mulroy Bay Broadwater	CW8	30.4289	106.2790	0	0	0	0	0	0	0.0035	0.000	0	0	0	0
NW_210_0000	Mulroy Bay Northwater	CW8	4.5968	27.7790	0	0	0	0	0	0	0.0002	0	0	0	0	0
NW_230_0000	Northern Atlantic Seaboard (HAs 40;02)	CW2	200.0678	177.1150	0	0	0	2.9609	89.0847	0	0.0040	0	0.115	0	0	0
NW_100_0000	Northwestern Atlantic Seaboard (HAs 37;38)	CW2	735.5116	460.8540	0	0.1511	0	10.6930	8.1467	0.0718	0.0061	0	0	0.159	0	0
NW_150_0000	Rutland Sound	CW5	9.4564	61.5700	0	0	0	0	0	0	0.0099	0	0.242	0	0	0
NW_150_0100	Sally's Lough	CW10	0.0452	1.7510	0	0	0	0	0	0	0	0	0	0	0	0
NW_190_0000	Sheephaven Bay	CW5	38.1668	77.2580	0.0056	0	0	0	0	0	0.0057	0	0.198	0	0	0
NW_180_0000	Tory Island Waters	CW2	32.8296	45.4120	0	0	0	0	0	0.2968	0.0027	0	0	0	0	0
NW_240_0000	Trawbreaga Bay	CW8	12.0989	39.3860	0	0	0	0	12.0039	0	0.0000	0	0	0	0	0
NW_130_0000	Trawena Bay	CW8	8.4127	25.8700	0	0	0	0	0	0	0	0	0	0	0	0
Total area / length of coastal water bodies and pressure footprints			***2230.03***	***1746.31***	***0.01***	***0.15***	***0.00***	***117.46***	***171.04***	***0.85***	***0.12***	***0.02***	***4.70***	***1.67***	***0.00***	***0.00***
Coverage of pressure footprints per coastal water body area / length (%)					***0.000***	***0.007***	***0.000***	***5.267***	***7.670***	***0.038***	***0.005***	***0.001***	***0.269***	***0.096***	***0.000***	***0.000***
NW_220_0200	Blanket Nook Lough	TW6	0.3203	4.6780	0	0	0	0.0400	0	0	0	0	0	0	11.855	0
NW_200_0200	Carrick Beg Lough (South)	TW6	0.0139	0.5340	0	0	0	0	0	0	0	0	0	0	0	0
NW_220_0400	Crana Estuary	TW2	0.8343	7.1880	0	0	0	0	0	0	0.0074	0.0003	0	0.560	0	0
NW_020_0100	Drowes Estuary	TW2	0.1372	1.8290	0	0	0	0	0	0	0	0	0	0	0	0
NW_010_0100	Duff Estuary	TW2	0.0053	0.4600	0	0	0	0.0053	0	0	0	0	0	0	0	0
NW_040_0100	Durnesh Lough	TW6	0.6964	8.1990	0	0	0	0	0	0	0	0	0	0	0	0
NW_060_0100	Eany Water Estuary	TW2	0.0771	3.9360	0	0	0	0	0	0	0.0002	0	0	0	0	0
NW_030_0100	Erne Estuary	TW2	2.5743	12.3110	0	0	0	0	0	0	0.0009	0.0003	0	0	0	0
NW_250_0100	Foyle and Faughan Estuaries	TW2	34.4844	124.6530	0.2432	0	0	1.5449	0	0	0.0002	0	0	0	11.580	0
NW_120_0100	Gweebarra Estuary	TW2	8.2565	46.0440	0	0	0	0	2.7872	0	0.0001	0	0.430	0	0	0
NW_160_0200	Gweedore Estuary	TW2	4.4500	35.5630	0	0	0	0	0	0	0.0003	0	0	0	0	0
NW_220_0300	Inch Lough	TW6	1.6287	10.5580	0	0	0	0.0027	0	0	0	0	0	0	11.516	0
NW_050_0100	Inner Donegal Bay	TW2	8.1223	48.5860	0	0	0	0	0	0	0.0057	0.0003	1.997	0	0	0
NW_190_0100	Lackagh Estuary	TW2	1.2162	10.9010	0	0	0	0	0	0	0	0	0	0	0	0
NW_160_0100	Loch Chionn Caslach (Kincas Lough)	TW6	0.0425	1.3080	0	0	0	0	0	0	0	0	0	0	0	0
NW_180_0100	Loch O Dheas, Tory Island	TW6	0.0352	1.1350	0	0	0	0	0	0	0	0	0	0	0	0
NW_140_0100	Maghery Lough	TW6	0.1670	2.3340	0	0	0	0	0	0	0	0	0	0	0	0
NW_160_0500	Meenaclady	TW2	0.0547	2.7090	0	0	0	0	0	0	0.0057	0	0	0	0	0
NW_160_0300	Moorlagh	TW6	0.0777	1.5560	0	0	0	0	0	0	0	0	0	0	0	0
NW_110_0100	Owenea Estuary	TW2	7.7138	31.4670	0	0	0	0	0.1703	0	0.0002	0	0	0	0	0
NW_220_0100	Swilly Estuary	TW2	59.3555	103.7890	0	0	0	0.0859	58.4947	0	0.0187	0.0006	9.420	1.543	23.139	1.985
NW_090_0100	Teelin Bay	TW2	1.1323	9.7560	0	0	0	0	0	0	0.0017	0	0.078	0	0	0
Total area / length of coastal water bodies and pressure footprints			***131.40***	***469.49***	***0.24***	***0.00***	***0.00***	***1.68***	***61.45***	***0.00***	***0.04***	***0.00***	***11.93***	***2.10***	***58.09***	***1.99***
Coverage of pressure footprints per coastal water body area / length (%)					***0.185***	***0.000***	***0.000***	***1.278***	***46.769***	***0.000***	***0.031***	***0.001***	***2.540***	***0.448***	***12.373***	***0.423***
Total RBD area / length			***2361.42***	***2215.81***	***0.249***	***0.151***	***0.000***	***119.143***	***232.489***	***0.845***	***0.162***	***0.017***	***16.627***	***3.772***	***58.089***	***1.985***
Coverage of pressure footprints per RBD area / length (%)					***0.011***	***0.006***	***0.000***	***5.045***	***9.845***	***0.036***	***0.007***	***0.001***	***0.750***	***0.170***	***2.622***	***0.090***

Table 6.15: Summary of pressure footprints identified for TraC water bodies within the SERBD. Expressed as a proportion of the total RBD TraC water body area

Water Body Code	Water Body Name	Water Body Type	Area (km^2)	Perimeter (km^2)	Land claim - High Impact	Land claim - Low Impact	Dredging - High Impact	Dredging - Low Impact	Other Disturbances to Seabed	Disposal at Sea	Flow and Sediment Manipulation Structures	Piled Structures	Shoreline Reinforcement - High Impact	Shoreline Reinforcement - Low Impact	Embankments	Causeways
SE_090_0000	Bannow Bay	CW8	9.5402	28.5340	0	0	0	0	0	0	0	0	1.695	0	0	0
SE_140_0000	Dungarvan Harbour	CW5	22.8231	25.1140	0	0	0	0	1.9826	0	0	0	2.616	0.880	0	0
SE_050_0000	Eastern Celtic Sea (HAs 13;17)	CW2	797.2917	295.1390	0	0	0	17.3949	143.5533	1.2372	0.0023	0	4.855	1.110	0	0
SE_045_0000	Rosslare Harbour	CW5	0.1073	1.8430	0	0	0	0.1060	0	0	0	0	0	0	0	0
SE_010_0000	Southwestern Irish Sea (HAs 11;12)	CW5	123.5815	139.8560	0	0	0	15.9996	7.9104	0.1523	0.0138	0	3.702	3.020	0	0
SE_120_0000	Tramore Back Strand	CW8	5.3019	21.3790	0.7397	0	0	0	1.8063	0	0.0340	0	1.204	0.592	2.453	0
SE_110_0000	Tramore Bay	CW5	12.2499	16.9160	0	0	0	0	0	0	0.0007	0	1.490	0	0	0
SE_100_0000	Waterford Harbour	CW2	33.3757	32.2250	0	0	0	13.6966	0.5425	0	0.0240	0.0040	0.315	0.706	0	0
SE_040_0000	Wexford Harbour	CW8	19.8100	27.1730	0	0	0	0	0	0	0.0048	0	0.409	0.582	4.063	0
Total area / length of coastal water bodies and pressure footprints			*1024.08*	*588.18*	*0.74*	*0.00*	*0.00*	*47.20*	*155.80*	*1.39*	*0.08*	*0.00*	*16.29*	*6.89*	*6.52*	*0.00*
Coverage of pressure footprints per coastal water body area / length (%)					*0.072*	*0.000*	*0.000*	*4.609*	*15.213*	*0.136*	*0.008*	*0.000*	*2.769*	*1.171*	*1.108*	*0.000*
SE_080_0200	Ballyteige Channels	TW6	0.4657	10.5800	0	0	0	0.4444	0	0	0	0	0	0	0	0
SE_100_0250	Barrow Nore Estuary Upper	TW2	0.6429	9.1480	0	0	0	0	0	0	0	0	0	0	0	0
SE_100_0100	Barrow Suir Nore Estuary	TW2	28.2138	44.0760	0	0	0.5105	6	2.7923	0.0199	0	0	1.620	0.874	0.000	0
SE_140_0200	Brickey Estuary	TW2	0.6285	9.1090	0	0	0	0.0544	0	0	0	0	0	0	2.836	0
SE_080_0100	Bridgetown Estuary	TW2	2.0283	18.2380	0	0	0	0.2419	0	0	0	0	0.832	0.000	4.711	0.000
SE_140_0100	Colligan Estuary	TW2	10.0265	34.1220	0	0	0	0	0	0	0	0	5.490	0.000	0	0
SE_090_0100	Corock Estuary	TW2	0.3487	11.1060	0	0	0	0	0	0	0	0	0	0	0	0
SE_060_0100	Lady's Island Lake	TW6	2.9605	17.7190	0	0	0	0	0	0	0	0	0	0	0	0
SE_040_0200	Lower Slaney Estuary	TW2	18.3502	63.3750	0.3024	0.0143	0	0	0	0	0.0287	0.0052	0.684	1.607	2.211	0.571
SE_100_0500	Lower Suir Estuary	TW2	4.3235	30.8060	0	0	0.1501	1.4039	0	0	0	0	0	0	0	0
SE_130_0100	Mahon Estuary	TW2	0.0956	8.2330	0	0	0	0	0	0	0	0	0	0	0	0
SE_100_0550	Middle Suir Estuary	TW2	7.0323	65.3870	0	0	0	0.4422	0	0	0	0	0	0	0	0
SE_100_0200	New Ross Port	TW2	6.7110	40.2100	0	0	0	1.8972	0	0	0	0	0	0	0	0
SE_100_0400	Nore Estuary	TW2	1.2578	34.1180	0	0	0	0	0	0	0	0	0	0	0	0
SE_040_0100	North Slob Channels	TW6	0.3718	11.2190	0	0	0	0	0	0	0	0	0	0	0	0
SE_020_0100	Owenavorragh Estuary	TW2	0.0631	4.4100	0	0	0	0.0281	0	0	0	0	2.626	0	0	0
SE_040_0400	South Slob Channel	TW6	0.5206	5.5770	0	0	0	0	0	0	0	0	0	0	0	0
SE_070_0100	Tacumshin Lake	TW6	3.1053	21.6510	0	0	0	0	0	0	0	0	0	0	0	0
SE_100_0300	Upper Barrow Estuary	TW2	1.1472	34.0110	0	0	0	0	0	0	0	0	0	0	0	0
SE_040_0300	Upper Slaney Estuary	TW2	0.8069	18.0740	0	0	0	0	0	0	0	0	0	0	0	0
SE_100_0600	Upper Suir Estuary	TW2	1.0902	28.2420	0	0	0	0.1066	0	0	0	0.0006	1.054	0.000	0.474	0
Total area / length of coastal water bodies and pressure footprints			*90.19*	*519.41*	*0.30*	*0.01*	*0.66*	*10.63*	*2.79*	*0.02*	*0.03*	*0.01*	*12.31*	*2.48*	*10.23*	*0.57*
Coverage of pressure footprints per coastal water body area / length (%)					*0.335*	*0.016*	*0.733*	*11.786*	*3.096*	*0.022*	*0.032*	*0.007*	*2.369*	*0.478*	*1.970*	*0.110*
Total RBD area / length			*1114.27*	*1107.59*	*1.042*	*0.014*	*0.661*	*57.827*	*158.587*	*1.409*	*0.108*	*0.010*	*28.592*	*9.371*	*16.748*	*0.571*
Coverage of pressure footprints per RBD area / length (%)					*0.094*	*0.001*	*0.059*	*5.190*	*14.232*	*0.126*	*0.010*	*0.001*	*2.581*	*0.846*	*1.512*	*0.052*

Table 6.16: Summary of pressure footprints identified for TraC water bodies within the ShIRBD. Expressed as a proportion of the total RBD TraC water body area

Water Body Code	Water Body Name	Water Body Type	Area (km^2)	Perimeter (km^2)	Land claim - High Impact	Land claim - Low Impact	Dredging - High Impact	Dredging - Low Impact	Other Disturbances to Seabed	Disposal at Sea	Flow and Sediment Manipulation Structures	Piled Structures	Shoreline Reinforcement - High Impact	Shoreline Reinforcement - Low Impact	Embankments	Causeways
SH_030_0000	Brandon Bay	CW5	47.02	38.63	0	0	0	0	47.013	0	0	0	0.564	0.452	0	0
SH_060_1400	Clooncóneen Pool	CW10	0.05	1.12	0	0	0	0	0	0	0	0	0	0	0	0
SH_080_0000	Doonbeg Bay	CW5	6.34	11.92	0	0	0	0.030	0	0	0	0	0.225	0	0	0
SH_050_0000	Inner Tralee Bay	CW8	15.61	28.11	0	0	0.006	0.498	15.607	0	0.022	0	1.881	0.194	0	0
SH_100_0000	Liscannor Bay	CW2	30.31	28.27	0	0	0	0	0	0	0.001	0	2.010	0	0	0
SH_060_0000	Mouth of the Shannon (HAs 23;27)	CW2	334.13	186.62	0.031	0.010	0	81.468	51.352	0	0.015	0.001	5.364	0.035	6.551	0
SH_040_0000	Outer Tralee Bay	CW5	215.81	111.56	0	0	0	31.181	215.096	1.577	0.0002	0.002	2.501	0.136	0	0
SH_060_1300	Scattery Island Lagoon	CW10	0.02	0.63	0	0	0	0	0	0	0	0	0	0	0	0
SH_070_0000	Shannon Plume (HAs 27;28)	CW2	379.35	249.78	0	0	0	6.923	67.273	0	0.003	0.0002	2.892	0	0.100	0
SH_020_0000	Smerwick Harbour	CW5	12.58	29.50	0	0	0	0	0	0	0.001	0	0.074	0.069	0	0
SH_010_0000	Southwestern Atlantic Seaboard (HA 23)	CW2	178.88	182.70	0	0	0	12.158	19.626	0	0	0	0.059	0	0	0
Total area / length of coastal water bodies and pressure footprints			***1220.10***	***868.83***	***0.03***	***0.01***	***0.01***	***132.26***	***415.97***	***1.58***	***0.04***	***0.004***	***15.57***	***0.89***	***6.65***	***0.00***
Coverage of pressure footprints per coastal water body area / length (%)					***0.003***	***0.001***	***0.001***	***10.840***	***34.093***	***0.129***	***0.003***	***0.0003***	***1.792***	***0.102***	***0.765***	***0.00***
SH_110_0100	Aille Clare Estuary	TW2	0.10	1.56	0	0	0	0	0	0	0	0	0	0	0	0
SH_050_0200	Blennerville Lake East	TW6	0.01	0.70	0	0	0	0	0	0	0	0	0	0	0	0
SH_050_0300	Blennerville Lake West	TW6	0.01	0.48	0	0	0	0	0	0	0	0	0	0	0	0
SH_060_0100	Cashen	TW2	2.67	33.54	0	0	0	1.145	0	0	0	0.001	1.001	0.161	23.139	0
SH_060_1200	Clonderalaw Bay	TW2	3.81	21.43	0	0	0	0	0	0	0	0	0	0	7.576	0
SH_060_0600	Deel Estuary	TW2	3.02	22.23	0	0	0	0.001	0	0	0	0	0	0	1.607	0
SH_080_0100	Doonbeg Estuary	TW2	0.89	4.82	0	0	0	0	0	0	0.001	0	0	0	0	0
SH_060_1100	Fergus Estuary	TW2	64.75	171.47	1.963	0.026	0	0.020	0	0	0.002	0.0002	0	0	61.988	0
SH_060_0350	Foynes Harbour	TW2	0.75	6.10	0	0	0	0.334	0	0	0	0	0.299	0	0	0
SH_100_0100	Inagh Estuary	TW2	0.63	23.44	0	0	0	0	0	0	0	0.001	0	0	0	0
SH_050_0100	Lee K Estuary	TW2	3.06	17.11	0	0	0	0	3.063	0	0.006	0	1.703	0	0	0
SH_060_0900	Limerick Dock	TW2	2.49	40.55	0.268	0	0.058	0.107	0	0.080	0	0	0	0	7.956	0
SH_090_0100	Lough Donnell	TW6	0.15	2.13	0	0	0	0	0	0	0	0	0	0	0	0
SH_040_0100	Lough Gill	TW6	1.40	6.56	0	0	0	0.0004	0	0	0	0	0	0	0	0
SH_060_0300	Lower Shannon Estuary	TW2	123.08	162.72	0.312	0	0.013	39.698	0	1.131	0.028	0.029	2.659	0.298	7.274	0
SH_060_0700	Maigue Estuary	TW2	3.21	47.10	0	0	0	1.426	0	0	0	0	0	0	40.431	0
SH_060_0400	Poulaweala Lough / Quayfield Lough	TW6	0.01	0.98	0	0	0	0	0	0	0	0	0	0	0	0
SH_060_1000	Shannon Airport Lagoon	TW6	0.19	1.82	0	0	0	0	0	0	0	0	0	0	0	0
SH_060_0200	Upper Feale Estuary	TW2	0.38	14.30	0	0	0	0.341	0	0	0	0.0003	0	0	12.380	0
SH_060_0800	Upper Shannon Estuary	TW2	39.51	82.05	0.566	0.014	0	2.799	0	0.044	0.013	0.005	0.214	0	44.790	0
Total area / length of coastal water bodies and pressure footprints			***250.13***	***661.07***	***3.11***	***0.04***	***0.07***	***45.87***	***3.06***	***1.25***	***0.05***	***0.04***	***5.88***	***0.46***	***207.14***	***0.00***
Coverage of pressure footprints per coastal water body area / length (%)					***1.243***	***0.016***	***0.028***	***18.339***	***1.225***	***0.501***	***0.020***	***0.014***	***0.889***	***0.069***	***31.334***	***0.000***
Total RBD area / length			***1470.23***	***1529.91***	***3.139***	***0.049***	***0.077***	***178.131***	***419.030***	***2.832***	***0.092***	***0.039***	***21.446***	***1.345***	***213.792***	***0.000***
Coverage of pressure footprints per RBD area / length (%)					***0.214***	***0.003***	***0.005***	***12.116***	***28.501***	***0.193***	***0.006***	***0.003***	***1.402***	***0.088***	***13.974***	***0.00***

