Warrenpoint Port

Maintenance Dredging 2024-2027

Information to Inform a MCZ Assessment

November 2023

Project Nr
642

Anthony D Bates Partnership LLP
7 Hen Parc Lane
Upper Killay
Swansea
SA27EY

info@anthonybates.co.uk
www.anthonybates.co.uk

Client: Warrenpoint Harbour Authority

Project: Warrenpoint Port - Maintenance Dredging 2024-2027

Title: Information to Inform a MCZ Assessment

	Prepared by:	Reviewed by:
DRAFT	**NAME** S Challinor	**NAME** Paul Mitchell
DATE 16/11/2023	**SIGNATURE** [signature]	**SIGNATURE** [signature]

	Prepared by:	Reviewed by:
Final	**NAME** S Challinor	**NAME** C Sheehan
DATE 30/11/2023	**SIGNATURE** [signature]	**SIGNATURE** [signature]

1 Introduction

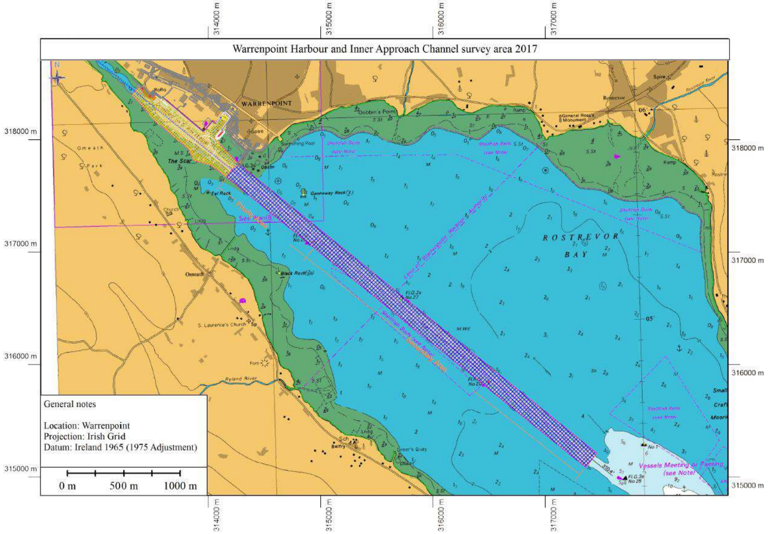
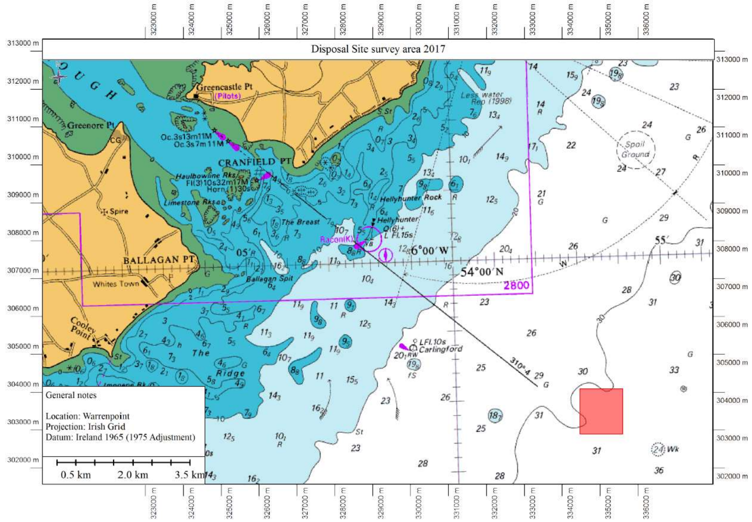
1.1.1 Warrenpoint Harbour Authority, the operators of Warrenpoint Port, are seeking a new marine licence to dispose of dredged material arising from maintenance dredging in the period 2024-2027. Maintenance dredging is required to conserve safe water depths for navigation and berthing in the port and its approaches.

1.1.2 The scope of the future maintenance dredging and disposal of dredged material in the period 2024-2027 is expected to be similar to that in the period 2020-2023. Accordingly, maintenance dredging is likely to be undertaken using a trailing suction hopper dredger (TSHD) supported by a bed leveller / plough dredger, and potentially a backhoe dredger or small grab hopper dredger, and is likely to result in a maximum of 805,000 tonnes of dredged material (including gravel, sand, silt and clay) being deposited in the sea at the Warrenpoint B disposal site.

2 Marine Act (Northern Ireland) 2013 – MCZ Assessment

2.1.1 In accordance with Section 23 of the Marine Act (Northern Ireland) 2013, in determining an application for a marine licence, DAERA must make an assessment of whether the proposed maintenance dredging within Warrenpoint Harbour and its Inner Approach Channel is capable of affecting (other than insignificantly) the protected features of a Marine Conservation Zone (MCZ) and/or any ecological or geomorphological process on which the conservation of any protected features of an MCZ is (wholly or in part) dependent.

2.1.2 This report provides the relevant information to DAERA in order to progress Warrenpoint Harbour Authority's marine licence through the MCZ assessment process. The information is provided in the table below. This report updates the information provided in 2015 and 2018 to support the previous marine licence applications associated with maintenance dredging at Warrenpoint Port. Minor changes have been made to incorporate new information, but the conclusions of this screening assessment are unchanged; that is, the proposed maintenance dredging is not considered capable of significantly affecting the protected features of the Carlingford Lough MCZ and/or any ecological or geomorphological process on which the conservation of any protected features of the MCZ is dependent.

Information to Inform a MCZ Assessment	
Name of project or plan	Warrenpoint Port maintenance dredging 2024-2027
Application number/reference	TBC
Brief description of the project or plan	Maintenance dredging will take place within the sub-tidal navigable channels and berths within the boundary of Warrenpoint Harbour and its Inner Approach Channel (**Figure 1, left**), and the disposal of dredged material will take place within the boundary of the Warrenpoint B disposal site (**Figure 1, right**). As for previous maintenance dredging campaigns, maintenance dredging from 2024 to 2027 will be undertaken using a TSHD supported by a plough dredger and, potentially, a mechanical dredger (e.g., backhoe dredger or grab dredger) supported by a self-propelled barge. As for previous maintenance dredging campaigns, the dredged material will be transported in a hopper inside a TSHD or a self-propelled barge and deposited at the Warrenpoint B disposal site. **Figure 1 Warrenpoint Harbour and Inner Approach Channel (left) and Warrenpoint B Disposal Site (right)**  

Information to Inform a MCZ Assessment	
Name and location of the MCZ site(s) potentially affected.	The following MCZ sites are potentially affected: • Carlingford Lough MCZ. Figures showing the MCZ boundary and features are provided at **Appendix 1**.
Description of MCZ site(s)	**Carlingford Lough MCZ** A noted in the document 'Site Summary Document. Carlingford Lough MCZ' (DAERA, 2016a): *Carlingford Lough is a narrow and shallow sea lough that lies on the east coast of Ireland, located at the border of Northern Ireland and the Republic of Ireland. The MCZ is located off the northern shore and lies north of the navigation channel in the inner part of the Lough.* *Carlingford Lough has an extensive intertidal area of sand and mudflats that provide key feeding grounds for overwintering birds.* *The MCZ consists of a shallow subtidal area of fine mud encompassing 3.23km^2. The MCZ has been designated as it supports the habitat Philine aperta (White lobe shell) and Virgularia mirabilis (Sea-pen) in soft stable infralittoral mud. This habitat is only present in Carlingford Lough; individual records of P. aperta and V. mirabilis occur throughout Northern Ireland (Figures 2 and 3). Both P. aperta and V. mirabilis occur in high densities within the MCZ and this habitat is thought to be a temporal variant of other sublittoral cohesive mud and sandy mud communities.* *Subtidal (sublittoral) mud habitats generally occur in water depths greater than 20-30m but may occur in shallower sea lough waters such as Carlingford Lough. As this site is sheltered from wave action, these soft mud communities are present in shallow depths (<15m).* *High densities of the White lobe shell (P. aperta) usually characterise this feature; however, in Carlingford Lough the MCZ also contains one of the densest beds of sea-pens (V. mirabilis) recorded in Northern Ireland.* *The biotope 'Philine aperta and Virgularia mirabilis in soft stable infralittoral mud' is characterised on the basis of its epifauna. The habitat created by the Sea-pens offer shelter, food and oxygen to a diverse range of small benthic infaunal organisms such as the very rare sea cucumber, Ocnus planci, which has regularly been observed in the MCZ. Apart from occasional Norway lobster (Nephrops norvegicus), burrowing crustacean megafauna are mainly absent from this habitat in Carlingford Lough.* *As subtidal (sublittoral) mud containing Philine aperta and Virgularia mirabilis communities in Carlingford Lough MCZ are currently in favourable condition, the recommended conservation objectives are set to maintain this feature in favourable condition.* Further information: [Carlingford Lough MCZ | Department of Agriculture, Environment and Rural Affairs (daera-ni.gov.uk)]
Summary of activities from the plan or project that	As noted in the document 'Conservation Objectives and Potential Management Options for Carlingford Lough MCZ' (DAERA, 2016b): *Philine aperta and Virgularia mirabilis communities have moderate vulnerability to the following pressures associated with infrastructure operations: increase and decrease in water flow (tidal current), de-oxygenation, physical loss (to land or freshwater habitat), physical change (to another seabed*