Table 6.17: Summary of pressure footprints identified for TraC water bodies within the SWRBD. Expressed as a proportion of the total RBD TraC water body area

Water Body Code	Water Body Name	Water Body Type	Area (km^2)	Perimeter (km^2)	Land claim - High Impact	Land claim - Low Impact	Dredging - High Impact	Dredging - Low Impact	Other Disturbances to Seabed	Disposal at Sea	Flow and Sediment Manipulation Structures	Piled Structures	Shoreline Reinforcement - High Impact	Shoreline Reinforcement - Low Impact	Embankments	Causeways
SW_200_0000	Ballinskelligs Bay	CW2	48.9436	60.2050	0	0	0	0	0	0	0.0004	0	1.610	0	0.492	0
SW_040_0000	Ballycotton Bay	CW5	26.5841	33.2120	0	0	0	0	0	0	0.0034	0	1.708	0.619	0	0
SW_140_0100	Ballyrisode Bridge Lagoon	CW10	0.0113	0.4420	0	0	0	0	0	0	0	0	0	0	0	0
SW_180_0000	Berehaven	CW5	16.3341	54.8770	0.0437	0.0024	0	16.2255	7.7652	0	0.0112	0.0027	1.552	1.095	0	0
SW_100_0400	Clogheen Strand	CW10	0.1292	3.1410	0	0	0	0.0046	0	0	0	0	0	0	0	0
SW_100_0000	Clonakilty Bay	CW5	31.7952	43.8780	0	0	0	0	0	0	0.0014	0	0.944	0	0	0
SW_060_0000	Cork Harbour	CW8	27.8111	55.1410	0.9124	0.2836	0.0469	4.5777	11.5303	0	0.0296	0.0298	11.947	1.135	0.385	0.787
SW_090_0000	Courtmacsherry Bay	CW5	59.0482	52.9850	0	0	0	0	0.1973	0	0.0006	0.0025	1.510	0	0	0
SW_240_0000	Dingle Harbour	CW5	4.1880	15.8100	0.0413	0	0	0	0	0.4864	0.0276	0.0002	1.364	1.967	0.685	0
SW_160_0000	Dunmanus Bay	CW2	84.5382	113.0170	0.0014	0	0	0	14.5749	0	0.0047	0.0001	0.196	0.810	0.144	0
SW_120_0000	Fastnet Waters	CW2	10.9455	12.0350	0	0	0	0	0	0	0	0	0	0	0	0
SW_100_0200	Inchydoney	CW10	0.0304	0.7450	0	0	0	0	0	0	0	0	0	0	0	0
SW_080_0000	Kinsale Harbour	CW5	14.8101	29.4700	0	0	0	0	0	0	0.0005	0	0.000	0	0	0
SW_080_0200	Kinsale Marsh, Commoge	CW10	0.0495	0.9190	0	0	0	0	0	0	0	0	0	0	0	0
SW_170_0000	Outer Bantry Bay	CW2	276.1832	182.7030	0	0	0	139.9455	79.4077	0.0434	0.0058	0.0026	0.697	0	0	0
SW_050_0000	Outer Cork Harbour	CW5	31.3534	42.5710	0	0.1506	0	6.3449	0.1871	0	0.0014	0.0001	0.755	0.316	0	0.258
SW_230_0000	Outer Dingle Bay	CW2	383.1596	153.8540	0	0	0	0	3.0496	0	0.0027	0	0.996	0	0	0
SW_190_0000	Outer Kenmare River	CW2	188.7632	283.7560	0	0	0	0	188.7380	0	0.0064	0.0002	1.778	0.709	0	0
SW_210_0000	Portmagee Channel	CW8	12.5931	47.3590	0.0053	0	0	0	10.7217	0	0.0109	0.0033	0.423	0	0	0
SW_060_1000	Raffeen Lake, Shanbally	CW10	0.0284	0.7340	0	0	0	0	0	0	0	0	0	0	0	0
SW_140_0000	Roaring Water Bay	CW2	189.5933	298.7900	0	0.0002	0	0	15.6977	0.8726	0.0115	0.0024	0.392	0.060	0	0
SW_110_0000	Rosscarbery Bay	CW5	68.8294	100.7880	0.0033	0	0	0	0	5.2997	0.0032	0.0003	1.915	0	0	0
SW_150_0000	South Western Atlantic Seaboard (HAs 21;22)	CW2	1540.3034	492.5820	0	0	0	34.3488	84.8635	0.7854	0.0014	0	0.213	0.584	0	0
SW_220_0000	Valencia Harbour	CW8	11.9634	33.9970	0	0	0	0	3.0771	0	0.0006	0	0.000	0	0	0
SW_010_0000	Western Celtic Sea (HAs 18;19;20)	CW2	513.8708	387.2080	0	0	0	5.9230	0.6738	5.7748	0.0013	0	0.556	0	0	0
SW_100_0300	White's Marsh	CW10	0.0250	1.1140	0	0	0	0.0007	0	0	0	0	0	0	1.145	0
SW_020_0000	Youghal Bay	CW5	46.8265	41.2200	0	0	0	0	0	0	0.0004	0	0.173	0.624	0	0
Total area / length of coastal water bodies and pressure footprints			*3588.71*	*2542.55*	*1.01*	*0.44*	*0.05*	*207.37*	*420.48*	*13.26*	*0.13*	*0.04*	*28.73*	*7.92*	*2.85*	*1.05*
Coverage of pressure footprints per coastal water body area / length (%)					*0.028*	*0.012*	*0.001*	*5.778*	*11.717*	*0.370*	*0.003*	*0.001*	*1.130*	*0.311*	*0.112*	*0.041*
SW_170_0500	Adrigole Harbour	TW2	1.8064	10.8390	0	0.0080	0	0	0	0	0.0012	0	0.000	0	0	0
SW_190_0100	Ardgroom	TW2	5.3877	24.0860	0	0	0	0	5.3856	0	0.0011	0	0.212	0	0	0
SW_090_0200	Argideen Estuary	TW2	4.9225	24.9350	0	0.0305	0	0	0	0	0.0046	0.0032	2.000	0	0	0
SW_190_0400	Blackwater K Estuary	TW2	0.1117	2.6690	0	0	0	0	0.1115	0	0	0	0	0	0	0
SW_230_0200	Castlemaine Harbour	TW2	6.3555	66.4730	0	0	0	0.3595	0	0	0.0006	0.0014	3.100	0.098	40.724	0
SW_100_0100	Clonakilty Harbour	TW2	1.7946	10.4780	0.0320	0	0	0	0	0	0.0020	0	5.178	0	2.014	0
SW_230_0100	Cromane	TW2	50.8741	107.4500	0	0	0	0.0183	0	0	0.0174	0.0006	3.985	1.449	8.331	0
SW_060_0200	Cuskinny Lake	TW6	0.0374	0.8070	0	0	0	0	0	0	0	0	0	0	0	0
SW_190_0500	Drongawn Lough, Sneem	TW6	0.1194	2.3590	0	0	0	0	0.1192	0	0	0	0	0	0	0
SW_160_0100	Farranamagh Lough	TW6	0.0443	1.1730	0	0	0	0	0	0	0	0	0	0	0	0
SW_220_0100	Ferta	TW2	2.4057	19.9870	0.0017	0.0092	0	0	0	0	0.0002	0.0037	0.000	0	0	0
SW_110_0300	Glandore Harbour	TW2	4.4943	22.1130	0	0	0	0	0	0	0.0019	0.0036	0.775	0	0	0
SW_060_0800	Glashaboy Estuary	TW2	0.1237	4.4710	0	0	0	0	0	0	0.0016	0.0008	0.000	0	0	0
SW_170_0400	Glengarriff Harbour	TW2	3.6638	23.4900	0.0181	0	0	0	0	0	0.0006	0.0010	0.286	0	0	0
SW_130_0100	Ilen Estuary	TW2	9.6603	89.9960	0.0145	0	0	0	0	0	0.0024	0.0067	0.479	0	0	0
SW_170_0100	Inner Bantry Bay	TW2	11.7354	35.7790	0.0098	0	0	0.1493	0	0	0.0052	0.0006	2.474	0	0	0
SW_190_0300	Inner Kenmare River	TW2	3.7869	28.4130	0	0	0	0	3.7843	0	0.0012	0.0011	0.268	0	0	0
SW_110_0100	Kilkeran Lake	TW6	0.1829	1.9090	0	0	0	0	0	0	0	0	0	0	0	0
SW_190_0200	Kilmakilloge Harbour	TW2	5.8519	37.1810	0	0	0	0	5.8487	0	0.0017	0	0.078	0	0	0
SW_170_0200	Kilmore Lake, Whiddy Island	TW6	0.0568	1.0240	0	0	0	0	0	0	0	0	0	0	0	0
SW_020_0400	Lackaroe (Glendine Estuary)	TW6	0.0414	1.2960	0	0	0	0	0	0	0	0	0	0	0	0
SW_060_0900	Lee (Cork) Estuary Lower	TW2	0.8863	10.9140	0.5797	0	0	0.4197	0	0	0.0017	0.0018	5.050	0.086	0	0
SW_060_0950	Lee (Cork) Estuary Upper	TW2	0.2524	14.2880	0	0	0	0	0	0	0	0.0141	1.789	0	0	0
SW_140_0200	Lissagriffin Lake	TW6	0.1552	1.9670	0	0	0	0	0	0	0	0.0036	0.0000	0	0	0
SW_060_1100	Lough Beg / Curraghbinny	TW6	0.0140	0.6470	0	0	0	0	0	0	0	0	0	0	0	0
SW_060_0750	Lough Mahon	TW2	12.2295	52.9500	0.6252	0	0	1.3561	0	0	0.0417	0.0046	10.962	3.269	1.390	0
SW_060_0700	Lough Mahon (Harper's Island)	TW2	2.0459	17.1080	0.2255	0	0	0	0	0	0.0148	0.0066	0.666	0	3.635	0
SW_080_0100	Lower Bandon Estuary	TW2	6.7854	49.0710	0	0.0062	0	0	0	0	0.0051	0.0062	1.416	0	0	0
SW_020_0100	Lower Blackwater M Estuary / Youghal Harbour	TW2	12.0684	95.6330	0	0	0	0.0047	0	0	0.0720	0.0041	3.879	0	3.617	0
SW_060_0300	North Channel Great Island	TW2	7.9616	37.7030	0	0	0	0	0	0	0.0002	0.0008	0.938	0.066	1.267	0
SW_060_0400	Owenacurra Estuary	TW2	1.1214	13.8710	0	0	0	0	0	0	0	0	0	0	0	0.733
SW_060_1200	Owenboy Estuary	TW2	2.4223	19.2900	0.0196	0	0	0	0	0	0.0010	0	4.980	1.257	0.117	0
SW_070_0100	Oysterhaven	TW2	3.6024	29.8160	0	0	0	0	0.8727	0	0.0111	0.0035	0.089	0	0	0
SW_070_0200	Oysterhaven Lake, Clashroe	TW6	0.0231	1.2050	0	0	0	0	0	0	0	0	0	0	0	0
SW_150_0100	Reen Point Pool	TW6	0.0075	0.3810	0	0	0	0	0	0	0	0	0	0	0	0
SW_170_0300	Reenydonagan Lough	TW6	0.2408	2.7400	0	0	0	0	0	0	0	0	0	0	0	0
SW_110_0200	Rosscarbery Harbour	TW6	0.2562	2.5270	0.0045	0.0005	0	0	0	0	0	0	0.7680	0	0	0
SW_060_0100	Rostellan Lake	TW6	0.1483	2.1250	0	0	0	0	0	0	0	0	0	0	0	0
SW_060_0600	Slatty Bridge, Fota Island	TW6	0.0169	0.6430	0	0	0	0	0	0	0	0	0	0	0	0
SW_190_0600	Sneem Harbour	TW2	0.7504	15.7290	0	0	0	0	0.7489	0	0	0	0	0	0	0
SW_080_0300	Upper Bandon Estuary	TW2	0.3505	8.5950	0	0	0	0	0	0	0	0	0	0	0	0
SW_020_0500	Upper Blackwater M Estuary	TW2	0.7032	20.2350	0	0	0	0	0	0	0	0	0	0	0	0
SW_030_0100	Womanagh Estuary	TW2	1.2922	22.1960	0	0	0	0.0029	0	0	0	0.0000	0	0	12.675	0
Total area / length of coastal water bodies and pressure footprints			*166.79*	*936.56*	*1.53*	*0.05*	*0.00*	*2.31*	*16.87*	*0.00*	*0.19*	*0.07*	*49.37*	*6.23*	*73.77*	*0.73*
Coverage of pressure footprints per coastal water body area / length (%)					*0.918*	*0.033*	*0.000*	*1.385*	*10.115*	*0.000*	*0.113*	*0.041*	*5.272*	*0.665*	*7.877*	*0.078*
Total RBD area / length			*3755.50*	*3479.12*	*2.538*	*0.491*	*0.047*	*209.681*	*437.355*	*13.262*	*0.314*	*0.112*	*78.101*	*14.144*	*76.620*	*1.779*
Coverage of pressure footprints per RBD area / length (%)					*0.068*	*0.013*	*0.001*	*5.583*	*11.646*	*0.353*	*0.008*	*0.003*	*2.245*	*0.407*	*2.202*	*0.051*

Table 6.18: Summary of pressure footprints identified for TraC water bodies within the WRBD. Expressed as a proportion of the total RBD TraC water body area