Information to Inform a MCZ Assessment	
may potentially affect the MCZ	*type) and habitat structure changes. The feature has a low vulnerability to organic enrichment, overall abrasion (surface and subsurface) and siltation rate changes (including smothering).* *Habitat loss or alteration, and direct damage to individual species are the main risks associated with existing infrastructure operations. In addition, the construction of new infrastructure may affect the local hydrodynamic and sediment transport regimes of inshore enclosed areas and consequently lead to a change in seabed type with subsequent loss of biodiversity.* *At present it is considered that the risk of not achieving the conservation objectives for the MCZ feature is low unless the location or intensity of coastal infrastructure operations was to change in the future.* As noted above, habitat loss or alteration and damage to individual species are the main risks associated with existing infrastructure operations. The proposed maintenance dredging would not change the location or intensity of maintenance dredging; it will take place within the confines of the existing dredging areas within Warrenpoint Harbour and its Inner Approach Channel and, therefore, should not pose a significant risk of direct habitat loss or alteration and/or direct species damage through impacts associated with physical loss, physical change, or habitat structure change. However, the proposed maintenance dredging will generate sediment plumes which may migrate beyond existing dredging areas within Warrenpoint Harbour and its Inner Approach Channel and, therefore, could pose a significant risk of indirect habitat alteration and/or indirect species damage through dredging-induced sediment dispersion causing water quality impacts such as increases in suspended sediment concentrations, decreases in dissolved oxygen concentrations, and/or increases in contaminant concentrations. The potential for such a risk to affect the MCZ feature is considered in detail in **Appendix 2**, and is informed by historical monitoring of dredging activities, and sampling and analysis of the physical and chemical characteristics of the sediment within Warrenpoint Harbour and its Inner Approach Channel (**Appendix 3**). In summary, the potential risk to the MCZ feature due to sediment dispersion is considered to be: • Negligible (occasionally low) in terms of increased suspended sediment concentrations. • Negligible in terms of decreased dissolved oxygen concentrations. • Negligible in terms of increased contaminant concentrations. • Temporally limited to the duration of a maintenance dredging campaign (i.e., up to c.10 weeks). • Spatially limited to within and a little distance beyond Warrenpoint Harbour and the Inner Approach Channel. Overall, maintenance dredging activities have taken place within Warrenpoint Harbour and its Inner Approach Channel for many years, and disposal of dredged material has taken place at the Warrenpoint B disposal site for many years too. Historical maintenance dredging activities have involved a main maintenance dredging campaign typically every 5-6 years (approximately 350,000m^3) and smaller maintenance dredging campaigns typically every 1-2 years (approximately 50,000m^3). The proposed maintenance dredging from 2024 to 2027 would not change the location or intensity of maintenance dredging campaigns and would not change the direct and/or direct risks associated with the maintenance dredging campaigns and, on this basis, the risk of not achieving the conservation objectives for the MCZ feature is considered to be low (in accordance with the findings of DAERA (2016b)).

Information to Inform a MCZ Assessment	
Is the activity capable of affecting (other than insignificantly) the protected features of the MCZ?	Please refer to 'Summary of activities from the plan or project that may potentially affect the MCZ', above.
Is the activity capable of affecting (other than insignificantly) any ecological or geomorphological process on which the conservation of any protected feature of an MCZ is (wholly or in part) dependent?	Please refer to 'Summary of activities from the plan or project that may potentially affect the MCZ', above.

References

DAERA (2016a). Site Summary Document Carlingford Lough Marine Conservation Zone.
DAERA (2016b). Conservation Objectives and Potential Management Options for Carlingford Lough Marine Conservation Zone.
DAERA (2016c). Carlingford Lough Marine Conservation Zone Designation Order.

APPENDIX 1: PLANS

Figure A1.1 Carlingford Lough MCZ Boundary (source: DAERA, 2016c)

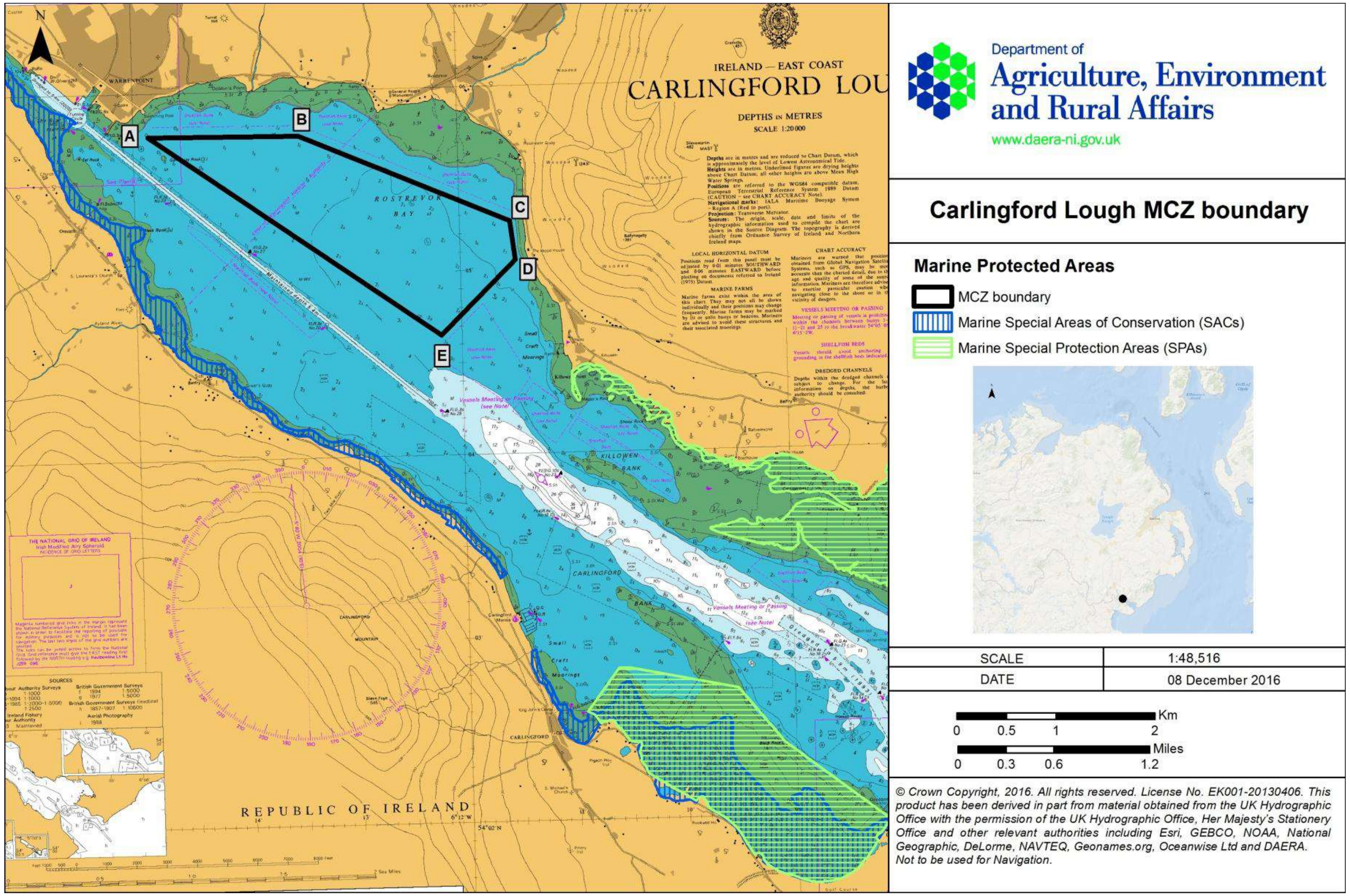
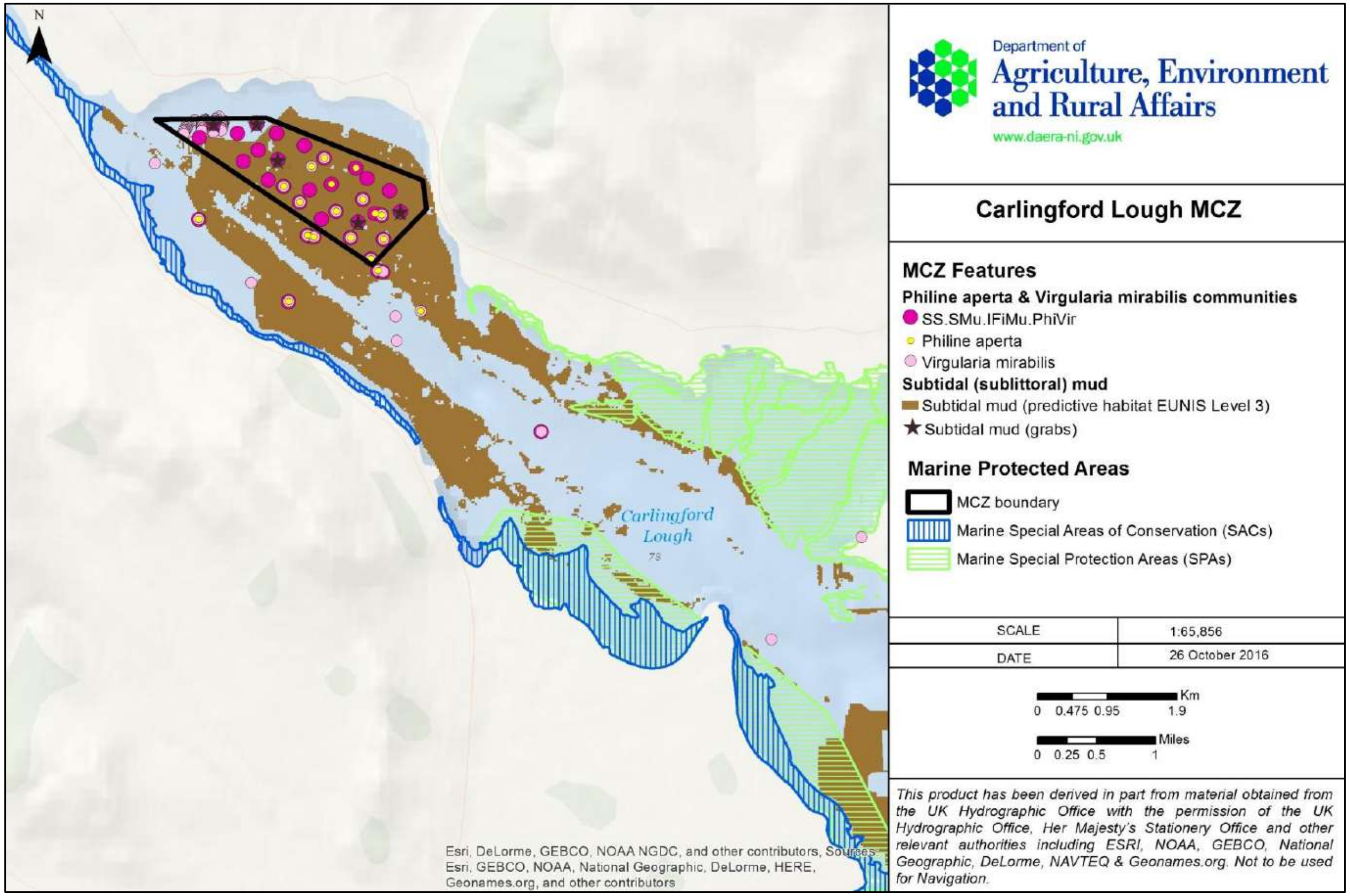


Figure A1.2 Carlingford Lough MCZ Features (source: DAERA, 2016a)



APPENDIX 2: SUPPORTING EVIDENCE FOR THE MCZ ASSESSMENT

Appendix A2.1 Narrative on the Potential Impact due to Sediment Dispersion

The potential impact on due to sediment dispersion can be considered in relation to the temporal and spatial extents of the following water quality parameters:

- Suspended sediment concentrations (and corresponding turbidity levels).
- Dissolved oxygen concentrations.
- Contaminant concentrations.

<u>Baseline Conditions: Water Quality</u>

Background water quality monitoring outside of dredging and disposal activities indicated that, in general, the baseline conditions for suspended sediment concentrations and turbidity levels within Warrenpoint Harbour and the Inner Approach Channel were highly variable and, at times, were characterised by high suspended sediment concentrations and turbidity levels, particularly around spring tides when low waters are at their lowest (AFBI, 2016).

Similarly, background water quality monitoring outside of dredging and disposal activities indicated that, in general, the baseline conditions for dissolved oxygen within Warrenpoint Harbour and the Inner Approach Channel were characterised by low dissolved oxygen concentrations, particularly around spring tides when low waters are at their lowest) (AFBI, 2016).

<u>Baseline Conditions: Sediment Quality</u>

Between June and August 2023, sediment samples within Warrenpoint Harbour and the Inner Approach Channel were collected by AFBI with DAERA in attendance and sent to Socotec's laboratory for testing and analysis to characterise its physical and chemical properties. Surface and core samples were taken from representative locations agreed in advance with DAERA within Warrenpoint Harbour and its Inner Approach Channel (see samples stations S1 to S19 in **Figure A3.1** in **Appendix 3**). Socotec's laboratory participates in the QUASIMEME Scheme (Quality Assurance in Marine Environmental Monitoring in Europe). The analytical results are presented in **Appendix 3** and are summarised below.

Physically, the sediment within Warrenpoint Harbour and its Inner Approach Channel was tested to determine its principal particle sizes and its organic matter content. The results indicate that the sediment is typically composed of organic silty clay comprising silt (typically >75 per cent), sand (typically <20 per cent) and, occasionally, gravel (typically <5 per cent), and organic matter (typically 1 to 3 per cent), as shown in **Table A3.1** in **Appendix 3**.

Chemically, the sediment within Warrenpoint Harbour and the Inner Approach Channel was tested to determine the concentrations of contaminants of concern (i.e., metals, organotin compounds, polyaromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PBCs)). The results indicate that the sediment contains negligible and low levels of these contaminants.

<u>Potential Impact on Water Quality: Suspended Sediment Concentrations</u>

The potential impact on suspended sediment concentrations can be informed by the water quality monitoring undertaken for the maintenance dredging campaigns in 2016 and 2017 by the Agri-Food and Biosciences Institute (AFBI) on behalf of Warrenpoint Port. The purpose of the monitoring was to provide a warning system for the potential onset of environmental risks from dredging to the shellfish industry, the passage of migratory fish, and the habitats and species associated with the nearby conservation areas in Carlingford Lough, including the SPAs, SACs and the MCZ. The water quality monitoring included real time monitoring of suspended sediment concentrations (correlated to turbidity levels) in the water column close to and upstream of the dredging areas in Warrenpoint Harbour. Water quality monitoring of the maintenance dredging campaigns in 2016 and 2017 recorded that dredging activities did not cause a significant increase in suspended sediment concentrations (or corresponding turbidity levels). Generally, suspended sediment concentrations at the monitoring station were well below 100mg/l for most of the time during dredging; for example, during maintenance dredging in 2017, suspended sediment concentrations at the monitoring station were below 25 mg/l for 70 per cent of the time (AFBI, 2017). Occasionally, suspended sediment concentrations at the monitoring station exceeded the 218mg/l alarm threshold (correlated to 150 NTU) and the 600mg/l alert threshold (correlated to 410 NTU), but they did not exceed the 600mg/l alert threshold for a duration longer than 6 hours and, therefore, no intervention measures were deemed necessary (AFBI, 2016; AFBI, 2017).