Water Body Code	Water Body Name	Water Body Type	Area (km^2)	Perimeter (km^2)	Land claim - High Impact	Land claim - Low Impact	Dredging - High Impact	Dredging - Low Impact	Other Disturbances to Seabed	Disposal at Sea	Flow and Sediment Manipulation Structures	Piled Structures	Shoreline Reinforcement - High Impact	Shoreline Reinforcement - Low Impact	Embankments	Causeways
WE_010_0000	Aran Islands, Galway Bay, Connemara (HAs 29;31)	CW2	1038.2298	426.3250	0	0	0	30.5186	546.5537	0.1700	0.0305	0	3.360	0	0	0
WE_130_0000	Aughinish Bay	CW8	5.5346	33.7320	0	0	0	0	5.5313	0	0	0	1.102	0	0	0
WE_300_0000	Ballynakill Bay	CW5	24.8998	67.2850	0.0037	0	0	0	11.0064	0	0.0033	0	0	0.604	0	0
WE_460_0000	Ballysadare Bay	CW8	8.3176	22.2120	0	0	0	0	0	0	0	0	0	0	0	0
WE_110_0000	Ballyvaghan Bay	CW5	10.6280	39.0160	0	0	0	0	10.6248	0	0.0019	0	1.735	0	0	0
WE_380_0000	Bellacragher Bay	CW8	7.5485	51.7270	0	0	0	0	0	0	0	0	0	0	0	0
WE_405_0000	Belmullet Bay	CW8	9.4401	28.6620	0	0	0	0	0	0	0	0	0	0	0	0
WE_230_0000	Bertraghboy Bay	CW5	37.6937	95.2400	0	0	0	0	37.6908	0	0.0076	0	0.146	0	0	0
WE_360_0000	Blacksod Bay	CW5	240.8847	179.9990	0	0	0	0	33.2100	0	0	0	0	0	0	0
WE_370_0000	Blacksod Bay SW / Achill Sound	CW5	38.1681	112.0090	0	0	0	0	4.6948	0	0	0	0	0	0	0
WE_400_0000	Broadhaven	CW5	57.3752	82.3970	0	0	0	0	1.7349	0	0	0	0	0	0	0
WE_420_0200	Cartoon Lough, Killala Bay	CW10	0.0298	1.1620	0	0	0	0	0	0	0	0	0	0	0	0
WE_190_0000	Casla Bay	CW5	9.1956	40.9950	0.0208	0	0	0	0.1665	0	0.0244	0	0.435	0	0	0
WE_340_0000	Clew Bay	CW2	198.4143	76.9270	0	0	0	0	146.7622	0.1138	0.0006	0	0	0	0	0
WE_430_0000	Donegal Bay Southern	CW2	573.0911	153.4010	0	0	0	106.0618	0	0	0	0	0	0	0	0
WE_350_0000	Inner Clew Bay	CW5	65.1723	203.2520	0	0	0	0.0125	65.0898	0	0	0	0	0	0	0
WE_170_0000	Inner Galway Bay North	CW5	37.4363	68.0850	0	0	0	2.7888	11.2693	0	0.0027	0.0010	1.252	0	0	0
WE_160_0000	Inner Galway Bay South	CW5	45.1864	80.8610	0	0	0	0.5548	37.6275	0	0.0017	0.0005	0.052	0	0	0
WE_200_0000	Kilkieran Bay	CW5	82.4779	276.3750	0	0	0	0	82.4505	0	0.0287	0.0038	0.811	0	0	1.013
WE_420_0000	Killala Bay	CW5	81.3774	68.0450	0	0	0	8.7495	0	0	0.0041	0	0	0	0	0
WE_310_0000	Killary Harbour	CW5	12.6891	53.1480	0.0104	0.0100	0	0	2.0778	0	0.0047	0.0004	0	0	0	0
WE_200_0100	Lettermullen Pool	CW10	0.0059	0.4150	0	0	0	0	0.0059	0	0.0001	0	0	0	0	0
WE_260_0000	Mannin Bay	CW5	9.8712	25.6890	0	0	0	0	9.8074	0	0.0008	0	0.088	0.085	0	0
WE_100_0000	Outer Galway Bay	CW2	136.7259	50.7450	0	0	0	9.5006	59.1037	0	0.0038	0	0.631	0.171	0	0
WE_460_0200	Portavaud East, Ballysadare Bay	CW10	0.0234	1.2390	0	0	0	0	0	0	0	0	0	0	0	0
WE_160_0710	Rincarna Pools North	CW10	0.0061	0.3730	0	0	0	0	0	0	0	0	0	0	0	0
WE_160_0700	Rincarna Pools South	CW10	0.0050	0.2900	0	0	0	0	0	0	0	0	0	0	0	0
WE_450_0000	Sligo Bay	CW5	81.7929	61.7950	0	0	0	36.0427	0	0	0	0	0	0	0	0
WE_470_0000	Sligo Harbour	CW8	8.0719	21.2450	0	0	0	0.4848	0	0	0	0	0	0	0	0
WE_250_0000	Western Atlantic Seaboard (HAs 32;33;34)	CW2	1754.1624	910.7680	0	0	0	3.6208	72.9662	0.1700	0.0094	0	0.636	0	0	0
Total area / length of coastal water bodies and pressure footprints			***4574.46***	***3233.41***	***0.03***	***0.01***	***0.00***	***198.33***	***1138.37***	***0.45***	***0.12***	***0.01***	***10.25***	***0.86***	***0.00***	***1.01***
Coverage of pressure footprints per coastal water body area / length (%)					***0.001***	***0.000***	***0.000***	***4.336***	***24.885***	***0.010***	***0.003***	***0.000***	***0.317***	***0.027***	***0.000***	***0.031***
WE_170_0300	Ardfry Oyster Pool	TW6	0.0569	1.3460	0	0	0	0	0	0	0	0	0	0	0	0
WE_140_0100	Aughinish Lagoon	TW6	0.0509	1.3210	0	0	0	0	0	0	0	0	0	0	0	0
WE_055_0100	Baile an Duin Lagoon	TW6	0.0035	0.2950	0	0	0	0	0	0	0	0	0	0	0	0
WE_240_0100	Ballyconneely Lough	TW6	0.1819	3.1020	0	0	0	0	0	0	0	0	0	0	0	0
WE_460_0300	Ballysadare Estuary	TW2	8.7174	25.9450	0	0	0	0	0	0	0	0	0	0	0	0
WE_160_0200	Bridge Lough, Knockakilleen	TW6	0.0832	2.7360	0	0	0	0	0.0829	0	0	0	0	0	0	0
WE_410_0100	Bunatrahir Bay	TW2	1.2668	5.0420	0	0	0	0	0	0	0	0	0	0	0	0
WE_200_0200	Camus Bay	TW2	10.7493	84.5150	0	0	0	0	6.4867	0	0.0029	0	0	0	0	0
WE_140_0200	Carrownahallia Lagoon, Aughinish	TW6	0.0017	0.1610	0	0	0	0	0	0	0	0	0	0	0	0
WE_190_0100	Casla Estuary	TW2	0.0151	0.6610	0	0	0	0	0	0	0	0	0	0	0	0
WE_270_0100	Clifden Bay	TW2	6.5681	33.3320	0.0104	0	0	0	3.9678	0	0.0019	0.0009	0.394	0	0	0
WE_420_0100	Cloonaghmore Estuary	TW2	0.5126	7.3610	0	0	0	0	0	0	0	0	0	0	0	0
WE_320_0100	Corragaun Lough	TW6	0.2393	3.5760	0	0	0	0	0	0	0	0	0	0	0	0
WE_170_0700	Corrib Estuary	TW2	9.6586	27.7270	0	0	0	1.0167	1.6362	0.1832	0.0209	0.0046	6.977	0.101	0	1.675
WE_370_0100	Dooniver Loughs	TW6	0.0262	0.9000	0	0	0	0	0	0	0	0	0	0	0	0
WE_480_0100	Drumcliff Estuary	TW2	4.0330	9.9720	0	0	0	0	0	0	0	0	0	0	0	0
WE_160_0800	Dunbulcaun Bay	TW2	2.0529	17.6120	0	0	0	0.0064	2.0513	0	0.0017	0	0	0	0	0
WE_440_0100	Easky Estuary	TW2	0.0346	1.0930	0	0	0	0	0	0	0	0	0	0	0	0
WE_310_0100	Erriff Estuary	TW2	0.4140	5.6050	0	0	0	0	0	0	0.0002	0	0	0	0	0
WE_350_0300	Furnace Lough	TW6	1.6764	15.6640	0	0	0	0	0	0	0	0	0	0	0	0
WE_470_0100	Garavoge Estuary	TW2	8.8254	21.4420	0.2068	0	0	0.9795	0	0	0	0	0	0	0	0
WE_160_0100	Kinvarra Bay	TW2	5.7272	37.3030	0	0	0	0	5.7239	0	0.0047	0	0.059	0.262	0	0
WE_090_0100	Loch Amurvy, Arainn	TW6	0.0019	0.2260	0	0	0	0	0	0	0	0	0	0	0	0
WE_200_0700	Loch an Aibhinn, Camus Bay	TW6	0.5425	6.1200	0	0	0	0	0.0056	0	0	0	0	0	0	0
WE_210_0100	Loch an Chaorain (L. Keeraun)	TW6	0.0142	0.7760	0	0	0	0	0	0	0	0	0	0	0	0
WE_060_0100	Loch an Chara, Arainn	TW6	0.0204	1.2420	0	0	0	0	0	0	0	0	0	0	0	0
WE_200_0400	Loch an Ghadai	TW6	0.0461	1.1120	0	0	0	0	0	0	0	0	0	0	0	0
WE_260_0100	Loch an tSaile (Lough Athola), Mannin Bay	TW6	0.1131	3.2050	0	0	0	0	0	0	0	0	0	0	0	0
WE_050_0100	Loch an tSaile, Arainn	TW6	0.0034	0.2460	0	0	0	0	0	0	0	0	0	0	0	0
WE_200_1100	Loch an tSaile, North of Camus Bay	TW6	0.8994	15.0720	0	0	0	0	0	0	0	0	0	0	0	0
WE_200_0800	Loch Cara Fionnla	TW6	0.1374	2.9070	0	0	0	0	0	0	0	0	0	0	0	0
WE_200_1200	Loch Conaortha (L. Aconeera)	TW6	0.2368	2.7340	0	0	0	0	0	0	0	0	0	0	0	0
WE_080_0100	Loch Dearg, Arainn	TW6	0.0098	0.3990	0	0	0	0	0	0	0	0	0	0	0	0
WE_200_1000	Loch Doire Bhanbh (Derravonniff)	TW6	0.0123	0.4800	0	0	0	0	0	0	0	0	0	0	0	0
WE_200_0500	Loch Fhada	TW6	0.0865	2.6940	0	0	0	0	0	0	0	0	0	0	0	0
WE_200_0300	Loch Fhada Upper Pools	TW6	0.0108	0.9760	0	0	0	0	0	0	0	0	0	0	0	0
WE_020_0100	Loch Mor, Inis Oirr	TW6	0.0655	1.4150	0	0	0	0	0	0	0	0	0	0	0	0
WE_040_0100	Loch na gCadhan, Inis Meain	TW6	0.0171	0.8980	0	0	0	0	0	0	0	0	0	0	0	0
WE_070_0100	Loch Phort Chorruch, Arainn	TW6	0.0305	1.0550	0	0	0	0	0	0	0	0	0	0	0	0
WE_200_0600	Loch Tanai	TW6	0.0959	2.2300	0	0	0	0	0	0	0	0	0	0	0	0
WE_220_0100	Lough an Mhuilinn (Mill Lough)	TW6	0.0573	2.0560	0	0	0	0	0	0	0	0	0	0	0	0
WE_290_0100	Lough Anillaun, Cleggan Bay	TW6	0.1135	2.5290	0	0	0	0	0	0	0	0	0	0	0	0
WE_280_0100	Lough B Finne, Inishbofin	TW6	0.0808	1.3010	0	0	0	0	0	0	0	0	0	0	0	0
WE_160_0400	Lough Fadda (Doorus Loughs)	TW6	0.0040	0.3310	0	0	0	0	0	0	0	0	0	0	0	0
WE_190_0200	Lough Faddacrussan	TW6	0.0182	0.8470	0	0	0	0	0	0	0	0	0	0	0	0
WE_160_0500	Lough Namona (Doorus Loughs)	TW6	0.0076	0.4650	0	0	0	0	0	0	0	0	0	0	0	0
WE_160_0600	Lough Sallagh (Doorus Loughs)	TW6	0.0056	0.3890	0	0	0	0	0.0055	0	0	0	0	0	0	0
WE_170_0200	Loughaunascalia, Ardfry Point	TW6	0.0042	0.2720	0	0	0	0	0	0	0	0	0	0	0	0
WE_160_0300	Loughaungreena (Doorus Loughs)	TW6	0.0017	0.1920	0	0	0	0	0	0	0	0	0	0	0	0
WE_420_0300	Moy Estuary	TW2	7.4168	39.4450	0	0	0	0.6457	0	0	0.0002	0	0	0	0	0
WE_110_0100	Muckinish Lough	TW6	0.0258	0.9930	0	0	0	0	0	0	0	0	0	0	0	0
WE_120_0100	Murree Lough	TW6	0.1307	1.5620	0	0	0	0	0	0	0	0	0	0	0	0
WE_170_0150	Mweeloon Pool North	TW6	0.0042	0.2690	0	0	0	0	0	0	0	0	0	0	0	0
WE_170_0100	Mweeloon Pool South	TW6	0.0043	0.2710	0	0	0	0	0.0035	0	0	0	0	0	0	0
WE_350_0200	Newport Bay	TW2	9.3457	61.3160	0	0	0	0.0012	9.3186	0	0	0	0	0	0	0
WE_170_0500	Oranmore Bay	TW2	3.5475	18.3040	0	0	0	0	0	0	0.0007	0	0	0	0	0
WE_030_0100	Port na Cora lochs, Inis Meain	TW6	0.0041	0.5510	0	0	0	0	0	0	0	0	0	0	0	0
WE_460_0100	Portavaud West, Ballysadare Bay	TW6	0.0103	0.7570	0	0	0	0	0	0	0	0	0	0	0	0
WE_170_0600	Renmore Lough, Galway City	TW6	0.0105	0.7860	0	0	0	0	0	0	0	0	0	0	0	0
WE_330_0100	Roonagh Lough	TW6	0.4265	3.9350	0	0	0	0	0	0	0	0	0	0	0	0
WE_150_0100	Rossalia Lagoon	TW6	0.0156	0.5800	0	0	0	0	0	0	0	0	0	0	0	0
WE_230_0100	Roundstone Bay	TW2	7.5691	48.0360	0	0	0	0	6.9810	0	0.0048	0	0.311	0	0	0
WE_180_0100	Spiddal Estuary	TW2	0.0626	1.1720	0	0	0	0	0.0626	0	0.0041	0	0.091	0	0	0
WE_400_0200	Sruwaddacon Bay	TW2	8.3928	42.5220	0	0	0	0	0	0	0	0	0	0	0	0
WE_460_0400	Tanrego Intake	TW6	0.0156	0.5930	0	0	0	0	0	0	0	0	0	0	0	0
WE_390_0100	Tullaghan Bay	TW2	17.2475	66.5860	0	0	0	0	0	0	0	0	0	0	0	0
WE_170_0400	Turreen Lough (Rinville West)	TW6	0.0230	1.0070	0	0	0	0	0	0	0	0	0	0	0	0
WE_350_0100	Westport Bay	TW2	15.3237	63.5400	0	0	0	0	15.1814	0	0	0	0	0	0	0
Total area / length of coastal water bodies and pressure footprints			***133.11***	***711.11***	***0.22***	***0.00***	***0.00***	***2.65***	***51.51***	***0.18***	***0.04***	***0.01***	***7.83***	***0.36***	***0.00***	***1.67***
Coverage of pressure footprints per coastal water body area / length (%)					***0.163***	***0.000***	***0.000***	***1.990***	***38.696***	***0.138***	***0.032***	***0.004***	***1.101***	***0.051***	***0.000***	***0.236***
Total RBD area / length			***4707.56***	***3944.52***	***0.252***	***0.010***	***0.000***	***200.984***	***1189.881***	***0.637***	***0.166***	***0.011***	***18.080***	***1.223***	***0.000***	***2.688***
Coverage of pressure footprints per RBD area / length (%)					***0.005***	***0.000***	***0.000***	***4.269***	***25.276***	***0.014***	***0.004***	***0.000***	***0.458***	***0.031***	***0.000***	***0.068***

7. GOOD PRACTICE REVIEW FOR MORPHOLOGICAL MITIGATION MEASURES

7.1 Introduction

This review brings together existing information on 'good practice measures' for activities which involve hydromorphological alterations to transitional or coastal waters. It is part of the Marine Morphology Literature Review, and has been included to provide initial guidance supporting the first round of RBMPs, specifically in defining POMs. Lessons learnt during the first phase of planning could be used to update and refine this preliminary guidance in the future.

This summary report and accompanying spreadsheet (Appendix 7-1) guide the user/reader to sources of information which can aid decisions for identifying which mitigation measures should be put in place to aim to ensure no deterioration in ecological status for new developments, or to identify measures to address existing modifications that will enable a water body to achieve its environmental objective under the WFD.

A generic decision guidance process has been produced, based on an outline given in the EU CIS (2006) technical report on hydromorphological alterations. The approach does not intend to produce prescriptive guidance in terms of the design or implementation of measures.

The report introduces some key concepts, summarises the types of information available and introduces what are considered to be potential measures to address hydromorphological pressures in transitional and coastal water bodies. The detailed content has been collated in an appended spreadsheet which links morphological pressures to mitigation measures, literature and guidance summaries, case studies and internet website links.

7.2 Key Definitions and Concepts

7.2.1 WFD Morphological Conditions in Transitional and Coastal Waters

The WFD identifies a series of 'quality elements' for biological, physico-chemical and hydromorphological components of all water bodies. These are used to monitor the status/quality of waters and therefore will be used as a baseline from which to assess and document the success of the PoMs which will be put in place for each RBD.

Measures related to morphology in TraC waters will be those that seek to prevent deterioration, maintain status/quality, or 'restore' conditions, related to:

- Depth variation
- Structure and substrate of the subtidal bed
- Structure of the intertidal zone

The hydrological elements are strongly connected with these and include the direction of dominant currents, the degree of wave exposure, and the amount of freshwater flow in estuaries.

Any activity which may impact on or alter these conditions is considered to be a pressure. These are listed in the accompanying spreadsheet together with the general impacts on morphological conditions. One pressure which has not been directly included is where potential mitigation measures may themselves result in direct or indirect changes to morphological conditions; for example one measure that has been suggested to reduce the frequency of dredging operations in estuaries is the use of training walls to promote self-scouring - however this may impact on all three of the morphological elements listed above.

7.2.2 Conceptual frameworks for restoration and recovery in TraC environments

Restoration may involve the recovery/reattainment of physical, chemical and biological environments by either active management interventions, or by passive means (natural recovery). These states imply re-establishing sustainable habitat with natural structure and function, essentially a return to a previous (pre-disturbance) condition in which a successful and sustainable ecological community can be maintained. The baseline for the original conditions present within a water body may not be known or achievable.

It is generally accepted that a greater body of research and evidence exists in the recovery of freshwater ecosystems, where practices are more formalised and advanced than in the

estuarine and coastal situation where examples are more recent, and the complexity of the systems perhaps means that the range of useful techniques is more constrained. Also, techniques rarely directly replace 'lost' habitats, but more frequently aim to create a 'compensatory' habitat. Elliott ***et al*** (2007) suggest that the process of removing pressures to promote natural recovery (by passive means) would be the most effective approach in estuarine and coastal locations, but this may not be possible given the importance of other 'uses'. Weinstein and Reed (2005) refer to the 'dual mandate' whereby there is a conflict in attempting to manage natural dynamic environments to a human environment that demands predictability and stability. The WFD addresses this discord by allowing less stringent objectives to be set in heavily modified environments where development or industry exists.

Some environments have a higher resistance or resilience to change, and also may be able to recover naturally from pressure or stress if the pressure is removed. For example, a dynamic feature in a high energy environment such as a mobile subtidal sandbank may recover more rapidly with no intervention. However some features may require management interventions to replace structural or functional elements, in an attempt to improve on a degraded state. The terms rehabilitation, restoration and remediation have been used to describe these practices, and may involve measures required to address pressures that have already impacted on estuarine or coastal waters. Management actions for rehabilitation or restoration may involve managed realignment, dock restoration, saltmarsh restoration or beach restoration, but may often be 'compensatory' or 'offsetting' measures which do not directly address or alter the initial pressure.

For new/planned interventions, the focus will be on 'mitigation'; making any predicted/potential impacts on morphology less severe. Elliott and Cutts (2004) suggest that mitigation is easily achieved for pressures such as pollution, dredging and disposal or temporary structures, whereas the construction of permanent structures would more likely require the 'offsetting' type measures indicated above.

A key (and currently only partially substantiated) assumption is that protecting or restoring morphological conditions will provide the required conditions to support the ecological elements (communities of benthic invertebrates, fish, angiosperms and phytoplankton). Research into these links is ongoing and likely to be informed by ongoing monitoring for the WFD.

7.3 Review Process

The review was undertaken by searching for and consulting a wide variety of different types of literature. The majority of the review was conducted using readily accessible internet sources (websites or downloaded documents). These documents (usually Adobe PDF files) can be accessed by hyperlinks in the spreadsheet. Some key relevant guidance manuals are copyrighted or are only available in hard copy. For these documents, a reference has been included but there is no active hyperlink.

Very little information was found that was produced in, or directed specifically at, the RoI. However, it is assumed that experience gained in Northern Europe, and more so the UK, will be relevant to the Irish situation.