The temporal magnitude of this impact is expected to last for the duration of an individual maintenance dredging campaign plus up to one week for residual sediment dispersion on cessation of dredging and disposal activities. The durations of individual maintenance dredging campaigns can be informed by previous campaigns: for example, maintenance dredging in 2016 lasted for approximately 5 weeks (from 03-06-2016 to 07-07-2016) and removed c.50,000m^3 sediment from the Deep Berth Pocket in Warrenpoint Harbour and the Inner Approach Channel, while maintenance dredging in 2017 lasted for approximately 7 weeks (from 30-05-2017 to 12-07-2017) and removed c.393,000m^3 sediment from the entire extent of Warrenpoint Harbour and Inner Approach Channel. In summary, the temporal magnitude of one maintenance dredging campaign is expected to be limited to a duration of up to 10 weeks.

The spatial magnitude of this impact for dredging activities is expected to be confined largely within the areas of Carlingford Lough that align with the dredging areas within Warrenpoint Harbour and the Inner Approach Channel. However, this impact is expected to extend upstream and, potentially, downstream of Warrenpoint Harbour and the Inner Approach Channel due to sediment dispersion driven by tidal currents. The spatial magnitude of this impact is informed by water quality monitoring undertaken for the previous maintenance dredging undertaken in 2016 and 2017 (AFBI, 2016; AFBI, 2017), which was based on a monitoring station being positioned immediately upstream of Warrenpoint Harbour so that it would capture sediment plumes dispersing upstream from the dredging areas in Warrenpoint Harbour, which was the most likely scenario for sediment dispersion given the flood dominant tide in Carlingford Lough and the lower reach of the Clanrye River. The water quality monitoring recorded that dredging activities did not lead to significant dispersion of sediment beyond the boundary of the dredging areas within Warrenpoint Harbour and Inner Approach Channel.

The spatial magnitude of this impact for disposal activities is expected to be confined largely within the area of the Warrenpoint B disposal site. However, this impact is expected to extend slightly beyond the boundary of the disposal site due to sediment dispersion driven by tidal currents. The spatial magnitude of this impact is informed by bathymetry monitoring undertaken for the previous maintenance dredging campaign undertaken in 2016 (Geomara, 2016). The bathymetry monitoring recorded that disposal activities did not lead to the significant dispersion of sediment beyond the boundary of the Warrenpoint B disposal site (**Figure A2.1**).

Given the above findings, the potential impact on water quality is considered to be generally negligible and occasionally low in terms of increased suspended sediment concentrations (and corresponding turbidity), temporally limited to the duration of a maintenance dredging campaign (i.e., up to c.10 weeks), and spatially limited to within and a little distance beyond the maintenance dredging areas within Warrenpoint Harbour and Inner Approach Channel, and within and a little distance beyond the Warrenpoint B disposal site.

Potential Impact on Water Quality: Dissolved Oxygen Concentrations

The potential impact on dissolved oxygen concentrations can be informed by the water quality monitoring undertaken for the maintenance dredging campaigns in 2016 and 2017 by the AFBI on behalf of Warrenpoint Port. The purpose of the monitoring was to provide a warning system for the potential onset of environmental risks from dredging to the shellfish industry, the passage of migratory fish, and the habitats and species associated with the nearby conservation areas in Carlingford Lough, including the SPAs, SACs and the MCZ. The water quality monitoring included real time monitoring of dissolved oxygen concentrations (correlated to turbidity levels) in the water column close to and upstream of the dredging areas in Warrenpoint Harbour. Water quality monitoring during maintenance dredging included real time monitoring of dissolved oxygen concentrations in the water column close to and upstream of the dredging areas in Warrenpoint Harbour. Water quality monitoring of the maintenance dredging campaigns in 2016 and 2017 recorded that the dredging did not cause a significant decrease in dissolved oxygen concentrations; although dissolved concentrations at the monitoring station fell below the 6mg/l alert threshold on a number of occasions, they did not fall below the 4mg/l alarm threshold on any occasion and, therefore, no intervention measures were deemed necessary (AFBI, 2016; AFBI, 2017).

The temporal magnitude of this impact is expected to be similar to that described above for suspended sediment (i.e., up to c. 10 weeks) because of the oxygen demand associated with the sediment dispersed during dredging and disposal activities (i.e., the majority of the oxygen demanding materials within the sediment are likely to associated with the sediment's particles (i.e., the organic matter).

The spatial magnitude of this impact for dredging activities is expected to be similar to that described above for suspended sediment (i.e., limited to within and a little distance beyond the maintenance dredging areas within Warrenpoint Harbour and Inner Approach Channel) because of the oxygen demand associated with the sediment dispersed during dredging activities.

The spatial magnitude of this impact for disposal activities is expected to be similar to that described above for suspended sediment (i.e., limited to within and a little distance beyond the Warrenpoint B disposal site) because of the oxygen demand associated with the sediment dispersed during disposal activities.

Given the above findings, the potential impact on water quality is considered to be generally negligible in terms of reduced dissolved oxygen concentrations, temporally limited to the duration of a maintenance dredging campaign (i.e., up to c.10 weeks), and spatially limited to within and a little distance beyond the maintenance dredging areas within Warrenpoint Harbour and Inner Approach Channel, and within and a little distance beyond the Warrenpoint B disposal site.

<u>Potential Impact on Water Quality: Contaminant Concentrations</u>

The potential impact on contaminant concentrations can be informed by the sediment quality monitoring undertaken for the maintenance dredging campaigns in 2023 by Warrenpoint Port. The purpose of the monitoring was to characterise the sediment quality in relation to sediment quality standards; namely, the Action Levels used to characterise dredged material in Northern Ireland and the Republic of Ireland, and the Gorham-Test Effects Ranges used to characterise the potential for toxic effects on benthic ecological receptors (**Table A3.2** in **Appendix 3**). The Action Levels are used in Northern Ireland and the Republic of Ireland to determine the contaminant loading of dredged material and its suitability for disposal at sea (i.e., disposal onto the seabed of open water, marine environments). Sediment with contaminant loads below Action Level 1 is generally considered suitable for disposal at sea, while sediment with contaminant loads above Action Level 2 is generally considered unsuitable and precluded from disposal at sea. The Gorham-Test Effects Ranges are used to determine the contaminant loading of sediment in relation to toxic effects on benthic communities. Sediment with contaminant loads around Effects Range Low (ERL) is generally considered to have a low potential for toxic effects (10^{th} percentile), while sediment with contaminant loads around Effects Range Median (ERM) is generally considered to have a moderate potential for toxic effects (50^{th} percentile). In summary, the sediment is believed to contain negligible and low levels of contamination because:

- The sediment within Warrenpoint Harbour and its Inner Approach Channel is characterised by contaminants generally present at concentrations that are below and slightly above the Action Level 1 used in Northern Ireland, as shown in **Tables A3.3, A3.4 and A3.5** in **Appendix 3**.

- The sediment within Warrenpoint Harbour and its Inner Approach Channel is characterised by contaminants generally present at concentrations that are below and slightly above the Action Level 1 used in the Republic of Ireland, as shown in **Tables A3.6, A3.7 and A3.8** in **Appendix 3**.
- The sediment within Warrenpoint Harbour and its Inner Approach Channel is characterised by contaminants generally present at concentrations that are below and slightly above the ERL used to indicate the potential for toxic effects on benthic ecological receptors, as shown in **Table A3.9** in **Appendix 3**.

The temporal magnitude of this impact is expected to be similar to that described above for suspended sediment (i.e., up to c. 10 weeks) because of the partitioning behaviour of the contaminants associated with the sediment dispersed during dredging and disposal activities (i.e., the majority of the contaminants within the sediment are likely to associated with the sediment's particles (i.e., contaminants attached or absorbed to the sediment's particle surfaces).

The spatial magnitude of this impact for dredging activities is expected to be similar to that described above for suspended sediment (i.e., limited to within and a little distance beyond the maintenance dredging areas within Warrenpoint Harbour and Inner Approach Channel) because of the partitioning behaviour of the contaminants associated with the sediment dispersed during dredging activities.

The spatial magnitude of this impact for disposal activities is expected to be similar to that described above for suspended sediment (i.e., limited to within and a little distance beyond the Warrenpoint B disposal site) because of the partitioning behaviour of the contaminants associated with the sediment dispersed during disposal activities.

Given the above findings, the potential impact on water quality is considered to be generally negligible in terms of increased contaminant concentrations, temporally limited to the duration of a maintenance dredging campaign (i.e., up to c.10 weeks), and spatially limited to within and a little distance beyond the maintenance dredging areas within Warrenpoint Harbour and Inner Approach Channel, and within and a little distance beyond the Warrenpoint B disposal site.

<u>Conclusion</u>

Given the above findings, the potential impact due to sediment dispersion is considered to be:

- Negligible (occasionally low) in terms of increased suspended sediment concentrations.
- Negligible in terms of decreased dissolved oxygen concentrations.
- Negligible in terms of increased contaminant concentrations.
- Temporally limited to the duration of a maintenance dredging campaign (i.e., up to c.10 weeks).
- Spatially limited to within and a little distance beyond Warrenpoint Harbour and Inner Approach Channel.

APPENDIX 3: SEDIMENT CONTAMINATION DATA AND COMPARISON TO QUALITY STANDARDS

Figure A3.1 Sample Identification: Sampling Station Location

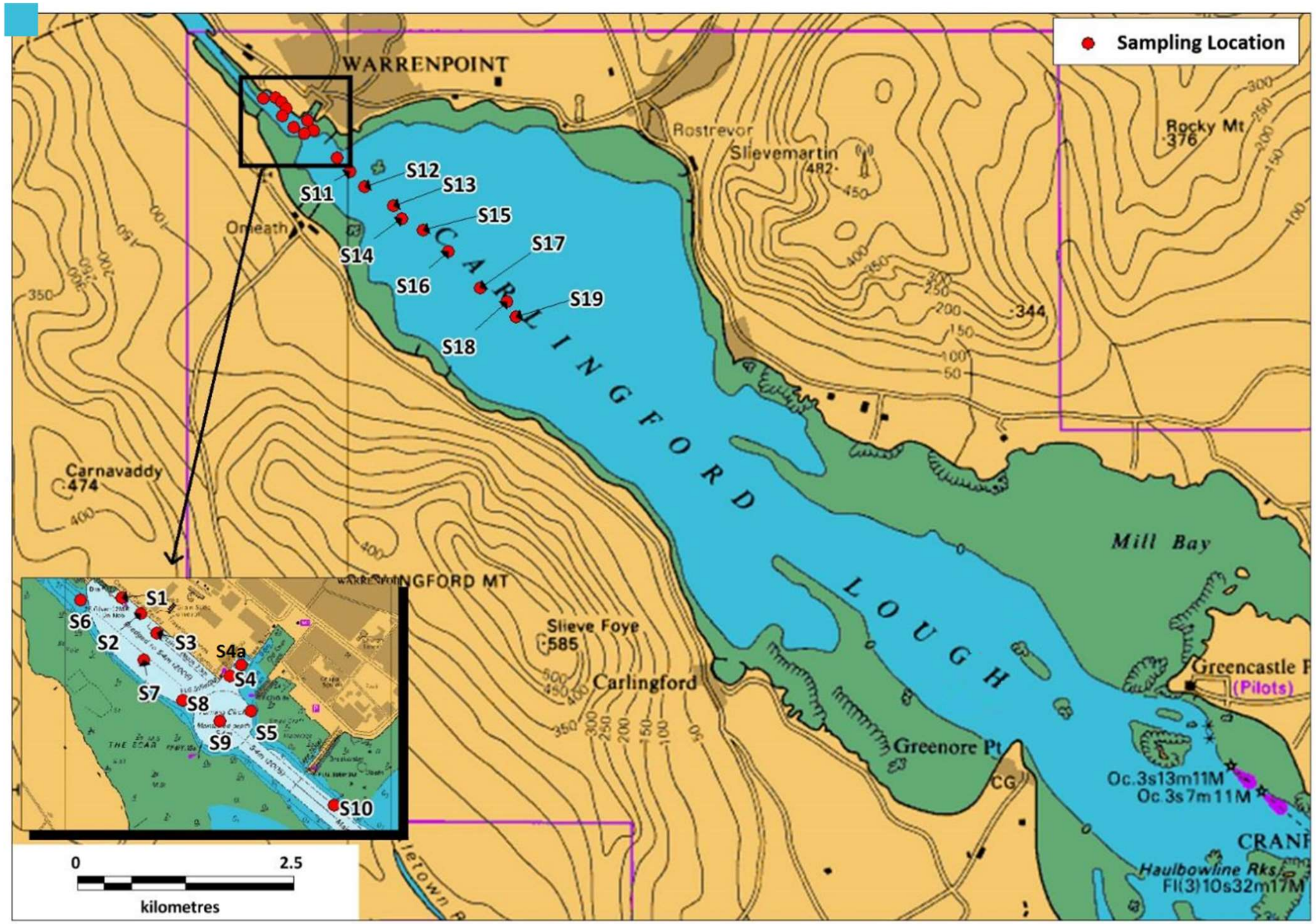


Table A.3.1 Sediment Composition

Sample ID	% Total Moisture	% Total Solids	% Gravel (>2mm)	% Sand (0.063-2mm)	% Silt (<0.063mm)	% Total Organic Carbon
S1 0.0m	67.8	32.2	0.00	11.92	88.08	1.70
S2 0.0m	68.4	31.6	2.96	13.96	83.07	2.42
S3 0.0m	66.7	33.3	0.00	13.96	86.04	2.50
S4 0.0m	66.9	33.1	0.00	12.76	87.24	2.42
S4a 0.0m	66.6	33.4	0.00	10.79	89.21	2.39
S5 0.0m	62.3	37.7	11.62	13.56	74.82	2.46
S6 0.0m	67.1	32.9	0.00	14.10	85.90	2.83
S7 0.0m	69.9	30.1	0.00	12.08	87.92	2.42
S8 0.0m	53.0	47.0	0.77	13.86	85.37	1.60
S9 0.0m	66.4	33.6	2.88	14.70	82.42	2.48
S10 0.0m	62.2	37.8	0.00	22.86	77.14	1.74
S11 0.0m	60.2	39.8	0.00	35.17	64.83	1.85
S12 0.0m	58.1	41.9	0.00	27.14	72.86	1.65
S13 0.0m	61.6	38.4	1.12	13.27	85.61	1.96
S14 0.0m	63.1	36.9	0.00	17.79	82.21	1.73
S15 0.0m	60.5	39.5	0.00	34.26	65.74	1.52
S16 0.0m	61.0	39.0	0.05	17.63	82.32	1.63
S17 0.0m	50.1	49.9	0.00	27.10	72.90	1.52
S18 0.0m	60.6	39.4	0.00	43.73	56.27	0.97
S19 0.0m	44.8	55.2	0.00	45.81	54.19	0.91
S4a 2.2m	61.3	38.7	0.00	12.75	87.25	2.44
S4a-1.2m	68.0	32.0	0.00	14.23	85.77	2.59
S4 2.2m	58.6	41.4	0.00	15.26	84.74	2.37
S4 1.2m	61.6	38.4	0.00	14.38	85.62	2.80
S3 1.7m	58.0	42.0	0.00	18.24	81.76	2.78
S1 1.8m	57.8	42.2	0.00	13.51	86.49	2.29
S10 1.3m	46.6	53.4	2.64	24.83	72.54	1.99
S12 1.6m	49.2	50.8	0.00	15.24	84.76	2.26
S13 1.0m	48.8	51.2	0.00	17.56	82.44	1.98
S14 1.4m	44.6	55.4	0.00	18.83	81.17	2.19