7.3.1 Information Reviewed

A variety of different types of information were found to be available. It is helpful to split these into some general categories:

Legislation-related guidance (e.g. EU CIS and UK TAG guidance papers)

These are reports produced by various working groups concerned with implementation of the WFD, including members of the competent authorities, and representatives from sectors such as the ports and navigation industries. Many have been produced at various stages of the WFD timetable, the most relevant being the 2006 EU CIS technical report on 'WFD and Hydromorphological Pressures (Good practice in managing the ecological impacts of hydropower schemes; flood protection works; and works designed to facilitate navigation)'. The report and appendix of case studies aims to provide guidance and good practice examples of prevention, remedies and mitigation for the ecological effects of impacts of activities. Information has been gathered from practitioners across the EU to address current alterations and future pressures. However there are only limited examples for Transitional and Coastal water bodies (and indeed lakes) – the main focus is on rivers.

Scientific papers/journal articles

A substantial body of scientific literature exists on ecosystem restoration, particularly from American experiences of wetland restoration. Journal articles, whether written by academics or practitioners, are peer-reviewed and represent current thinking. Case study-type articles are the most common, while reviews of particular techniques or of concepts in management provide a more generic viewpoint. The most practically useful articles are probably those written in journals written by and aimed at the engineering sector such as

the Proceedings of the Institution of Civil Engineers (Engineering Sustainability; Maritime Engineering), and the Chartered Institute of Water and Environmental Management (CIWEM) Water and Environment Journal, while relevant research and academic concepts are found in Estuarine, Coastal and Shelf Science, Aquatic Conservation (Marine and Freshwater Ecosystems), Restoration Ecology, Estuaries, Marine Pollution Bulletin etc. Journal abstracts are free to search through using web search engines such as ScienceDirect or Google Scholar, but full text versions may have to be purchased.

Conference and seminar presentations/papers

Presentations given at conferences and seminars are increasingly being published on the relevant website after the event. Many presentations are made – but the resulting outputs from them are not peer-reviewed to give the same level of confidence in their results as with scientific literature. However, they often give a good summary of the latest thinking on a specific topic.

Project Reports and Environmental Impact Statements

In some cases, detailed project reports may be available including information about design aspects and monitoring success – sometimes they may be available on the internet. If available, EIAs of similar works may state generic and more specific mitigation measures. It is difficult to ascertain whether specific project reports and the mitigation types stated therein represent Good or Best Practice. It is also difficult to draw generic good practice lessons from project specific situations. A full review of EISs was undertaken as part of the wider Literature Review, rather than for this Good Practice Section. The EIS information obtained included various types of estuarine and coastal projects in Ireland from 1989-2005. Almost all of these projects stated some type of mitigation to reduce or remove impacts related to water quality/pollution or morphology (or knock-on impacts on ecology). 33 types of mitigation addressing morphology were included, not all of these were ‘mutually exclusive’. The most common of these were:

- Do not disturb sensitive areas (8 quotes);
- Minimise the construction/reclamation area (10 quotes);
- Correct choice of dredging equipment and methods (12 quotes);
- Ensure sediment release during dredging is monitored/controlled (7 quotes).

Table 7.1 below conveys the distribution of measures related to morphology that have been quoted in Irish EISs as reviewed for the Literature Review.

Table 7.1: list of mitigation measures from environmental statements for coastal and estuarine works in Ireland (1989-2005)

Mitigation Type	Number of References
Limit length of impoundment	1
Maintain natural tidal cycles	1
Settling ponds	2
Construction works during low tide	1
Minimise area of extraction	2
Undertake baseline surveys	2
Do not disturb sensitive areas	8
Saltmarsh/intertidal habitat creation	2
Minimise construction/reclamation area	10
Choice of dredging equipment/methods	12
Avoid sensitive time of year for fish/mussels	5
Undertake environmental monitoring	6
Onshore disposal of dredgings	2
Restoration of disturbed habitats	3
Suitable dredge-dump sites	5
Control amount of sediment released	7
Good site management	3
Shingle/sediment bypassing	2
Turbidity monitoring	3
Permeable bunding to reduce mudflat erosion	2
Beneficial use of dredgings	3
Ecological surveys	3
Silt traps	4
Reprofile seabed after dredging	1
Sympathetic design of structures	3
Compensatory habitat	1
Temporary fencing	1
Limit duration of works	1
Fish pass	1
Recreate/restore shellfish beds	2
Avoid periods of bad weather	1
Debris management	1
Minimise need for future dredging	1

Case studies

The review incorporates a series of case study examples – learning from positive and negative past experiences can be extremely beneficial. However, due to the case specific nature of such information, it is better to canvas for general 'lessons learned' rather than for specific guidance. It is also likely that successes are more widely reported than failures. Case studies can be found within the bodies of other literature including guidance manuals, technical documents, journals and widely on the internet (through either information gateways or dedicated sites). For example, the 'Online Managed Realignment Guide' (www.abpmer.net/omreg) contains a searchable database of over 80 UK and European schemes.

CIRIA (and similar) guidance manuals

CIRIA (Construction Industry Research and Information Association) manuals are acknowledged in the UK as principal sources of information for practitioners across many engineering disciplines. Two manuals have been published on relevant topics and have been reviewed; The Beach Management Manual (1996 but currently being updated) and Coastal and Estuarine Managed Realignment, Design Issues (2004). These aim to 'share knowledge and best practice' and contain theoretical background and guidance on the whole project and design process. Other manuals have been published by interest groups such as RSPB, and there is a recent move towards mounting information on accessible web-based platforms (for example the Saltmarsh Manual www.saltmarshmanagementmanual.co.uk and the Managed Realignment Electronic Platform www.intertidalmanagement.co.uk which are sponsored by the Environment Agency (EA).

Codes of Practice (e.g. Ports sector)

Voluntary 'Codes of Practice' are a potential measure promoted by initial research into measures required for the WFD. They can also provide useful sources of information, particularly in relation to the experiences of the Ports sector. Port infrastructure and navigation are two of the key drivers and activities which may need to be mitigated to achieve WFD objectives for TraC waters. The port sector has been actively involved in drawing up codes of practice, (for example ESPO (European Sea Ports Organisation) 1994 (revised 2003), and in 2007 published a code specifically related to the Birds and Habitats Directives). These contain useful information in relation to consenting and mitigating dredging and port construction activities (and wider issues).

7.4 Potential Types of Measures

The sources that have been reviewed indicate that there are numerous established and developing techniques, which have more generally been brought into use through general good environmental practices, for example identification and mitigation of impacts as part of EIA, or to comply with previous legislation such as the Bird and Habitats Directive. Many of these relate to and could be classed as 'measures' for morphology. These can generally be classified into the following groups:

- General good environmental practice and management plans, for example as summarised in 'Guidelines for Port Environmental Management' (Paipai, 1999) and the uptake of Environmental Management Systems (EMS) and monitoring programmes in Ports, which contain information about the morphological elements, particularly substrates (and also integrate data on biological and chemical/water quality aspects). One example case study given in the appended spreadsheet is the introduction of an EMS at Dover Harbour (UK) (Dover Harbour Board, 2006). These are proving beneficial in identifying appropriate mitigation measures or in adapting management to reduce impacts.

- Mitigation measures, which in the example of dredging can involve planning issues such as the timing, frequency and extent of dredging activities to avoid sensitive locations; using improved technology to minimise suspension of sediment and damage to the bed; and investigation opportunities for 'beneficial' use of sediments for example in recharge of beach or intertidal sediments. A key reference for intertidal habitat management is the CIRIA 2004 manual 'Coastal and Estuarine Managed Realignment - Design Issues'. See also Table 7.1 listing the mitigation measures related to morphology that have been quoted in previous Environmental Statements.

- Restoration measures, the most frequent use of which is to create or recreate intertidal mudflats and saltmarsh succession lost through land claim or coastal development, often through processes of managed realignment

- Natural recovery should also not be discounted as an option, although unlikely to be within the timescales of a round of River Basin Planning, over longer timescales it may be the most cost-effective and sustainable approach.

Detailed information on these measures, including theory and case studies are included in the spreadsheet and the reference links within.

7.5 Contents and use of the accompanying spreadsheet (Appendix 7-1)

The information collected in the literature review has been collated in the appended spreadsheet. The spreadsheet can be printed out but contains a series of links between pages and to external sources, and is therefore best viewed electronically/'interactively'. The information is organised as set out below:

- Pressures and Mitigation Summary: This page summarises the key pressures and impacts on TraC Waters, matched with potential generic mitigation measures. More detail on specific types of mitigation measures can be found in the literature summaries and case studies pages.

- Literature summaries for key documents: This page introduces a set of the most useful documents that refer to good practice for specific mitigation measures and also generally in terms of good environmental management to minimise and identify potential morphological impacts. It can be used to identify whether a particular document contains relevant information as it can be difficult to search for specific information in a lengthy document from the contents list alone.

- Case studies: This page provides details for about 50 case studies, giving evidence of hydromorphological, ecological and cost effectiveness where documented. In all UK examples found, the measures have been carried out on water bodies which are provisionally identified as 'Heavily Modified', rather than on those without existing morphological pressures. Very little information is available on how relevant these measures are for less modified water bodies. Links are given to sources that provide more detailed information/images.

- Web-based Good Practice Information: This page lists the sources of information available on the internet with a summary of the aim of the research project or information available on the website and a hyperlink to the website.

- Full reference list

7.6 Identifying Potential Measures

7.6.1 Applying the good practice guidance

In reviewing generic ‘Good Practice’, it is important to emphasise that mitigation measures that have proven successful in one location may not be directly applicable in other environments. Most good practice guidance emphasises the need for site-specific investigations and designs in the context of a wider strategy (in this case the strategic scale is led by the RBMP). Important initial considerations of whether mitigation measures are potentially appropriate would include the water body classification type (e.g. a coastal lagoon or a polyhaline, mesotidal estuary) and for HMWB, what the uses are and whether the measure may compromise this use.

7.6.2 Information on costs/cost effectiveness

The WFD has generated a need for RBMPs to assess the ‘cost-effectiveness’ of various measures, and a number of economics-based research reports have been recently undertaken (or are ongoing), for example the ‘Collaborative Research Programme’ (CRP), lead by the Department for Environment, Food and Rural Affairs (DEFRA) in England and Wales. Outputs from this programme include developing a methodology to assess disproportionate costs (RPA, 2004) and the development of a database for benchmark costs and guidance on applying cost-effectiveness methodology (Entec, 2006). The latter report contains a worked example for morphological pressures (navigation/port operations) on a coastal water body (p39-51), in which steps 4-6 include issues related to costs.

A scoping report has also been produced with specific focus on economic impacts in TraC waters (Brooke, 2005). This is based on a stakeholder workshop, and concludes that the financial and economic implications for sectors operating in TraC waters could be significant. Measures which might be achievable at minimum cost typically include the development or application of codes of good practice, better enforcement of (often existing) local regulation, some zoning initiatives, and various research initiatives. Potential measures involving anticipated moderate costs (i.e. neither minimal nor necessarily significant) include some research initiatives, required modifications (whether to plant, gear or working methods) and/or certain types of constraints imposed on activities by regulatory bodies (for example some seasonal restrictions or constraints on working methods). Depending on the detail, measures prohibiting certain activities or working methods (e.g. certain dredging techniques) may be shown to be disproportionately costly, particularly if the full range of consequential costs is considered in the analysis.

Costing of individual measures is difficult for a number of reasons: the lack of available and up to date data (often information is confidential and related to contracts, e.g. costs of dredging in ports); the geographical scale of implementation required; site specific details and the necessary costs of feasibility and design; and, the associated costs of legislative or other mechanisms to implement the measures, are key examples. Table 7.2 summarises quantitative and qualitative cost information for specific examples that have been obtained from case studies or other documentation as part of this review. More information on the project details is available in case studies in the appended spreadsheet.

Table 7.2: Quoted costs of specific examples for a limited number of measures

Measure	Specific Example	Quoted Costs
Saltmarsh erosion protection	Oosterschelde Estuary, SW Netherlands. Construction of low stone dam along saltmarsh. (CIS, 2006)	€500,000 to protect 4-5 km of saltmarsh. Also protects dykes and polders from wave attack.
Flood bank breach	Hullbridge, River Crouch, Essex, England. Breaching a low flood bank to create compensatory intertidal habitat for essential flood defence works. (CIS, 2006)	€1.5m approx (including flood defences).
Environmental Information Systems	Thames Estuary, England. Establishing framework for decision-making including stakeholder dialogue, GIS information exchange system. (CIS, 2006)	£100,000 set-up, £15,000 per year costs, £100,000 projected annual savings.
Managed realignment scheme appraisal and design	Alkborough Flats, Humber Estuary, England. Creation of 440 hectares of intertidal, freshwater and wetland habitats when earth embankments breached. (www.frameproject.eu)	Significant appraisal and design costs compared to construction costs.
Re-introduction of tidal processes	Breebaart Polder, Ems-Dollart Estuary, Netherlands. Restore brackish area with natural processes by reinstating a former watercourse and re-introducing partial/controlled tidal processes. (CIS, 2006)	€1.8m.
Removal of short sections of bank protection	River Elbe, near Hamburg, Germany. Short sections of hard bank protection removed to partially restore natural bank profiles and tidal zoned habitats. (CIS, 2006)	Low cost.
Beneficial use of dredged sediment (small scale intertidal restoration)	Maldon, Blackwater Estuary, Essex, England. Small-scale restoration of eroded saltmarsh, direct placement of dredged material to raise foreshore level. (RSPB/CIWEM, 2005)	Simple, small-scale works, relatively inexpensive as sediment was available locally.
Seawall breach	Nigg Bay, Highlands, Scotland. 2 breaches in seawall, a relic creek system still existed so this was used rather than new earthworks. (RSPB/CIWEM, 2005)	Land acquisition plus £50,000.
Regulated tidal exchange system	Goosemoor, Exe Estuary, Devon, England. Self-regulating tidegate and culvert through river wall. (RSPB/CIWEM, 2005)	£100,000 estimate.
Mudflat sedimentation fences	Wellhouse, West Mersea, Essex, England. Rows of double wooden stakes filled with brushwood were constructed running perpendicular to the shore. Fence length, varied between 20-80 metres. (www.saltmarshmanagementmanual.co.uk)	Economic justification questionable due to low value of land.
Environmental monitoring of dredging activities	Harwich Haven, England. Bathymetric surveys to monitor sediment dispersal. (CIS, 2006)	£150,000 annually.
Water column recharge	Harwich Haven, England. Water column recharge of dredged material to mitigate loss of intertidal habitat by capital and maintenance dredging. (CIS, 2006)	Similar costs to sea disposal of dredging.

A measure with more reported cost information available (partly due to the high public profile of such schemes) is managed realignment. Collection and dissemination of project information has been undertaken as part of the 'Online Managed Realignment Guide' (ABPmer, 2007). For 28 schemes undertaken in the UK, the costs per hectare are given in Figures 7.1 and 7.2). This also indicates the huge variation in costs according to the scale of site and increasing technical complexity. Many of the costs of such schemes are associated with feasibility and design studies and land purchase, rather than construction costs.

Figure 7.1: Reported cost of estuarine/coastal managed realignment sites less than 20 hectares in area

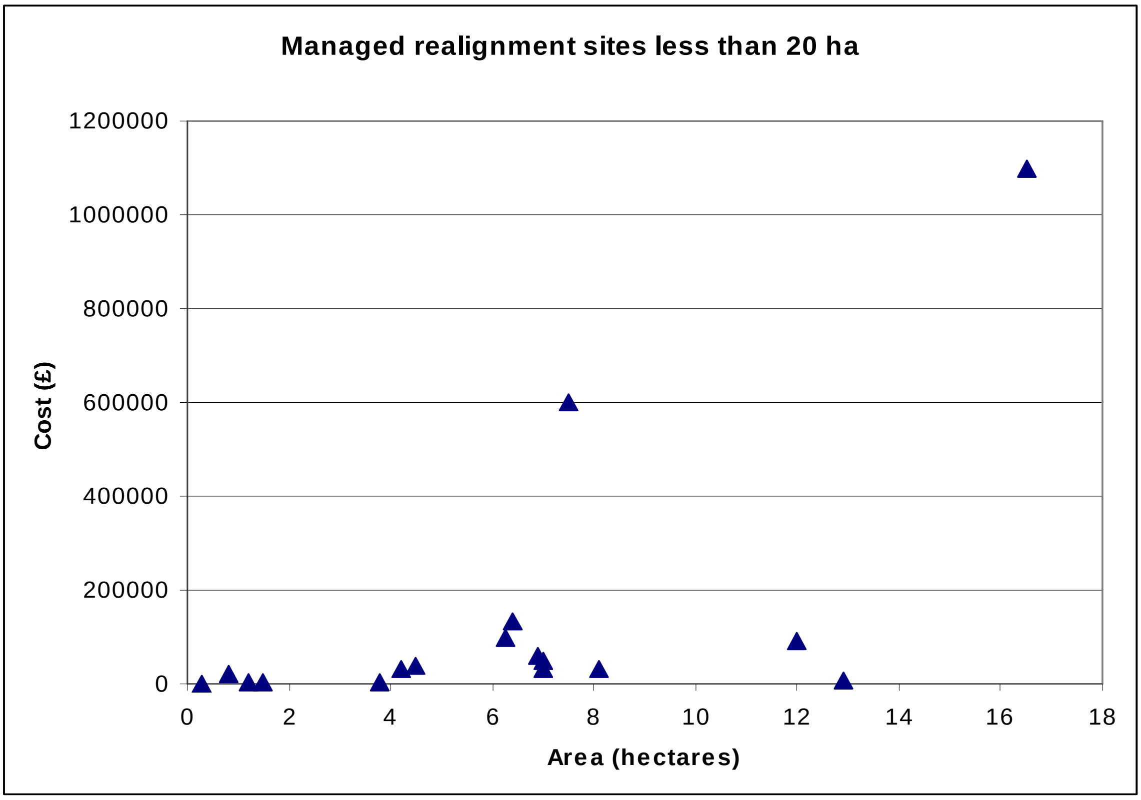
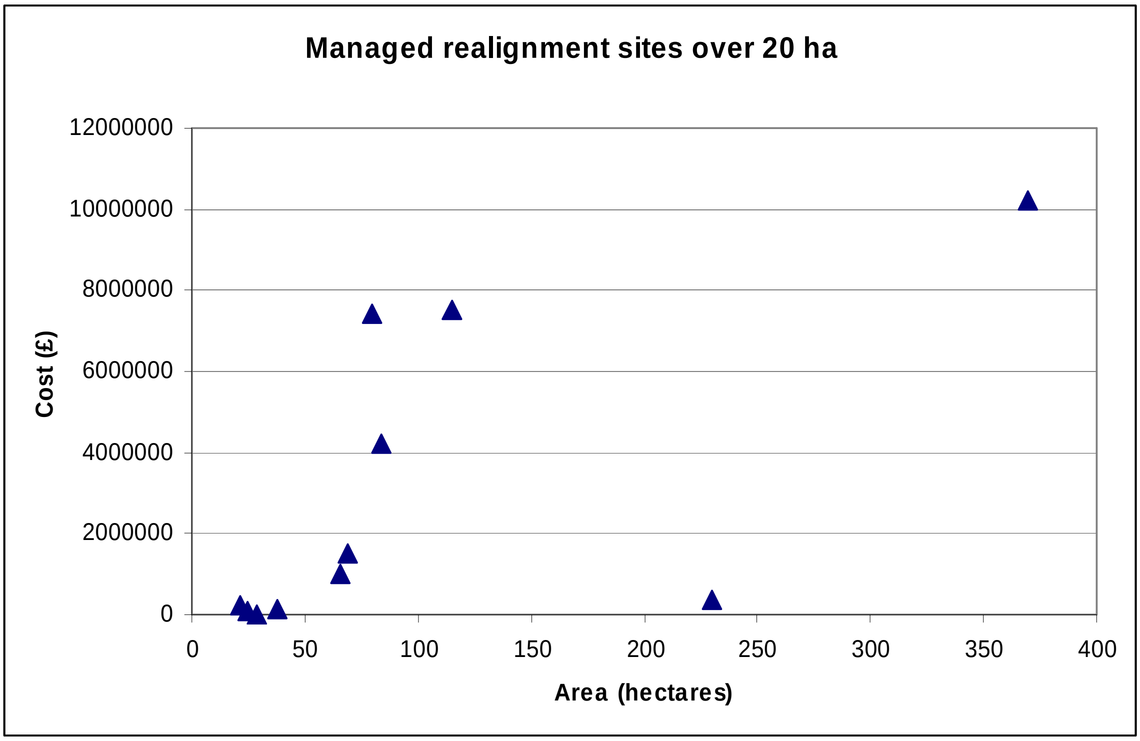