Table A3.2 Sediment Quality Standards

Contaminant	Units	Northern Ireland		Republic of Ireland		Gorham-Test Effects Range	
		Acton Level 1	Action Level 2	Acton Level 1	Action Level 2	Low	Medium
Arsenic	$mg.kg^{-1}$ dry weight	20	100	20	70		
Cadmium	$mg.kg^{-1}$ dry weight	0.4	5	0.7	4.2		
Chromium	$mg.kg^{-1}$ dry weight	40	400	120	370		
Copper	$mg.kg^{-1}$ dry weight	40	400	40	110		
Mercury	$mg.kg^{-1}$ dry weight	0.3	3	0.2	0.7		
Nickel	$mg.kg^{-1}$ dry weight	20	200	40	60		
Lead	$mg.kg^{-1}$ dry weight	50	500	60	218		
Zinc	$mg.kg^{-1}$ dry weight	130	800	160	410		
Organo-tins: TBT and DBT	$mg.kg^{-1}$ dry weight	0.1	1	0.1	0.5		
PCBs: sum ICES 7	$\mu g.kg^{-1}$ dry weight	10		7	1,260		
PCBs: sum 25 congeners	$\mu g.kg^{-1}$ dry weight	20	200				
PAHs: individual	$\mu g.kg^{-1}$ dry weight	100					
PAHs: acenaphthene	$\mu g.kg^{-1}$ dry weight					44	640
PAHs: acenaphthylene	$\mu g.kg^{-1}$ dry weight					16	500
PAHs: anthracene	$\mu g.kg^{-1}$ dry weight					85	1,100
PAHs: benz[a]anthracene	$\mu g.kg^{-1}$ dry weight					261	1,600
PAHs: chrysene	$\mu g.kg^{-1}$ dry weight					384	2,800
PAHs: dibenz[a,h]anthracene	$\mu g.kg^{-1}$ dry weight					63	260
PAHs: fluoranthene	$\mu g.kg^{-1}$ dry weight					600	5,100
PAHs: fluorene	$\mu g.kg^{-1}$ dry weight					19	540
PAHs: naphthalene	$\mu g.kg^{-1}$ dry weight					160	2,100
PAHs: phenanthrene	$\mu g.kg^{-1}$ dry weight					240	1,500
PAHs: pyrene	$\mu g.kg^{-1}$ dry weight					665	2,600
PAHs: sum USEPA 16	$\mu g.kg^{-1}$ dry weight			4,000			
DDT	$\mu g.kg^{-1}$ dry weight	1					
Dieldrin	$\mu g.kg^{-1}$ dry weight	5					
TEH	$g.kg^{-1}$ dry weight			1			
γHCH	$\mu g.kg^{-1}$ dry weight			0.3	1		
HCB	$\mu g.kg^{-1}$ dry weight			0.3	1		

Key to Sediment Contaminant Data Comparison to Sediment Quality Standards

Indicator	Data Comparison to Sediment Quality Standards
(green)	Data is below Action Level 1 / Gorham-Test Effects Range Low
(yellow)	Data is above Action level 1 and below Action Level 2 / above Gorham-Test Effects Range Low and below Gorham-Test Effects Range Median
(orange)	Data is above Action Level 2 / above Gorham-Test Effects Range Median
	Not applicable as there is no Action Level / Gorham-Test Effects Range

Table A3.3 Sediment Contamination: Metals and Organo-tins (mg.kg^{-1} dry weight) compared to Northern Ireland Action Levels

Sample ID	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Dibutyltin	Tributyltin
S1 0.0m	11.7	0.26	69.8	21.6	27.6	<0.01	30.6	91.3	<0.005	<0.005
S2 0.0m	16.9	0.39	99.2	37.2	45.5	<0.01	47.5	187	<0.005	<0.005
S3 0.0m	18.4	0.51	102	35.8	47.4	<0.01	45.0	173	<0.005	<0.005
S4 0.0m	19.9	0.48	107	36.2	50.3	<0.01	47.3	176	<0.005	<0.005
S4a 0.0m	20.2	0.48	105	36.1	49.8	<0.01	48.0	177	<0.005	<0.005
S5 0.0m	16.0	0.39	92.5	30.1	42.6	<0.01	42.1	151	<0.005	<0.005
S6 0.0m	18.1	0.51	98.2	38.7	49.7	<0.01	44.6	185	<0.005	<0.005
S7 0.0m	25.6	0.65	140	51.2	69.1	0.03	62.8	243	<0.005	<0.005
S8 0.0m	14.8	0.39	90.5	28.6	42.5	<0.01	38.4	141	<0.005	<0.005
S9 0.0m	17.4	0.45	96.4	32.0	46.4	<0.01	43.1	160	<0.005	<0.005
S10 0.0m	15.2	0.38	86.2	26.0	41.2	<0.01	37.8	132	<0.005	<0.005
S11 0.0m	15.1	0.31	85.0	24.6	38.9	<0.01	37.4	127	<0.005	<0.005
S12 0.0m	14.9	0.30	87.9	24.8	37.0	<0.01	36.6	120	<0.005	<0.005
S13 0.0m	15.7	0.30	88.1	23.7	39.4	<0.01	37.6	128	<0.005	<0.005
S14 0.0m	16.0	0.30	86.6	24.8	39.0	<0.01	38.3	128	<0.005	<0.005
S15 0.0m	15.1	0.28	85.7	22.1	35.2	<0.01	38	114	<0.005	<0.005
S16 0.0m	16.5	0.28	89.9	23.7	39.2	<0.01	39.4	124	<0.005	<0.005
S17 0.0m	13.6	0.22	83.4	19.7	34.7	<0.01	35.7	109	<0.005	<0.005
S18 0.0m	11.1	0.15	65.7	13.9	27.2	<0.01	29.6	75.7	<0.005	<0.005
S19 0.0m	8.6	0.15	66.2	16.2	26.2	<0.01	25.3	64.8	<0.005	<0.005
S4a 2.2m	16.1	0.29	89.6	36.4	52.7	0.21	43.3	169	<0.005	<0.005
S4a-1.2m	17.8	0.33	87.2	36.6	54.8	0.20	42.0	177	<0.005	<0.005
S4 2.2m	18.6	0.27	81.6	33.0	52.9	0.22	39.2	159	<0.005	<0.005
S4 1.2m	18.5	0.36	82.9	35.7	54.4	0.17	41.6	168	<0.005	<0.005
S3 1.7m	18.5	0.33	81.6	34.3	54.0	0.17	40.1	164	<0.005	<0.005
S1 1.8m	15.9	0.35	80.0	37.4	51.0	0.15	41.8	156	<0.005	<0.005
S10 1.3m	14.0	0.29	71.1	25.8	43.9	0.12	34.4	133	<0.005	0.0165
S12 1.6m	16.5	0.26	78.4	27.9	49.2	0.14	37.8	144	<0.005	<0.005
S13 1.0m	16.2	0.30	81.7	29.0	56.5	0.21	38.9	155	<0.005	<0.005
S14 1.4m	17.9	0.29	85.1	28.8	52.0	0.13	41.3	153	<0.005	<0.005

Table A3.4 Sediment Contamination: PAHs (µg.kg^{-1} dry weight) compared to Northern Ireland Action Levels