Figure 7.2: Reported cost of estuarine/coastal managed realignment sites greater than 20 hectares in area



7.6.3 A decision-making framework to select measures

The flow diagrams below illustrate a decision-making framework to assess which measures may be applicable for existing modifications (e.g. to improve morphological conditions to achieve the environmental objectives) (Figure 7.3), and for new proposals or ongoing activities (e.g. to prevent deterioration) (Figure 7.4). This is the current recommended approach, based on recent EU guidance (CIS, 2006) but the principles applied may evolve further. Project WFD54 (on the effectiveness of measures, SNIFFER, 2006) includes worksheets to assess measures in terms of the magnitude and certainty of effects, the speed of their effect, durability, adaptability, practicability and possible side-effects.

Additionally, consideration will need to be given to implementation (time exemption, prioritisation in combination with other measures such as cost and the likelihood of a measure being disproportionately costly).

Figures 10.2 and 10.3 of Chapter 10 expand further on the applicability of the framework outlined in Figure 7.3 by recommending steps to prioritise water bodies for the application of appropriate measures.

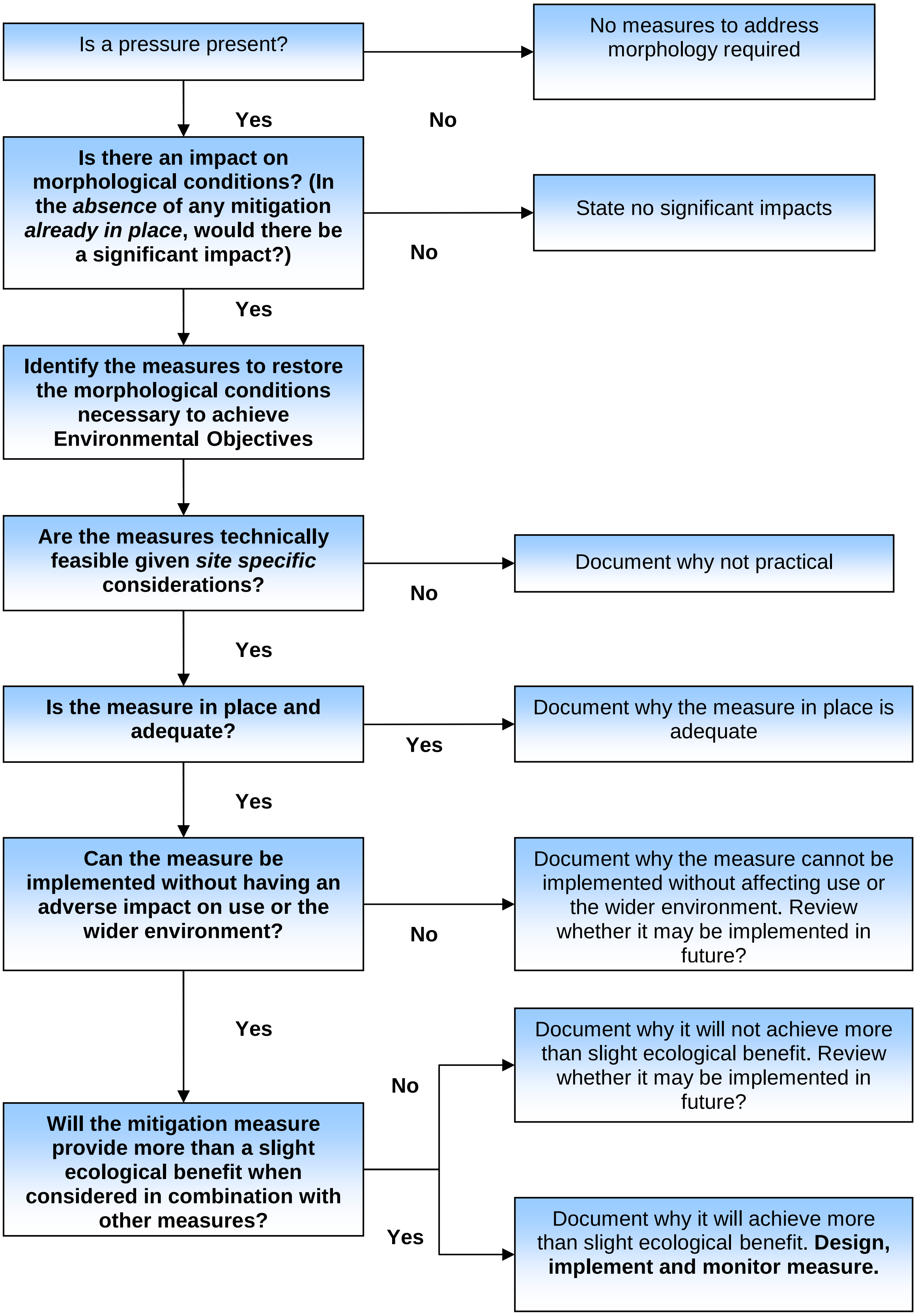


Figure 7.3: Overall framework for using measures to achieve Environmental Objectives for existing modifications or ongoing activities (derived using CIS, 2006)

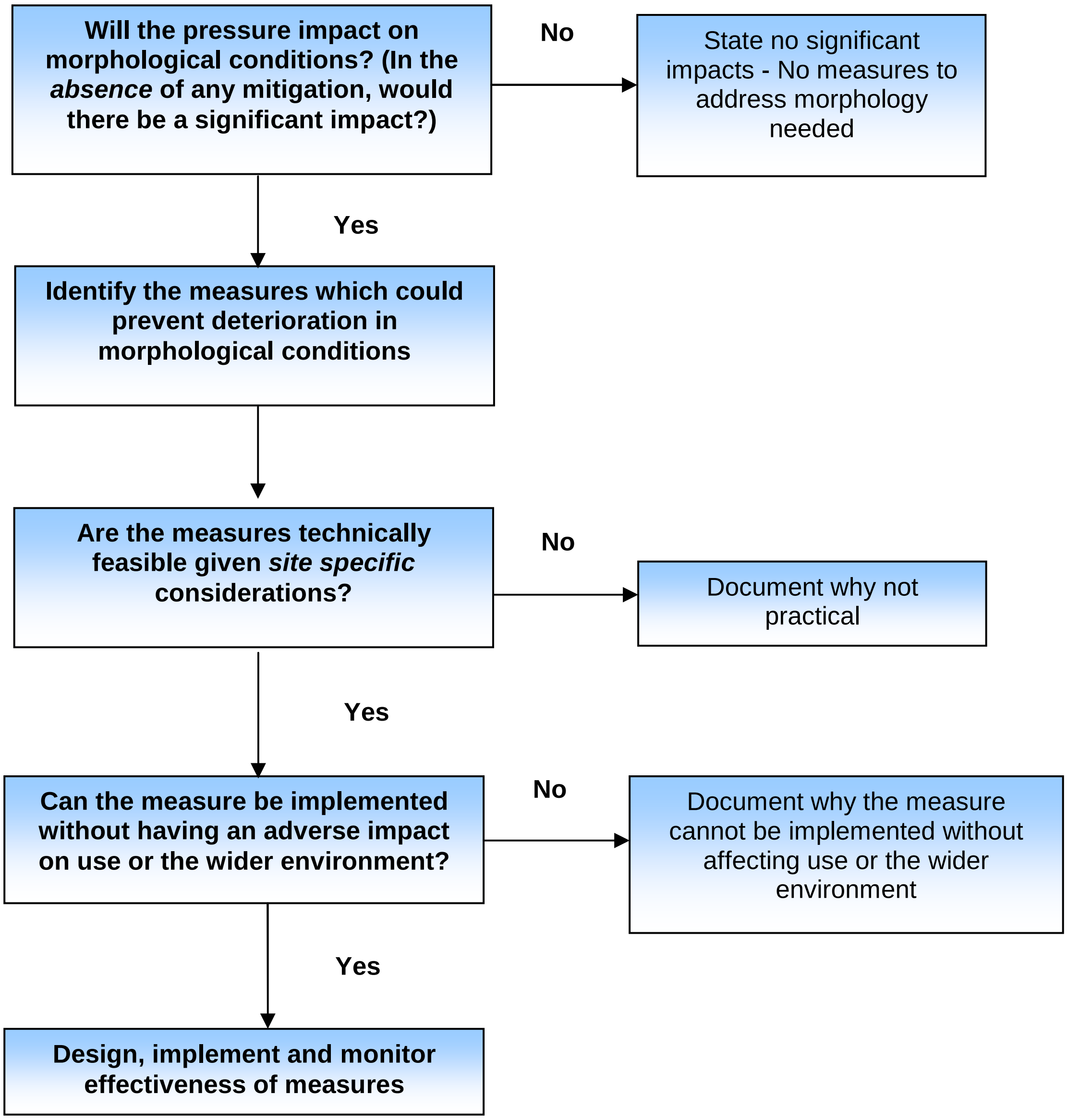


Figure 7.4: Overall framework for using measures to achieve Environmental Objectives for new proposals that may include modifications to morphology (derived using CIS, 2006)

8 FUTURE TRENDS

8.1 Introduction

The WFD requires the projection of risk to a water body failing to achieve good ecological status by 2015. There is therefore a need to analyse not only existing pressures, but also those that potentially occur in the future that may impact on transitional or coastal waters.

Scope

A wide range of sources were consulted to undertake a strategic review to identify potential developments across a range of sectors/pressures which could impact on morphological conditions. This review assumes that population growth in coastal counties will lead to some degree of pressure for development, but it is not in the scope of this report to quantify these pressures. The pressures considered are those affecting physical modifications to transitional and coastal waters: (see Chapter 5)

- Land claim- High impact
- Land claim- Low impact
- Dredging- High Impact
- Dredging- Low impact
- Other disturbances to seabed
- Sea disposal of dredgings
- Structure to manipulate flow/sediment
- Structures with piled supports
- Shoreline reinforcement- High impact
- Shoreline reinforcement- Low impact
- Flood defence embankment
- Tidal channel realignment- High impact
- Tidal channel realignment- Low impact
- Impounding structures
- Causeways

Methodology

Sources that have been consulted to identify potential future pressures on estuaries and coasts include National and County Development Plans and the DCENR and DAFF in relation to applications for Dumping at Sea Licenses and energy generation and foreshore licences/leases. Also consulted were the Marine Institute, including the Irish Maritime Development Office (IMDO), along with a number of project and interest group websites and reports.

8.2 Drivers / Sectors

The drivers / sectors that are considered most likely to contribute to morphological pressures in transitional and coastal water bodies are listed below:

- Coastal Defence
- Flood Management
- Infrastructure, including oil, gas and cables
- Navigation
- Agriculture
- Fisheries and Aquaculture*****
- Mining, quarrying and mineral extraction
- Recreation
- Water Abstraction for industrial use

Specific issues such as sea level rise are discussed at appropriate points.

***** Detailed assessment of aquaculture or fisheries is not within the scope of this study. However, for the purpose of the risk assessments aquaculture was reviewed as a component of the morphological pressure ‘other disturbances to seabed’ (estimated areas dredged for shellfish). The potential future trend of the aquaculture industry is briefly addressed in this chapter as it can potential be associated with significant supporting coastal infrastructure as well as dredging activities.

8.2.1 Coastal Defence and Flood Management

The development of coastal defence puts in place flow and sediment modification structures, impoundments and/or shoreline alteration and embankments in order to protect human populations, property and important environmental assets and from the sea.

Ireland has a high proportion of its population located in coastal areas, where the majority of major towns and cities are situated. County Development Plans of Irish coastal counties suggest that there may be increased development in coastal areas.

Whilst only around 25% of Irelands population live in Coastal Electoral Districts, most of Irelands urban centres are coastal, and a much larger percentage are dependant on these areas (Sweeney et al, 2003). The Sustainable Rural Housing Guidelines for Planning Authorities (DEHLG, 2005) acknowledges the likely increased demands for coastal development and the requirements for management for both housing and tourism industries (holiday homes and facilities). It was estimated that there could have been increases up to 50% in coastal populations around Ireland between 1991 and 2001 (EEA, 2006) exceeding most other European areas.

Together with consideration of sea-level rise, this could potentially result in the need for more widespread or raised coastal defences. Such developments can alter the morphology of estuaries and make the ecology susceptible to 'coastal squeeze' or the compression and change of shoreline succession in biotopes or removal of intertidal areas. Existing (increasingly stringent) legislation related to land use planning and development in flood risk areas should limit such pressures relating to coastal defence development, particularly with the increasing commitment to Integrated Coastal Zone Management (ICZM). There may be some new impacts related to the implementation of 'soft' flood management and erosion protection techniques such as managed realignment schemes. Another 'soft' protection option is the reuse of suitable materials from dredging or foreshore development for beach nourishment.

Based on the data provided by Marine Institute (Shoreline erosion risk data, received 2007), 1562 km of Ireland's 10837 km coastline is at risk of erosion (though 3827 km has no data available). A small proportion currently falls under areas of population requiring coastal defence. Around 4% of Ireland's coastline is currently protected (as

opposed to over 80% in the UK and Netherlands). However, pressure from development and population growth may increase the amount of defence required in the future, as will changes in sea level.

The new Floods Directive (2007/60/EC) on the Assessment and Management of Flood Risks entered into force on 26 November 2007. This Directive now requires Member States to assess if all watercourses and coastlines are at risk from flooding, to map the flood extent and assets and people at risk in these areas and to take adequate and coordinated measures to reduce this flood risk. The identification of potential areas of risk, may result in the development of further flood protection. However, whether this is co-ordinated on a national basis or at a strategic or local level is as yet unclear.

8.2.2 Sea-level rise

One of the major unknown factors for pressures on marine areas is the question of sea-level rise and possible increase in storm surge activity which could further raise sea levels in extreme conditions. This may lead to impacts including wave damage on soft shores, increased seasonal flooding and inundation of low-lying areas, interference with coastal developments and infrastructure, and the disruption of coastal habitats (changes in near-shore salinities, sediment loading and distribution due to alterations in river discharges). The IPPC (Intergovernmental Panel on Climate Change) highlights the uncertainties in assessing average global sea level rise, but have recorded that global sea level has risen approximately 175mm on average between 1961-1990 and the rate is increasing. Sea-level rise increased in the decade 1993–2003 to 3.1 mm/year compared to the average of 1.8 mm/year for the years 1961–2003. The main reason is because water expands as temperature rises, though losses from ice sheets in Greenland and Antarctica are very likely to have contributed in recent years (IPCC, 2007).

The UK ‘Foresight’ report on Flood and Coastal Defence (GoS, 2004) aimed to produce a challenging and long-term (30 - 100 years) vision for the future of flood and coastal defence for the UK that takes account of such uncertainties. The report identified the drivers and receptors of future trends in flooding, and assessed the likely environmental and socioeconomic impacts. For Northern Ireland, the report predicts rises in relative sea level (between 20 cm and 69 cm) and greater storm surge intensities in the Irish Sea causing a risk of significant flooding in the east of Ireland.

Secular mean sea level rise for the tidal gauge station in Dublin is at a rate of 0.23mm per year (POL, 2000). Sweeney et al, (2003) provides a best estimate of future sea level rise for Ireland, from a number of sea level rise models, of 0.48m from 1990 to 2100. The report suggests that up to 300 km^2 of land could be inundated by the sea if sea level rose by 48 cm by the end of the century. The report particularily highlights the potential impacts on urbanised areas, where flood and sea defences are most likely to be constructed to mitigate against flooding, due to the economic value of these areas.

Eurosion (2002) states the "worst case" scenario, global mean sea-level is expected to rise 95 cm by the year 2100, with large local differences due to tides, wind and atmospheric pressure patterns, changes in ocean circulation, vertical movements of continents etc. The Eurosion report (2002) also references the IPCC, a series of flood risk studies which are currently being undertaken in Ireland, in accordance with the new Floods Directive (2007/60/EC) to assess the potential flood risk areas within RBDs. This is being undertaken by local authorties and the Coastal Engineering Division (OPW, DAFF and DCENR).

Sea level rise is only one potential change to sea defence requirements. Climate change also causes increases in average wave height and storm surges. In Ireland, the Wave and Storm in the Northern Atlantic group (WASA, 1998) has recorded an increase rate of 0.3% per year of average west coastal wave height. Storminess is more difficult to quantify, though the IPPC (IPPC, 2001) have determined that in general increases in storminess has been within natural variability, Storm occurrence in Ireland is also linked to large scale circularion changes (Sweeney et al, 2000), which have tripled in the last decade and associated with North Atlantic low pressure systems, which have seen a similar increase. Small scale changes of wave height and storm events may result in over-topping of exisiting or natural protection causing saltwater intrusion into terrestrial and freshwater areas, as well as damage coastal infrastructure. In areas where existing measures are damaged or saltwater intrusion occurs, these coastal measures may then require repair, extension or redevelopment.

Increased sea levels and wave heights are likely to mean an increase in requirements for foreshore stregthening and coastal defence including sea walls and impoundments. Proposals for tidal barrages could also increase if sea levels rise. An existing proposal for such a development is that outlined by Clonakilty Urban District

Council for the development of a rock armoured tidal barrage across Clonakilty Bay proposed to reduce tidal flooding and assist freshwater flood prevention. Dublin and Cork have had various schemes suggested in the press in 2007, but no schemes or plans have been offically submitted.

8.2.3 Infrastructure

A range of infrastructure developments may cause pressures on marine morphology. The demands on coastal development are already increasing dramatically as it provides the location or natural resources vital to energy, communications, and transportation in competition with increasing demand for housing in coastal locations along with the infrastructure associated with housing development. In Ireland the most significant expected alterations are from ports and oil and gas facilities. Modifying the coastal structure, maintaining channels for shipping and reclaiming land for facilities can extensively modify a water body. Ireland as an island is socio-economically reliant on ports for the import and export of materials, supplies and commodities.

Ports

The most significant coastal infrastructure is likely to be port development (see also navigation below), which by their nature must be located on estuaries or coasts. Coastal locations for port developments are limited, requiring appropriate access on a range of tides, and a sufficiently sheltered location to allow vessels to be loaded and unloaded as efficiently and safely as possible. Ports are a vital transport link for the Ireland; it is estimated that up to 90% of Dublin City's resources are transported via the port. In smaller estuaries and within smaller ports, the opportunities for new port capacity are very limited. The growth in some sectors such as containerised traffic and roll-on roll-off, combined with changes in traffic patterns, means that ports continue to propose substantial new developments to increase capacity. These require additional land, reclamation of estuaries and the deepening of approach channels. In addition, the increase in containerisation has increased the efficiency of much of the transportation industry, but requires large storage facilities within ports to process the containers.

Shipping operators are pivotal in dictating the direction the industry takes in terms of infrastructure investment; by commissioning bigger vessels (particularly container ships), pressure is placed upon port operators to provide suitable infrastructure or lose trade to competitors. Ports wishing to retain trade have to expand, provide

deeper access channels, bigger berths and more shore-side cargo handling and storage capacity (MI, IMDO, DEHLG, 2007). Typical developments which may be part of a port expansion that may impact on marine morphology include quaylines, berths, breakwaters, land/foreshore claim, dredging, and causeways.

Ports are seen as an important contributor to the Irish economy and a source of growth, and many County Development Plans (for example Kerry, Wexford, Wicklow, Louth, Galway, Clare, Limerick and Waterford) (DEHLG, 2007) support the further development of ports by improving infrastructure, safeguarding lands against inappropriate development and making provision to establish new ports (NDP, 2006). Many ports have recently submitted expansion proposals, a summary of each is given below (DoT, 2006)

- **Greenore Port:** Proposal for a 300m quay, part of the terminal to be reclaimed from the sea and associated dredging.
- **Drogheda/Bremore Port:** New terminal - proposal for a 500m quay, berthing facilities, 2.3km breakwater, 58ha reclamation.
- **Dublin Port:** 2 x 360m quays, 21ha foreshore reclamation.
- **Rosslare:** Dredging, quay extension and reconstruction.
- **Waterford:** 300m new quay.
- **Cork:** New container terminal, 480m quay, land claim.
- **Shannon-Foynes:** 700m quay (plus another potential 600m), 35.5ha land claim.

In addition to the port itself there are associated industries within or adjacent to the ports that require development, land claim and foreshore protection. Perhaps the most significant is the onshore facilities associated with the oil and gas industries, such as the proposed LNG facility in the Shannon, currently being designed, or the associated receiving and gas power stations that have been proposed for receiving gas and electricity generation from the Corrib Gas field.

Oil, Gas, Pipelines and Cables

Ireland has a small number of existing pipelines, servicing the oil and gas infrastructure at Seven Heads and Kinsale with another currently being developed at Corrib. Between 1997 and 2000 only 10 exploration and appraisal wells were drilled in Irish waters but no commercial discoveries were made - in total only 187 have been drilled in Irish waters. Eight exploratory licences were issued in 1995 in the Porcupine Licensing Round but these have been relinquished. Of the eleven

exploratory licences issued in 1997 in the Rockall Licensing Round, 10 have been relinquished.

The Petroleum Affairs Division of the DCENR has released two further offshore areas for exploration in the last two years (DCENR/ former Department of Communications Marine and Natural Resources (DCMNR), Ministerial announcements 2007/8). The first resulted in five applications from four companies for Frontier Exploration Licences in the Frontier Sylne/Erris/Donegal Licensing Round. IOSEA1 (Irish Offshore Strategic Environmental Assessment 1) and IOSEA2 and the upcoming IOSEA3 by the Petroleum Affairs Division provide further information on Ireland's exploratory oil and gas work.

Though uptake on the Irish markets is low, due to the more extreme conditions and depth of drilling operations required, there has been increasing interest in the resources under the European Western Margin. As resources decrease elsewhere, the Irish Energy Policy has prioritised security of supply for Ireland from localised oil and gas exploration, meaning that this activity is set to increase and the associated infrastructure (pipelines, well rigs, support vessels etc) will also increase. Finds from the current and recent licensing rounds will require infrastructure should any be developed into production phases.

Cables are a vital conduit for telecommunications and power transfer between Ireland, its coast and islands, and with its neighbours. Ireland is also adjacent to much of the transatlantic cables from the US into Europe. The rights of development and laying of cables is protected under UNCLOS (United Nations Convention on Law of the Sea, 1984 (in force 1994)). In addition to the existing cables around Ireland there are proposals for more telecommunication cables to the UK and US. Also power cables have been proposed from Dublin and Belfast to the UK and Scotland for electricity trading. The proposed renewable energy industries, discussed in the next section, will also need power connectors and sub-sea cables with coastal grid connectors.

EirGrid plc, the company responsible for operating Ireland's national electricity grid have submitted a foreshore licence to carry out surveys of the seabed conditions in the vicinity of Rush Bay in north Dublin. The purpose of the marine survey is to assist in the selection of a preferred route for an interconnector linking two separate transmission systems.

There are a number of short and long sea outfalls around Ireland, most notably two for Dublin (Dollymount) and two in Cork (Carrigrennan and Tranmore) and one in Galway (Mutton Island). The use of these for treated sewage disposal may increase as a result of measures arising from the WFD as highlighted in the Significant Water Management Issues reports. The Groundwater and Municipal and Industrial Programmes of Measures study for the WFD will have more information on these issues as the treatment of effluent and its' discharge is considered in detail in these studies. Other types of infrastructure development may include Waste Water Treatment Plants near the coast or on estuaries to service increasing populations.

Renewable Energy

Major Foreshore Licences have been granted by DCENR for offshore wind farms at Arklow and at Codling Bank (DCENR, 2007). The impending construction of these may have a range of impacts (although these should be identified and mitigated through the requirement for Environmental Impact Statements). Codling Wind Park on Codling bank has been granted a major foreshore licence agreement for its development as a lease, dated 15/11/2005, under Section 2 of the Foreshore Acts to construct and operate a wind farm at Codling Bank off the coast of County Wicklow for a term of 99 years. A number of areas have been designated for offshore wind farm development on the east and west coast. They are released and leased in a similar way to oil and gas production blocks with a licence from the DCENR.

The Marine Institute, who are actively promoting research into wave and tide energy, consider that Ireland's offshore renewable energy resources (offshore wind, wave and tide), are among the best in the world. Based on available wind and wave conditions, several areas have been identified for future development by the Marine Institute (DCENR, 2007 and Marine Institute data incorporated into the Marine Morphology Other Pressures, see Chapter 3). In addition, Ireland recently announced a 33 per cent renewable energy target for 2020 and specifically mentioned marine renewables (DCENR, Press release, 11 February 2008). The Marine Institute have developed a technology hub in Galway Bay where new technologies can be trialled, such as the WaveBob design that was demonstrated in 2006 (Marine Institute and DCMNR press release 21 March 2006).

8.2.4 Navigation

Navigation is closely linked to pressures associated with port development. The most significant impacts on marine morphology (particularly bed sediments) is the removal of material by dredging, either to maintain, deepen or create navigation channels and, to a lesser extent, maintaining berths. Maintenance dredging in ports and harbours is likely to be ongoing, and the impacts are generally considered to be low and short-lived if good practice is followed. Capital dredging to deepen or create new channels will be less widespread and will usually be linked closely with port development issues discussed above. There are also links to recreational navigation which is discussed below.

The disposal of dredged material/spoil is another significant pressure. Disposal sites identified as located within WFD TraC water body boundaries are recorded in the GIS pressure shapefiles. Table 8.2 below outlines the most recent ‘Dumping at Sea’ licences authorised by DAFF (the former DCMNR).

Table 8.1: Summary of Dumping at Sea Licences, obtained from DAFF (former DCMNR) website (2007)

Permit Holder	Permit No.	Date of Issue	Period of Validity	Description	Quantity (tonnes)
Drogheda Port	Amended Permit No. 345	08/02/07	15/1/07 – 31/12/07	Dredge Spoil	9,000 tonnes daily to a max of 312,400 tonnes
Drogheda Port	Amended Permit No.378	15/01/07	15/01/07 – 28/02/07	Dredge Spoil	10,000 tonnes daily to a max of 250,000
Port of Cork	Amended Permit No. 354	23/02/07	19/01/07 – 31/12/07	Dredge Spoil	20,000 tonnes daily to a max of 1,650,000
Shannon Foynes	Amended Permit No. 365	23/02/07	17/02/07 – 31/12/08	Dredge Spoil	30,000 daily to a max 750,0000
Port Oriel, Co. Louth	380	14/02/07	9/02/07 -28/02/07	Dredge Spoil	4,500 tonnes
Port Oriel, Co. Louth	Amended 380	23/02/07	28/02/07 – 21/03/07	Dredge Spoil	4,500 tonnes
Drogheda Port	381	28/03/07	27/03/07 – 28/04/07	Dredge Spoil	10,000 tonnes
Drogheda Port	382	06/07/07	03/07/07 --31/07/07	Dredge Spoil	10,0000 tonnes
Galway County Council Inishbofin	383	13/07/07	12/07/07 – 31/10/07	Dredge Spoil	1,000 daily up to 54,000 tonnes (including any material dumped since 2005)
Dublin City Council	384	10/0707	24/10/07 – 30/11/07	Dredge Spoil	2,500 tonnes
Port of Waterford	Amended Permit No. 360	16/11/07	16/11/07 – 29/02/08	Dredge Spoil	Up to a max of 2,193,000 tonnes (inclusive of material dumped since 23/01/04)
Dublin Port	Permit No. 388	18/12/07	18/12/07 – 17/12/08	Dredge Spoil	80,000 tonnes daily to a max of 800,000 tonnes

8.2.5 Recreation

Recreational use of TraC waters has recently been promoted by the Marine Institute through its 'Development Strategy for Marine Leisure Infrastructure' (MI, 2005) which focuses on developing leisure-related infrastructure around water-based tourism clusters. This type of infrastructure may include marinas, pontoons, moorings, slipways, piers, breakwaters, and dredging operations, with similar impacts, albeit on a smaller spatial scale, to those caused by infrastructure and navigation.

The 'Development Strategy for Marine Leisure Infrastructure' (MI, 2005) suggests a limited number of new facilities, predominantly along the west coast of Ireland, with enhancement and upgrade of existing facilities in most other areas (for example at Wexford, Helvick and Ballycotton. In Cork, the need for a large development in the Baltimore/Schull area was identified (DEHLG, 2007), with the suggestion that Castletownbere harbour is strategically well located and would benefit from the development of leisure boat facilities. On the west coast, Kilronan is identified as a potentially strategic site for development, whilst the Galway area was identified as justifying a marina. Clifden, Westport, Killala, Sligo and Donegal might justify smaller scale developments. North Mayo is underdeveloped at present for marine leisure and careful consideration needs to be given to the siting of a major development. In Donegal, the fishing ports of Killybegs and Burtonport have been proposed as strategically important sites and marina developments are planned for Rathmullen and Buncrana (MI, 2005).

8.2.6 Agriculture

Agriculture tends to be a less significant risk to morphology of coastal areas than to freshwater habitats. However there are some low-impact activities that occur in coastal areas, particularly on saltmarsh habitats. A search of the Ramsar database showed that overgrazing and drainage are considered to be 'threats' to the ecological integrity of some estuarine and coastal wetlands around Ireland. Grazing of saltmarsh is a traditional management practice, but if the numbers of livestock increase significantly the overgrazing impacts may become more intense and/or widespread.

NPWS have proposed measures to limit overgrazing of coastal wetlands, especially Annex 1 habitats such as saltmarsh and bogs within protected areas, and there are

financial incentives under the REPS scheme to protect these areas from overgrazing. The results of a saltmarsh distribution study will be produced in mid 2008 (NPWS).

Intensive coastal agriculture has not yet been mapped with sufficient confidence to make assessments of future trends. For the Marine Morphology PoMS study the output of the Corrine survey was used to identify areas of agricultural land and urbanised areas to use as an indicator of areas of intensive land use.

The REPS (Rural Environment Protection Scheme) does recognise coastal grazing pressure and encourages non intensive use but does not differentiate habitat types.

8.2.7 Mining, Quarrying and Mineral Extraction

There is currently limited extraction of marine aggregates almost exclusively for marine area infilling for land reclamation. However, with a decline in the availability of viable onshore alternatives, significant research is being undertaken to acquire baseline data to inform strategies for potential increase in such activities. One of the outputs of the INFOMAR project (GSI, 2007) is to identify potential future resources. The INFOMAR programme has identified a number of priority bays and three coastal areas to map in detail (see Figure 4.3 of Chapter 4) As well as providing information for other uses, the outputs will be assessed for potential marine aggregates. The current Irish Sea Marine Aggregates Initiative (IMAGIN) (INTERREG, 2006) aims to develop a strategic framework for exploitation of marine aggregate resources in the Irish Sea, with minimal risk of environmental impacts or risks to other marine users and have currently identified a number of possible areas for exploitation to the east of Ireland (INTERREG, 2006). Such activities are likely to be further offshore but could be considered to pose a potential future pressure (and also potentially increase shipping traffic/dock developments).

Much of Ireland’s ability to extract marine sands and gravels has been limited by the investment that would be required to find suitable resources (Interreg, 2001). However, the INFOMAR and INSS (Irish national Seabed Survey) will provide the information to identify the extent and potential of these resources, which may lead to future demands for extraction, especially as land based resources are under increasing pressure. By way of an indication of the potential importance of this resource, in the UK marine aggregates supply 21% of sand and gravels requirements in England (and 90% of Wales’ sand requirements) (Gubbay, 2006)

In addition, Ireland has previously granted small scale license for maerl extraction and several areas have been identified as under pressure for industry development (e.g. Blackhead Bay Co, Clare Heritage Council Landscape reports, 2006, Lonehort Point, Bear Island, Co. Cork, MI, 2005). However, it is considered that Lonehort is the currently the only existing licence.

8.2.8 Water Abstraction

The information collated as part of the marine morphology task has shown there are few licences for marine abstraction in Ireland, with the exception of some small scale coastal water abstractions in the Shannon associated with gas infrastructure. Water from marine and coastal waters is predominantly extracted for cooling water for industrial processes and power generation. The most likely trend in marine abstraction is an increase due to the oil and gas industries and associated power generation.

Liquid Natural Gas (LNG) has been identified for development in Ireland in order to assist in the security of gas supply networks (DCENR, 2007). LNG is natural gas that has been cooled to a very low temperature (minus 160 degrees centigrade), at which point it becomes a liquid. Liquefying natural gas reduces the volume it occupies by more than 600 times, making it manageable for storage and transportation. Current developments include the facility in Shannon, which will comprise of 600 acres of coastline and a dredged channel to receive LNG tankers from export sources include Algeria, Australia, Egypt, Indonesia, Malaysia, Nigeria, Oman, Qatar and Trinidad. The facility includes abstractions of cooling waters from the estuary as part of the degasification process. The natural gas is then piped onto the grid and is expected to be operational by 2011 (Minister for Enterprise, Trade and Employment press release 22 May 2006).

In addition, gas powered electric generating stations have been proposed in combination with the Corrib development and LNG facilities in the west of Ireland. The DCENR outlines the development of coastal power stations and the conversion or upgrade of existing facilities, such as those in Cork and Dublin, to generate electricity from natural gas (DCENR, 2007). Such facilities will require cooling waters and therefore are likely to need abstractions from coastal resources in order to operate.

Along the east coast of Ireland the potential long term implications of water demand and shortfalls are being examined. Dublin in particular has identified a significant

water shortage by 2012. The Dublin Water Feasibility SEA (DCC, 2006) identifies a desalination option with estimated flow capacity of between 9,090 m^3/h (Phase 1) and 13,636 m^3/h (Phase 2). If approved this would be a significant marine abstraction and is provisionally planned in North Fingal.