Sample ID	Acenaphthene	Acenaphthylene	Anthracene	Benz[a]anthracene	Benzo[a]pyrene	Benzo[b]fluoranthene	Benzo[g,h,i]perylene	Benzo[k]fluoranthene
S1 0.0m	<5	<5	20.0	68.9	99.8	101	92.5	110
S2 0.0m	<5	<5	23.6	60.8	79.5	101	86.0	117
S3 0.0m	28.1	<5	29.4	57.7	77.5	109	81.7	101
S4 0.0m	<5	<5	19.8	73.6	88.6	124	97.8	107
S4a 0.0m	<5	<5	<5	57.3	76.6	102	75.5	86.1
S5 0.0m	<5	<5	19.2	66.6	91.0	108	89.5	104
S6 0.0m	<5	<5	26.2	105	140	159	135	164
S7 0.0m	<5	<5	21.4	84.4	95.4	116	98.2	108
S8 0.0m	<5	<5	14.6	45.2	51.4	79.6	60.5	66.4
S9 0.0m	<5	<5	15.0	88.7	138	148	132	141
S10 0.0m	<5	<5	22.2	90.3	89.5	113	89.4	105
S11 0.0m	<5	16.2	42.9	151	139	146	117	153
S12 0.0m	<5	<5	<5	48.3	58.3	67.1	55.4	66.1
S13 0.0m	<5	<5	<5	44.6	56.3	69.3	56.3	70.4
S14 0.0m	<5	<5	15.2	74.0	82.4	83.2	79.7	111
S15 0.0m	<5	<5	35.0	40.7	52.9	61.5	53.3	66.9
S16 0.0m	<5	<5	14.8	60.1	65.3	118	69.9	85.3
S17 0.0m	<5	<5	10.6	32.6	40.1	61.1	42.4	47.0
S18 0.0m	<5	<5	13.7	54.6	72.3	123	84.0	80.3
S19 0.0m	<5	<5	9.17	21.7	27.5	35.1	27.8	24.2
S4a 2.2m	9.17	11.6	35.9	124	155	170	143	204
S4a-1.2m	9.31	9.22	22.0	70.8	87.6	137	114	141
S4 2.2m	8.24	11.4	33.8	111	152	166	130	158
S4 1.2m	18.0	11.0	26.5	78.8	121	113	112	173
S3 1.7m	6.73	8.07	20.9	62.1	89.9	115	96.6	107
S1 1.8m	8.44	12.7	26.5	89.6	129	159	131	165
S10 1.3m	2.03	2.88	7.85	22.2	29.5	33.2	24.0	26.7
S12 1.6m	5.53	7.58	20.4	66.4	93.6	146	105	123
S13 1.0m	8.60	15.2	34.3	105	157	206	168	182
S14 1.4m	8.13	22.4	46.0	179	204	205	150	218

Table A3.4 continued Sediment Contamination: PAHs (μg.kg^{-1} dry weight) compared to Northern Ireland Action Levels

Sample ID	Chrysene	Dibenz[a,h]anthracene	Fluoranthene	Fluorene	Indeno[1,2,3-c,d]pyrene	Naphthalene	Phenanthrene	Pyrene	Sum of USEPA 16
S1 0.0m	87.3	16.6	136	24.2	113	44.1	73.6	114	1,111.00
S2 0.0m	79.6	<5	143	26.2	94.9	34.1	68.2	121	<1,049.90
S3 0.0m	77.8	18.2	375	60.2	103	39.0	298	243	1,703.6
S4 0.0m	90.6	17.3	145	25.9	108	38.1	81.6	124	1,151.3
S4a 0.0m	72.0	13.1	101	15.1	91.6	28.1	57.1	97.9	888.40
S5 0.0m	84.2	18.1	120	22.4	93.0	34.1	64.0	113	1,037.10
S6 0.0m	120	19.2	167	27.6	147	42.2	73.8	167	1,503.0
S7 0.0m	106	18.5	154	26.4	117	35.2	87.7	139	1,217.2
S8 0.0m	51.5	<5	78.0	14.9	62.6	50.8	43.6	76.0	<710.10
S9 0.0m	105	17.7	143	23.5	147	40.5	69.4	136	1,354.80
S10 0.0m	98.6	14.6	169	23.6	98.3	32.0	77.6	147	1,180.1
S11 0.0m	159	24.1	339	21.8	136	41.2	117	267	1,875.2
S12 0.0m	56.8	<5	86.2	15.6	64.2	28.3	45.9	74.6	<686.80
S13 0.0m	53.0	<5	89.1	17.7	65.3	26.8	49.9	77.0	<695.70
S14 0.0m	84.8	<5	112	21.8	84.2	37.6	60.4	107	<968.3
S15 0.0m	52.4	<5	72.1	15.6	53.7	23.9	50.9	65.1	<281.3
S16 0.0m	74.1	<5	102	19.1	85.0	27.1	60.3	87.4	<381
S17 0.0m	37.2	<5	59.2	13.3	45.7	22.0	40.9	53.0	<520.1
S18 0.0m	69.2	13.5	97.7	16.7	81.9	30.3	53.4	95.7	896.3
S19 0.0m	28.3	<5	42.4	<5	29.8	16.1	32.8	39.8	<354.7
S4a 2.2m	144	30.1	240	33.2	160	48.2	121	211	1,840.17
S4a-1.2m	88.3	22.3	141	25.8	127	44.5	75.9	135	1,250.73
S4 2.2m	142	28.3	224	30.1	158	48.6	117	193	1,711.44
S4 1.2m	107	23.5	162	30.2	134	46.4	85.8	152	1,394.2
S3 1.7m	87.2	19.9	128	24.0	117	38.8	78.5	114	1,113.70
S1 1.8m	119	27.0	176	30.5	158	48.2	100	160	1,539.94
S10 1.3m	26.9	5.15	44.4	5.92	26.8	7.88	26.1	40.8	332.31
S12 1.6m	89.3	22.0	127	21.1	122	38.9	75.8	115	1,178.61
S13 1.0m	129	34.1	190	30.6	190	53.2	99.1	186	1,788.10
S14 1.4m	207	33.3	375	40.4	171	34.1	239	332	2,464.33

Table A3.5 Sediment Contamination: PCBs (µg.kg^{-1} dry weight) compared to Northern Ireland Action Levels

Sample ID	PCB28	PCB52	PCB101	PCB118	PCB138	PCB153	PCB180	Sum of ICES 7
S1 0.0m	0.20	0.25	0.15	0.29	0.10	0.23	0.10	1.32
S2 0.0m	0.30	0.33	0.13	0.24	0.17	0.19	0.11	1.47
S3 0.0m	0.18	0.22	0.14	0.30	0.09	0.18	<0.08	<1.19
S4 0.0m	0.36	0.65	0.71	1.00	0.62	0.76	0.53	4.63
S4a 0.0m	0.17	0.19	0.10	0.32	0.16	0.18	<0.08	1.20
S5 0.0m	0.16	0.14	0.09	0.18	0.15	0.14	0.09	0.95
S6 0.0m	0.19	0.22	<0.08	0.21	0.14	0.21	0.14	1.19
S7 0.0m	0.34	0.70	0.55	0.79	0.55	0.57	0.60	4.10
S8 0.0m	0.13	0.15	0.10	0.15	0.12	0.18	0.11	0.94
S9 0.0m	0.15	0.11	<0.08	0.28	0.21	0.19	<0.08	<1.10
S10 0.0m	0.10	0.09	<0.08	0.18	<0.08	0.11	<0.08	<0.72
S11 0.0m	0.11	0.10	<0.08	0.18	0.12	0.14	<0.08	<0.81
S12 0.0m	0.09	0.09	<0.08	0.08	0.08	0.12	<0.08	<0.62
S13 0.0m	0.15	0.13	<0.08	0.22	0.17	0.12	<0.08	<0.95
S14 0.0m	0.12	0.12	0.12	0.12	<0.08	0.15	0.08	<0.79
S15 0.0m	0.09	0.10	<0.08	0.09	0.10	0.11	<0.08	<0.65
S16 0.0m	0.10	0.11	0.16	0.31	0.24	0.23	0.08	<1.23
S17 0.0m	0.19	0.23	0.10	0.19	0.14	0.20	<0.08	<1.13
S18 0.0m	<0.08	<0.08	<0.08	0.09	<0.08	<0.08	<0.08	<0.49
S19 0.0m	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.56
S4a 2.2m	0.23	0.13	0.14	0.22	0.15	0.21	0.11	1.19
S4a-1.2m	0.21	0.10	0.12	0.21	0.20	0.17	<0.08	<1.09
S4 2.2m	0.18	0.12	0.15	0.15	0.26	0.29	0.15	1.30
S4 1.2m	0.19	0.10	0.10	0.23	0.21	0.30	<0.08	<1.21
S3 1.7m	0.23	0.11	0.13	0.22	0.15	0.19	0.09	1.12
S1 1.8m	0.58	0.44	0.38	0.44	0.33	0.54	0.35	3.06
S10 1.3m	0.17	0.09	0.10	0.14	0.19	0.25	<0.08	<1.02
S12 1.6m	0.22	0.15	0.12	0.19	0.25	0.30	0.08	1.31
S13 1.0m	0.21	0.14	0.19	0.22	0.19	0.31	<0.08	<1.34
S14 1.4m	0.21	0.12	0.13	0.22	0.22	0.26	<0.08	<1.24