8.3 Conclusions

The River Basin Management Plans will set out proposals for waterbodies on a six year cycle. As a result there is a requirement to assess the drivers and sectors likely to affect marine morphology and specifically the pressures on eco-morphological factors over the future, which may in turn affect the ecological status of transitional and coastal waters.

The main overarching trends likely to affect marine morphology are climate change and associated sea level rise, and the effect these have on coastal areas, causing increased flooding and the need for coastal protection, affecting the morphology and 'squeezing' the ecology. The sea level rise is likely to be exacerbated by an increase in storm surges causing flooding resulting in a need for greater coastal flood defenses.

The uncertainties of climate change make it difficult to predict with any accuracy the coastal protection that might be associated with sea level rise / increase in storm surges and possible freshwater shortages that could affect Ireland in the future.

Additional pressures, that are linked to climate change, are the possibility of water demands exceeding supply in some areas, resulting in the need for water abstraction and potentially desalination, to meet requirements. The possibility of these water shortages can change agricultural patterns to put more pressure on coastal areas, and increase the need for expansion of fisheries and aquaculture industries to meet growing demands.

Pressure from ports and coastal population centres are also likely to develop in coastal areas and estuaries. {At present Ireland has concentrated coastal communities with low levels of population in the majority of regions, such that overall the pressure on the coastal zone is currently limited to a low percentage of Ireland's coastline in comparison to its European neighbours (EEA, 2006) However, Ireland is reliant on sea transport for much of its trade. All major Irish ports are likely to expand

in the near future and there are plans to increase and distribute national capacity by the addition of new facilities. Ports often expand by land claim or need shoreline reinforcements and flow modification structures to operate. Ports also require safe navigation, meaning dredging of channels and berths, and the dumping of this material at sea.

Marine energy generation is also likely to increase in the near future. Oil and Gas exploration licencing is currently being rolled out in Ireland with the National Energy Policy highlighting the need for safeguarding Ireland energy supplies. Also within the energy policy are drivers to increase the amount of renewable energy production, and marine technologies (wind, wave and current) are most likely to increase in the near future. The expansion of these industries will also result in increased requirements for subsea pipelines and cables.

Fisheries and aquaculture are a significant industry in Ireland with plans to expand, though these industries have a low impact on morphology they can have a cumulative effect and the associated support infrastructure on the coastal zone can affect the marine morphology. Coastal and marine recreation are also important sectors which there is a likelyhood of increase, meaning more coastal structures and facilites, such as accomadation and marinas.

Finally, there have been programmes undertaken to assess the offshore agregates available to Ireland. As terrestrial sources become scarcer or more expensive, there is a possibility that marine aggregate industries may wish to develop in Ireland.

Ireland is likely to see an increase on demand for coastal resources in the future, which in tern will mean an increase in coastal pressures and could affect marine morphology if not properly managed.

9 Recommendations for the Design of the Monitoring Programme

9.1 Introduction

As outlined in Chapter 4 Ireland has in place a series of monitoring programmes in the marine environment, assessing various factors relating to sediments, water quality, chemistry and fish/shellfish quality. The WFD proposes to combine these programmes into a strategic sampling programme. This monitoring programme has been scoped, proposed and costed by the Marine Institute and EPA, but has yet to provide specific assessment of hydromorphology.

Overall there are two requirements for marine morphological data - to provide monitoring for the classification of water body status, and, to detect changes that may affect this status. To achieve this, a morphological baseline for TraC water bodies is needed to determine the existing condition of a water body, and then the relationship between pressures and their impact on morphology (and subsequently ecology) needs to be refined so that changes can be efficiently monitored.

A baseline of morphology should include sediment type, bathymetric profile, and flow conditions. From a review of existing and planned monitoring programmes (Chapter 4) it is proposed to adapt and record morphological monitoring surrogates to firstly input to the assessment of current conditions then to assist in the monitoring of changes until such time as a national inshore morphological baseline is available.

Morphological monitoring should ideally be collected within existing monitoring programmes including that proposed for coastal waters within the WFD monitoring programme. This is not only the most efficient method, but also enables morphological data to be associated with other information such as ecological data which may assist in the interpretation of changes and the potential reasons for these changes.

9.2 Recommendations for baseline conditions and change

9.2.1 Baseline Conditions (existing status)

The reporting of baseline conditions requires the physical survey of Ireland's TraC water bodies to provide a fixed reference from which changes can be assessed. At

present this does not exist for Ireland. Therefore, surrogate information (such as historical timeline information of physical parameters recorded from previous monitoring programmes, site specific assessments for the purpose of EIAs, foreshore licence applications, etc.) can indicate existing status as well as long term changes where no fixed reference conditions are available. However, as noted previously; morphology changes can be triggered by natural changes in TraC waters and this should be considered in all interpretations of monitoring results.

A central repository for such information would prove beneficial to the collation and use of national morphological data. This is discussed furthering Section 9.2.4.

The INFOMAR project is of particular relevance in supplying baseline morphological information for many TraC water bodies.

In the absence of adequate baseline data to provide evidence-based reference conditions, the presence or absence of pressures on morphology, as identified by this study, may be used as indicators of morphological status class. The SNIFFER study titled 'Development of Hydromorphological Reference Conditions and Draft Classification Scheme for Transitional and Coastal Waters', discussed in Section 5.4.2 of Chapter 5, based many of the classification 'metrics' on the extent or presence / absence of a pressure. For example; Metric 2, 'changes in sediment budget and composition', has the following assessment threshold: '***length of frontage influenced by reinforcement or beach management / total length of frontage'***. Although this SNIFFER study was not progressed, the UK Environment Agency in association with the UK and Ireland Marine Task Team have undertaken extensive research for these metrics. It is therefore recommended that in the absence of formal monitoring systems to refine impact assessment methods such as TraC-MImAS, 'metrics' such as those outlined by SNIFFER may be used to report on high status water bodies.

Chapter 6 identified those water bodies for which no, or minimal, pressures are currently present. On completion of the national PoMS studies and the formal classification of biological and physico-chemical quality elements, those water bodies not considered at risk from achieving high ecological status due to other factors can be confirmed. The further assessment of these water bodies as a priority to address any information restrictions experienced by this study (e.g. restricted orthophoto coverage) can confirm the presence or absence of pressures impacting on

morphology. TraC water bodies not impacted by other factors and not influenced by physical alterations [upstream or adjacent] may be considered as demonstrating high ecological status in the absence of monitoring. However, it is important to ensure legacy issues are considered, particularly if the biological classification tools applied do not relate to morphology.

In the absence of formally adopted classification tools defining the parameters and standards / conditions required, it is difficult to recommend specific monitoring requirements. However, using the framework of TraC-MImAS, possible morphological indicators can be recommended for inclusion in future monitoring programmes (baseline and assessment of changes). Module 1 of TraC-MImAS considers a series of ecologically relevant features and process, and as noted in Chapter 5, each of these attributes was chosen "***for its role in the direct or indirect support of ecological communities and the supporting processes needed to create and maintain the physical environment on which ecological communities depend***" (SEPA, 2007 version a4).

The first RBMPs will identify those water bodies provisionally classified as high status. It is recommended that monitoring of baseline morphological conditions is undertaken at these sites to provide reference conditions which can be considered for monitoring in relation to surveillance and operational programmes. These reference conditions are likely to be specific to each water body. However, further definition of the water body typologies via baseline monitoring may facilitate type-specific reference conditions. In addition to refining the typologies as a whole, this study has identified a requirement for the site specific assessment of various water bodies for which the existing typology may not be consistent with actual conditions (see Chapter 6).The completion of such monitoring will contribute to the requirements of the WFD in relation to classification.

Table 9.1 below outlines the potential sources of baseline information and future monitoring data that can be used to report on and monitor these eco-geomorphic attributes. Potential additional monitoring and other practices which may be applied to supplement existing and proposed monitoring systems for these purposes are also suggested where possible.

Table 9.1: Eco-geomorphologic attributes and potential monitoring parameters, including likely ecological monitoring indicators

Eco-geomorphic Attributes	Definition	Monitoring	Frequency / Coverage	Ecological monitoring / survey	Additional monitoring / practices
		Potential existing and future sources of monitoring parameters	Frequency and spatial extent of existing/proposed systems	Associated ecological observations from ecological / biometric monitoring	Recommendations for the collection of baseline (status) date and assessment of change
All eco-geomorphic attributes		**Additional monitoring / practices:** ***Centralised repository for data collected by existing and future systems (including EIA, Foreshore applications and conservation monitoring).***			
Hydrodynamics	**Describes the influence of the tides, waves and freshwater inflow**				
Tidal range	***The height that the sea rises and falls over a tidal cycle***	Marine Institute Tidal network observations Ports tidal gauge information	Regular interval or continual monitoring. Limited coverage, only a few offshore observations and ports (HMWB)	Changes in habitat distribution, especially intertidal most notably strandline location Possible changes to biotopes with greater /less exposure tolerance.	Increase tidal gauge network to represent TraC water bodies. May need to be supplemented from other studies including EIA, Foreshore licence applications etc where available
Currents	***Currents associated with the rise and fall of the tide***	Current metering. Marine Institute Tidal network observations Current monitoring (EISs', Foreshore / dumping at sea licences) Granulometry/ depth recordings	Regular interval or continual monitoring. Limited coverage, only a few offshore observations and ports (HMWB) Some additional data available from other studies but limited availability Surveys and monitoring (EISs, Foreshore / dumping at sea licences) usually once-off survey events. SAC monitoring – 3 year cycle for Site Inspection Reporting, and 7 year reporting cycle for Favourable Conservation Status	Changes in ecology to biotopes associated with more / less exposed conditions. Changes in sediment type	Increase tidal gauge network to represent TraC water bodies. Co-ordination with INFOMAR programme and SAC baseline surveys into central repository to build seabed sediment maps and bathymetric data store for Ireland.
Freshwater flow	***Riverine input into TraC Waters, maybe modified by human interference of catchment hydrology/land use changes***	CDT (Conductivity, depth and temperature readings) Intertidal salinity measurements (optic)	EPA existing CDT monitoring programme, and basic measurements from other programmes, monitoring programme. Frequency may change under WFD. Single record / intermittent	Changes / localized opportunistic euryhaline algal growth / bloom. Increase in species with FW tolerance.	Co-ordinate with hydrometrics and other PoMS studies; expand assessments to TraC water bodies.
Flushing/exchange	***The length of time it takes for a transitional water or sea loch to exchange its water***	Flow readings (Hydrometrics)	Some flow meters in CFB and EPA networks. Regular measurements through hydrometrics programmes, underway and planned.	Possible changes to biotopes with greater /less exposure tolerance.	Co-ordinate with hydrometrics and other PoMS studies; expand assessments to TraC water bodies.
Salinity / mixing / stratification	***Occurs in transitional waters and sea lochs where freshwater input is important***	CDT (Conductivity, depth and temperature readings) Intertidal salinity measurements (optic)	EPA existing CDT monitoring programme, and basic measurements from other programmes, variable frequency Optic measurements from EIA / Foreshore applications – usually single temporal record	Possible changes to biotopes with greater /less freshwater tolerance.	Salinity measurements within a number of the proposed WFD monitoring programmes need to be centrally collated from all programmes.
Waves	***Waves are important in driving sediment transport processes***	No specific monitoring planned. MI localized monitoring and planned SmartBay prototype. Ports tidal gauge information, Some wave estimation models have been carried out for wave energy development.	National wave model could be developed under Sea Change programme to identify resources for wave energy. Likely to be at coarse scale model. Estimation models and field surveys to support flood evaluations.	Possible changes to biotopes with greater /less exposure tolerance.	Link to flood monitoring and Floods Directive programmes which will evaluate wave height for coastal inundation and defence Collation of studies undertaken for specific developments

Table 9.1 (continued): Eco-geomorphologic attributes and potential monitoring parameters, including likely ecological monitoring indicators.

Eco-geomorphic Attributes	Definition	Monitoring	Frequency / Coverage	Ecological monitoring / survey	Additional monitoring / practices
		Potential existing and future sources of monitoring parameters	Frequency and spatial extent of existing/proposed systems	Associated ecological observations from ecological / biometric monitoring	Recommendations for the collection of baseline (status) date and assessment of change
Intertidal Zone	**Describes the size and structure of the intertidal zone**				
Geometry	Describes the spatial extent and form of the intertidal zone				
Planform	***Aerial view showing planar area of the intertidal zone (2D perspective). Describes the outline and spatial extent, or area of the intertidal zone which can change in response to prevailing coastal processes and/or realignment of the high water mark due to engineering activities.***	Bathymetry, shoreline profile, especially multibeam swathe (INFOMAR) Shallow water LiDAR Ortho photography	Baseline required for RoI waters. Frequency of repetition is not set, however, surveys are most cost effective if included with existing programmes Shallow water LiDAR, national coverage to be carried out. Can be repeated in areas of suspected change (erosion / deposition); 3 or 6 yrs suggested Frequency of orthophotography are as per the OSi coastal mapping requirements. Variable frequency dependant on changes.	Possible changes to biotopes with greater /less exposure tolerance. Possible changes to biotopes with greater /less freshwater tolerance. Changes in habitat distribution, habitat loss.	Co-ordinate morphological survey with existing programmes. SAC monitoring transects and other intertidal survey programmes. National repository for bathymetric data collected from other programmes (Foreshore / EIA) Co-ordinate with OSi for orthophotographic records to compare and LiDAR / Digital Elevation Model data.
Profile	***Cross sectional form of an estuarine channel or gradient of the shoreline.***	Bathymetry, shoreline profile, especially multibeam	Baseline required for RoI waters. Frequency of repetition is not set, however, surveys are most cost effective if included with existing programmes	Possible changes to biotopes with greater / less exposure tolerance. Possible changes to biotopes with greater / less freshwater tolerance. Changes in habitat distribution, habitat loss.	Co-ordinate morphological survey with existing programmes. SAC monitoring transects and other intertidal survey programmes. National repository for shore profile data collected from other programmes (Foreshore / EIA)
Morphological features and substrate	Describes the shape and character of geomorphological features, and the size, structure and sorting of the intertidal sediments				
Nature and extent of coastal features	***Topography and geomorphological and vegetation features of the coastal zone e.g. saltmarsh, seagrass, sand dunes, mudflats, sand bars, spits.***	NPWS SAC monitoring and habitat mapping. Coastal LiDAR Orthophotography	Baseline required for RoI waters. Frequency of repetition is not set, however, surveys are most cost effective if included with existing programmes	Possible changes to biotopes with greater /less exposure tolerance. Possible changes to biotopes with greater /less freshwater tolerance. Changes in habitat distribution, habitat loss.	Co-ordinate morphological survey with existing programmes. SAC monitoring transects and other intertidal survey programmes. Ground truthing surveys of coastal orthophotography and LiDAR to identify and record features
Natural sediment size range	***Is the sediment size distribution natural***	Granulometry samples (benthic sampling)	Baseline required for RoI waters. Frequency of repetition is not set, however, surveys are most cost effective if included with existing programmes	Changes in habitat distribution. Habitat loss, change of biotope to altered substrate.	Co-ordinate morphological survey with existing programmes. SAC monitoring transects and other intertidal survey programmes. Add parameter to propose WFD marine monitoring programme and those active transitional WFD subnets. Ground truthing surveys of coastal orthophotography and LiDAR to identify and record features Supplement field observations with Particle Size Analysis (PSA) to ensure consistency.

Table 9.1 (continued): Eco-geomorphologic attributes and potential monitoring parameters, including likely ecological monitoring indicators.

Eco-geomorphic Attributes	Definition	Monitoring	Frequency / Coverage	Ecological monitoring / survey	Additional monitoring / practices
		Potential existing and future sources of monitoring parameters	Frequency and spatial extent of existing/proposed systems	Associated ecological observations from ecological / biometric monitoring	Recommendations for the collection of baseline (status) date and assessment of change
Continuity and sediment supply	Assesses interruptions to coastal processes and sediment supply				
Longitudinal sediment transport processes	***Describes sediment mobilisation pathways i.e. transport of material by littoral drift from adjacent water bodies.***	Current metering, turbidity / suspended solids Flood risk studies, EUROSION network Localised changes in sediment type, profile or bathymetry	Currently infrequent.	Changes in habitat distribution. Habitat loss, change of biotope to altered substrate.	Data from flood risk studies should be co-ordinated with other surveys to provide data. Coastal process modelling should be carried out when sufficient data is collected Co-ordinate morphological survey with existing programmes. SAC monitoring transects and other intertidal survey programmes. (coastal erosion) Supplement field observations with Particle Size Analysis (PSA) to ensure consistency.
Lateral sediment transport processes	***Includes land to sea connectivity and describes inputs and outputs of sediment from erosion of cliffs, catchment derived input from fluvial sources and material transported from offshore.***	Current metering, turbidity / suspended solids Flood risk studies, EUROSION network Habitat loss, change of biotope to altered substrate.	Currently infrequent.	Changes in habitat distribution. Habitat loss, change of biotope to altered substrate.	Data from flood risk studies should be co-ordinated with other surveys to provide data. Coastal process modelling should be carried out when sufficient data is collected Co-ordinate morphological survey with existing programmes. SAC monitoring transects and other intertidal survey programmes (coastal erosion) Supplement field observations with Particle Size Analysis (PSA) to ensure consistency.
Sub tidal Zone	**Describes the size and structure of the subtidal zone**				
Geometry	Describes the spatial pattern and form of the subtidal zone				
Planform	***Aerial view showing planar area of the subtidal zone (2D perspective). Describes the outline and spatial extent, or area of the subtidal zone which can change in response to prevailing coastal processes and/or engineering activities.***	Bathymetry, shoreline profile, especially multibeam (INFOMAR) Shallow water LiDAR, ortho photography.	Baseline required for RoI waters. Frequency of repetition is not set, however, surveys are most cost effective if included with existing programmes	Possible changes to biotopes with greater /less exposure tolerance. Possible changes to biotopes with greater /less freshwater tolerance. Changes in habitat distribution, Habitat loss	Co-ordination with INFOMAR programme and SAC baseline surveys into central repository to build Seabed sediment maps and bathymetric data store for Ireland
Profile	***Cross sectional form of a channel or of the coastal zone perpendicular to the coastline***	Bathymetry, shoreline profile, especially multibeam	Baseline required for RoI waters. Frequency of repetition is not set, however, surveys are most cost effective if included with existing programmes	Possible changes to biotopes with greater /less exposure tolerance. Possible changes to biotopes with greater /less freshwater tolerance. Changes in habitat distribution, Habitat loss	Co-ordination with INFOMAR programme and SAC baseline surveys into central repository to build Seabed sediment maps and bathymetric data store for Ireland Supplement field observations with Particle Size Analysis (PSA) to ensure consistency.

Table 9.1 (continued): Eco-geomorphologic attributes and potential monitoring parameters, including likely ecological monitoring indicators.

Eco-geomorphic Attributes	Definition	Monitoring	Frequency / Coverage	Ecological monitoring / survey	Additional monitoring / practices
		Potential existing and future sources of monitoring parameters	**Frequency and spatial extent of existing/proposed systems**	**Associated ecological observations from ecological / biometric monitoring**	**Recommendations for the collection of baseline (status) date and assessment of change**
Morphological features and substrate	Describes the shape and character of geomorphological features, and the size, structure and sorting of the intertidal sediments				
Nature and extent of bed features	***Topography or specific features of the seabed e.g. sand banks, ripples.***	Bathymetry, shoreline profile, especially multibeam / ADGS or video transects. Shoreline profile / Shallow water LiDAR	Baseline required for RoI waters. Frequency of repetition is not set, however, surveys are most cost effective if included with existing programmes	Possible changes to biotopes with greater /less exposure tolerance. Possible changes to biotopes with greater /less freshwater tolerance. Changes in habitat distribution, Habitat loss	Centralised repository for data collected by other studies (EIA, Foreshore licence application, SAC monitoring s etc) Co-ordination with INFOMAR programme and SAC baseline surveys into central repository to build Seabed sediment maps and bathymetric data store for Ireland Supplement field observations with Particle Size Analysis (PSA) to ensure consistency.
Natural sediment size range	***Is the sediment size distribution natural***	Granulometry samples (benthic sampling)	Baseline required for RoI waters. Frequency of repetition is not set, however, surveys are most cost effective if included with existing programmes	Habitat loss, change of biotope to altered substrate.	Co-ordination with INFOMAR programme and SAC baseline surveys into central repository to build Seabed sediment maps and bathymetric data store for Ireland Add parameter to propose WFD marine monitoring programme and those active transitional WFD subnets. Supplement field observations with Particle Size Analysis (PSA) to ensure consistency.
Continuity and sediment supply	Assesses interruptions to coastal processes and sediment supply				
Longitudinal sediment transport processes	***Describes sediment mobilisation pathways i.e. transport of material by littoral drift from adjacent water bodies.***	Shoreline profile / Shallow water LiDAR Granulometry samples (benthic sampling)	Currently infrequent.	Changes in habitat distribution. Habitat loss, change of biotope to altered substrate.	Data from flood risk studies should be co-ordinated with other surveys to provide data. Coastal process modelling should be carried out when sufficient data is collected Supplement field observations with Particle Size Analysis (PSA) to ensure consistency.
Lateral sediment transport processes	***Includes land to sea connectivity and describes inputs and outputs of sediment from erosion of cliffs, catchment derived input from fluvial sources and material transported from offshore.***	Shoreline profile / Shallow water LiDAR Granulometry samples (benthic sampling)	Currently infrequent.	Changes in habitat distribution. Habitat loss, change of biotope to altered substrate.	Data from flood risk studies should be co-ordinated with other surveys to provide data. Coastal process modelling should be carried out when sufficient data is collected Supplement field observations with Particle Size Analysis (PSA) to ensure consistency.

9.2.2 Monitoring of morphological changes

Morphological conditions are very site specific and subject to natural fluctuations. It is therefore considered that extensive research, that extends beyond the existing WFD monitoring system, is required before a national morphological monitoring programme can be established to adequately assess changes in ecologically relevant features and processes. Monitoring of specific morphological attributes has been limited to date; therefore, monitoring trials may be required to provide confidence in monitoring practices defined to indicate changes influenced by anthropogenic modifications.

From the review of monitoring outlined in Chapter 4, recordings from proposed and active monitoring and survey programmes in Ireland have been assessed. The parameters used have been evaluated against their potential use as morphological indicators.

TraC-MImAS provides a suitable framework to assist in the regulation of future physical alterations. The modular structure of this framework enables the further development of specific aspects of the tool. Investigative monitoring is essential to refine the modules in this tool so as to increase confidence in its use as a decision support tool.

Until such time as an adequate national baseline is available, the information collected for morphology as part of existing programmes or proposed monitoring may be used to indicate potential changes in morphology (changes to eco-geomorphic attributes) that may affect water body status.

Using the existing and proposed monitoring programmes detailed in Chapter 4 a number of recommendations are suggested to help ensure morphology is adequately surveyed under the WFD requirements.

9.2.3 Intertidal

Special Areas of Conservation (SAC) are currently monitored for conservation status using a series of transects that have been established to assess the biological quality of the SAC and in particular their features of interest. As a set transect, this provides an opportunity to monitor the morphology of the intertidal area whilst providing additional information that can be used to interpret the biological data*****. Also,

the physiotope data currently collected by this monitoring system can provide some time series data to inform morphological baseline / reference conditions.

Consideration could be give to an alternative method of collecting additional intertidal morphological information by levelling the transects used to monitor SACs. At present there are samples taken from habitat transition points along the transect, and a GPS location is taken. By survey levelling of these sites, changes in morphology can be assessed. This information, coupled with the granulometric**** and biological data can be used as an indicator of morphological changes, and allow better interpretation of biological changes along the transect. Such changes of monitoring systems however would require additional time and resources.

For some SAC sites, diver transects may be carried out as part of the monitoring and can be treated in a similar way with digital depth gauge readings at sample sites to level the transect together with ecological and substrate observations. This information is likely to be limited in accuracy, however it would provide some baseline data and indications of gross morphological changes until suitable baseline data is available (potentially via the INFOMAR programme).

9.2.4 Subtidal, Coastal and Transitional

Registers of marine models and Environmental Impact Statements (EISs) completed in Ireland were generated as part of the Literature Review (Appendices 2-1 and 3-2 respectively). The studies identified are potential sources of baseline information regarding specific issues that may arise from future developments or site specific requirements.

***** However, after discussion with NPWS (telecom Dr E Kelly, 04/02/2008) it seems NPWS may be changing the intertidal SAC monitoring to a stratified random transect programme in the near future which suggests that direct comparison of results and assessment of local changes in morphology and assessments attributing changes in ecology may be restricted. Levelling data on the stratified random transects within SACs could still assist the classification of a water body's morphology and provide information on baseline conditions from which changes can be assessed. However, due to the length of some areas of the foreshore collection of such data within the existing programmes may not be practical or cost effective.

****** granulometry can be attributed to sediment type and depth

Activities with significant potential morphological impact are required to provide baseline data on the bathymetric profile and sediment types, pre and post the activity being undertaken. For example, in the case of dredging, analysis of the sediments to be removed is carried out prior to the dredging activity. In most cases this is accompanied by bathymetric survey maps, the quality of which can vary significantly. The results are submitted with the application to the appropriate regulator. Similar studies are required for the laying of cables and pipelines and other marine activities, especially for the oil and gas industries.

A national database of such models, surveys and analyses would be of significant benefit to compilation of a national register of baseline TraC morphological conditions. The structure of the NS-Share Monitoring Database, discussed in Section 4.3.1 of Chapter 4, may provide a suitable framework to develop this.

Also, the submission of electronic, and where possible geo-referenced, copies of survey results and reports from dredging, dumping at sea and coastal development applications could be collated a central repository to allow the data to be assessed and compared with ongoing work, and also in providing a national baseline through the INSS and INFOMAR programmes.

As outlined previously in Chapter 4, the INFOMAR programme, a hydrographic mapping programme of select areas around the coast, may be interpreted to provide a national inshore morphological baseline. This can be supported by ecological surveys by the NPWS and Marine Institute to allow evaluation of ecological status and eco-morphological assessments.

The shallow water LiDAR surveys being carried out for the flood management and National Flood monitoring programme could be repeated in areas of concern to examine possible changes in morphology and provide valuable baseline data in the subtidal areas.

Another potential combining of marine morphology monitoring and other programmes could be to carry out bathymetric / Acoustic Ground Discrimination system (AGDS) monitoring during benthic and plantonic surveys. This has been suggested in a draft proposal made by the Marine Institute (MI (Draft), 2006). If adopted, this would provide interim baseline transect (plankton surveys) and point records (benthic

surveys) that can be used as an indicator to monitor changes in marine morphology. Such a programme would require additional time and potentially extensive resources. However this system of monitoring would not only provide baseline information (until national datasets can be compiled), but also provide time series repeat transects that can be assessed for changes. Such a system could be prioritised for those water bodies indicating no or little risk to high ecological status to provide reference conditions.

Finally a programme of investigative monitoring to establish the coastal process pathways (erosion, deposition, coastal currents) should be instigated in the future, building on the data being collected from existing programs such as EUROSION European erosion studies, and Catchment Flood Risk Assessment and Management Study (CFRAMS) flood risk mapping. Such information can assist with management and determination of morphological processes and the effects of marine morphological pressures upon water bodies.

9.3 Recommendations for information requirements

To help refine and / or clarify some the assumptions made throughout this study regarding the relationship between pressures and impacts on morphology (and subsequently ecology) it is recommended that the framework of SEPA's TraC-MImAS tool is used as a basis for future assessment.

TraC-MImAS assesses the impact of pressures differently for the intertidal and subtidal zones. A national dataset depicting these zones is unavailable. To support the use of TraC-MImAS and also refine the general relationship between pressures, and morphological conditions to assist future monitoring, detailed scale maps are required. Detailed maps of high and low water marks will have significant benefit to the assessment of coastal changes (erosion and deposition etc).

Module 1 – Eco-geomorphic attributes

Table 9.1 outlines the eco-geomorphic attributes considered in TraC-MImAS and recommends monitoring systems to collect information relevant to these. These attributes were determined by professional judgement in the absence of field-based data.

Monitoring can help refine, or in some cases discount, this professional judgement by providing scientific data to confirm the relevance of these attributes to morphology of TraC waters. Suggestions as to how this may be undertaken are outlined in Table 9.1. However, it is difficult to define exact parameters and methods in the absence of previous monitoring for many of these attributes.

The TraC-MImAS tool does not require data to be entered for these attributes, but assumes their relevance to six TraC water body 'types'. There is potential for the association of certain eco-geomorphic attributes with water body types, to be refined as the monitoring of TraC waters progresses.

Module 2 - Typology

It is a recommendation of this study (and the Marine Morphology Steering Group) that on completion of sufficient TraC monitoring programmes, Irish TraC water bodies are reviewed and re-typed where required. In addition to refining 'type-specific' reference conditions, this will help increase confidence in the use of TraC-MImAS, the results of which are largely dictated by the water body 'type' being assessed. As noted in Section 5.2.2 in Chapter 5, the eighteen TraC water body types defined within Ireland and the UK for the WFD were grouped into six overall water body types for the development and application of TraC-MImAS. The typology of TraC water bodies was defined using 'System B' as specified in Annex II of the WFD, and therefore meets the requirements of the WFD. However, TraC-MImAS can be refined by using both ecological and morphological baseline conditions to further type water bodies. For example, it may be possible to divide a water body into various sub-types to reflect the appropriate baseline conditions to allow for increased sensitivity values to be applied to certain water bodies such as those supporting large saltmarsh habitats. At present the typology module does not support the assessment of specific Protected Areas. Detailed monitoring of such areas will improve the framework for future assessment of change.

In addition to refining the assumptions of TraC-MImAS, the WFD requires that type-specific hydromorphological conditions are established to represent the quality elements. However, Annex II (1.3)(iii) allows for type-specific conditions to be established using expert judgement where other methods are not possible.

In establishing type-specific reference conditions, the WFD allows the exclusion of a quality element from the assessment of ecological status if it is not possible to

establish reliable type-specific reference conditions '***due to high degrees of natural variability in that element***' (Annex II (1.3)(vi)). In such circumstances Member States must state the reasons for this exclusion in the RBMPs.

Module 3 – Morphological and Ecological Sensitivity

The morphological component of this module is based on the likelihood that an attribute of the particular water body type being assessed will change in response to a pressure. To estimate ecological sensitivity (relating to all WFD biological elements) the likelihood that a disturbance to individual attributes (via pressures) will result in a degradation of community or species integrity is estimated and quantified. The sensitivity of both these elements is again based on professional judgement.

As noted in Chapter 4, only three of the TraC biological classification tools can be related to morphological conditions (macroalgae, saltmarsh and seagrass). The completion of these studies in addition to existing monitoring undertaken by the NPWS can help refine the sensitivity values used in TraC-MImAS for the purpose of supporting regulation. With regard to classification of morphological conditions, the relationship between the attributes and biological elements will require focused investigation. The monitoring of eco-geomorphic attributes at sites identified for the application of these biological classification tools should help identify the existing conditions relative to the biology present. Historic biological monitoring results available for such a site can then be reviewed to determine any relationship between biology and the introduction of physical alterations.

The establishment of a nationally consistent monitoring programme for morphological change is not considered possible or efficient at this stage. Due to the current lack of scientific evidence of the relationship between morphology and ecology, focused investigative monitoring is recommended so as to adequately inform national monitoring programmes for both classification and impact assessment purposes.

Recommendations for the collation of national baseline data have been made. Prior to this, baseline conditions can be monitored at those water bodies identified as having little or no physical alterations. If monitoring is undertaken in association with the relevant biological classification tools, an adequate reference condition for that water body type may be determined. If confidence is established in the typology of a water body then similar monitoring can be undertaken in a water body of the same 'type' which is subject to physical alterations.

The difficulty with this process is that attributes such as planform and natural sediment size range require site specific historic data to determine the reference condition for a particular water body. Therefore, although the typology of two water bodies may be comparable using the parameters defined by the WFD there specific morphological attributes may vary significantly. As noted previously to resolve this difficulty, the presence or absence of anthropogenic physical alterations may be considered as an appropriate reference condition. Qualitative values can then be used to determine changes in morphological condition, the thresholds for which can be informed by investigative monitoring, but are likely to always require some expert judgement.

Module 4 – Impact Assessment

The assessments within this module are independent of water body type. The module forms a distinction between the intensity and extent of impacts by estimating the likelihood that a morphological alteration will have an impact on an eco-geomorphic attribute, and quantifies whether impacts are likely to be contained within the vicinity of the pressure, or be pervasive. The ‘zone of impact’ is considered an important aspect of monitoring for morphological impacts/changes. The assessment of direct loss of habitat associated with physical alterations is a simple process. However, the nature of TraC waters may restrict the definition of ‘zones of impact’ i.e. natural fluctuations in conditions can significantly alter how the effects of a pressure are received by the environment.

Again, the values contained with TraC-MImAS were determined using professional judgement. Therefore investigative monitoring, and research, are required to increase confidence in these values. As noted in Chapter 6, water body trials were undertaken across Ireland and Scotland. However, with the exception of initial trials undertaken by SEPA during the development of TraC-MImAS, these trials did not include field assessments.

Module 5 – Cumulative Impact Assessment

In the absence of environmental standards for morphological elements, Morphological Condition Limits were defined, and trialled, for use in TraC-MImAS (see Section 5.2.5 of Chapter 5). The results of the trials indicated good correlation between the MCLs and professional judgement of ecological status. Also, the results of the further characterisation process (Chapter 6) are considered consistent with

general existing conditions for many water bodies. Those water bodies for which the results have been questioned (highlighted in red italics in Appendix 6-3) are for the most part associated with the lack of data to adequately consider the pressures on a water bodies. In addition to data gaps identified by Chapter 3, a significant gap in the assessment of morphological pressures is that relating to aquaculture (and fishing) practices. It is recommended that morphological monitoring specific to the 'worked' areas is undertaken to refine the results of the further characterisation process.

Further development of the MCLs, in the absence of formal classification, will require field assessments including investigative monitoring to refine the association of these values with morphological and ecological status class.

9.4 Conclusions

A WFD marine monitoring programme has been identified and proposed to meet the requirements of the Directive. The monitoring programme, does not specifically address morphology. However, information can be collected and assessed within existing systems to allow further water body characterisation and measurement of changes.

In the absence of formally adopted classification tools defining the parameters and standards / conditions required for morphology, it is difficult to recommend specific monitoring requirements.

It is essential for the monitoring of marine morphology, that a reliable baseline against which to make assessments and assess future development proposals is collected. There are a number of programmes already underway, (the most notable being INFOMAR), that can provide this information. However, they will not be complete until towards the end of this first River Basin Management Plan cycle.

As a result, it is proposed that records from a number of national survey and monitoring programmes are used to assess potential marine morphological changes until such time as this baseline is available. To improve the efficiency of such a process, it is recommended that a central repository of available data is compiled for use by the relevant authorities. It is proposed later in this report (Chapter 11) that future development applications are accompanied by GIS-based data to enable development of a national centre for such assessment data. Applications could provide drawings and location maps in GIS or georeferenced Autocad drawings to support establishment of an electronic archive of coastal developments relevant to marine morphology.

The WFD should ensure that monitoring undertaken for the purpose of such applications considers the quality elements specified by the WFD. This data, collated in a central repository can help inform future assessments and establish a national baseline. Formal guidance at Government level would facilitate this process (this is discussed further in Chapter 11).

Once this baseline is available it will be possible to investigate morphological changes that have caused ecological deterioration.

It is recommended that in the absence of formal monitoring systems to refine impact assessment methods such as TraC-MImAS, 'metrics' such as those outlined by SNIFFER (2007) may be used to report on high status water bodies, i.e. for use in the classification and reporting of high water body status to the European Commission.

It is considered that further investigation and refinement of the components of TraC-MImAS will help form a more efficient monitoring system. There is currently a lack of field-based scientific knowledge relating to the assessment of TraC morphology and further research is required before a national monitoring system can be established and applied with confidence.

Further field trials, monitoring results, and professional judgement throughout Ireland will all benefit the refinement of TraC-MImAS as a whole. However, due to the nature of estuarine and coastal water bodies, TraC-MImAS, or any similar tool developed, has limited capabilities for the assessment of site specific conditions. Therefore, further development should be focused at refining this tool for its continued use in **supporting** regulation.