Table A3.6 Sediment Contamination: Metals and Organo-tins (mg.kg^{-1} dry weight) compared to Republic of Ireland Action Levels

Sample ID	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Dibutyltin	Tributyltin
S1 0.0m	11.7	0.26	69.8	21.6	27.6	<0.01	30.6	91.3	<0.005	<0.005
S2 0.0m	16.9	0.39	99.2	37.2	45.5	<0.01	47.5	187	<0.005	<0.005
S3 0.0m	18.4	0.51	102	35.8	47.4	<0.01	45.0	173	<0.005	<0.005
S4 0.0m	19.9	0.48	107	36.2	50.3	<0.01	47.3	176	<0.005	<0.005
S4a 0.0m	20.2	0.48	105	36.1	49.8	<0.01	48.0	177	<0.005	<0.005
S5 0.0m	16.0	0.39	92.5	30.1	42.6	<0.01	42.1	151	<0.005	<0.005
S6 0.0m	18.1	0.51	98.2	38.7	49.7	<0.01	44.6	185	<0.005	<0.005
S7 0.0m	25.6	0.65	140	51.2	69.1	0.03	62.8	243	<0.005	<0.005
S8 0.0m	14.8	0.39	90.5	28.6	42.5	<0.01	38.4	141	<0.005	<0.005
S9 0.0m	17.4	0.45	96.4	32.0	46.4	<0.01	43.1	160	<0.005	<0.005
S10 0.0m	15.2	0.38	86.2	26.0	41.2	<0.01	37.8	132	<0.005	<0.005
S11 0.0m	15.1	0.31	85.0	24.6	38.9	<0.01	37.4	127	<0.005	<0.005
S12 0.0m	14.9	0.30	87.9	24.8	37.0	<0.01	36.6	120	<0.005	<0.005
S13 0.0m	15.7	0.30	88.1	23.7	39.4	<0.01	37.6	128	<0.005	<0.005
S14 0.0m	16.0	0.30	86.6	24.8	39.0	<0.01	38.3	128	<0.005	<0.005
S15 0.0m	15.1	0.28	85.7	22.1	35.2	<0.01	38	114	<0.005	<0.005
S16 0.0m	16.5	0.28	89.9	23.7	39.2	<0.01	39.4	124	<0.005	<0.005
S17 0.0m	13.6	0.22	83.4	19.7	34.7	<0.01	35.7	109	<0.005	<0.005
S18 0.0m	11.1	0.15	65.7	13.9	27.2	<0.01	29.6	75.7	<0.005	<0.005
S19 0.0m	8.6	0.15	66.2	16.2	26.2	<0.01	25.3	64.8	<0.005	<0.005
S4a 2.2m	16.1	0.29	89.6	36.4	52.7	0.21	43.3	169	<0.005	<0.005
S4a-1.2m	17.8	0.33	87.2	36.6	54.8	0.20	42.0	177	<0.005	<0.005
S4 2.2m	18.6	0.27	81.6	33.0	52.9	0.22	39.2	159	<0.005	<0.005
S4 1.2m	18.5	0.36	82.9	35.7	54.4	0.17	41.6	168	<0.005	<0.005
S3 1.7m	18.5	0.33	81.6	34.3	54.0	0.17	40.1	164	<0.005	<0.005
S1 1.8m	15.9	0.35	80.0	37.4	51.0	0.15	41.8	156	<0.005	<0.005
S10 1.3m	14.0	0.29	71.1	25.8	43.9	0.12	34.4	133	<0.005	0.0165
S12 1.6m	16.5	0.26	78.4	27.9	49.2	0.14	37.8	144	<0.005	<0.005
S13 1.0m	16.2	0.30	81.7	29.0	56.5	0.21	38.9	155	<0.005	<0.005
S14 1.4m	17.9	0.29	85.1	28.8	52.0	0.13	41.3	153	<0.005	<0.005

Table A3.7 Sediment Contamination: PAHs (µg.kg^{-1} dry weight) compared to Republic of Ireland Action Levels

Sample ID	Acenaphthene	Acenaphthylene	Anthracene	Benz[a]anthracene	Benzo[a]pyrene	Benzo[b]fluoranthene	Benzo[g,h,i]perylene	Benzo[k]fluoranthene
S1 0.0m	<5	<5	20.0	68.9	99.8	101	92.5	110
S2 0.0m	<5	<5	23.6	60.8	79.5	101	86.0	117
S3 0.0m	28.1	<5	29.4	57.7	77.5	109	81.7	101
S4 0.0m	<5	<5	19.8	73.6	88.6	124	97.8	107
S4a 0.0m	<5	<5	<5	57.3	76.6	102	75.5	86.1
S5 0.0m	<5	<5	19.2	66.6	91.0	108	89.5	104
S6 0.0m	<5	<5	26.2	105	140	159	135	164
S7 0.0m	<5	<5	21.4	84.4	95.4	116	98.2	108
S8 0.0m	<5	<5	14.6	45.2	51.4	79.6	60.5	66.4
S9 0.0m	<5	<5	15.0	88.7	138	148	132	141
S10 0.0m	<5	<5	22.2	90.3	89.5	113	89.4	105
S11 0.0m	<5	16.2	42.9	151	139	146	117	153
S12 0.0m	<5	<5	<5	48.3	58.3	67.1	55.4	66.1
S13 0.0m	<5	<5	<5	44.6	56.3	69.3	56.3	70.4
S14 0.0m	<5	<5	15.2	74.0	82.4	83.2	79.7	111
S15 0.0m	<5	<5	35.0	40.7	52.9	61.5	53.3	66.9
S16 0.0m	<5	<5	14.8	60.1	65.3	118	69.9	85.3
S17 0.0m	<5	<5	10.6	32.6	40.1	61.1	42.4	47.0
S18 0.0m	<5	<5	13.7	54.6	72.3	123	84.0	80.3
S19 0.0m	<5	<5	9.17	21.7	27.5	35.1	27.8	24.2
S4a 2.2m	9.17	11.6	35.9	124	155	170	143	204
S4a-1.2m	9.31	9.22	22.0	70.8	87.6	137	114	141
S4 2.2m	8.24	11.4	33.8	111	152	166	130	158
S4 1.2m	18.0	11.0	26.5	78.8	121	113	112	173
S3 1.7m	6.73	8.07	20.9	62.1	89.9	115	96.6	107
S1 1.8m	8.44	12.7	26.5	89.6	129	159	131	165
S10 1.3m	2.03	2.88	7.85	22.2	29.5	33.2	24.0	26.7
S12 1.6m	5.53	7.58	20.4	66.4	93.6	146	105	123
S13 1.0m	8.60	15.2	34.3	105	157	206	168	182
S14 1.4m	8.13	22.4	46.0	179	204	205	150	218

Table A3.7 continued Sediment Contamination: PAHs (µg.kg^{-1} dry weight) compared to Republic of Ireland Action Levels

Sample ID	Chrysene	Dibenz[a,h]anthracene	Fluoranthene	Fluorene	Indeno[1,2,3-c,d]pyrene	Naphthalene	Phenanthrene	Pyrene	Sum of USEPA 16
S1 0.0m	87.3	16.6	136	24.2	113	44.1	73.6	114	1,111.00
S2 0.0m	79.6	<5	143	26.2	94.9	34.1	68.2	121	<1,049.90
S3 0.0m	77.8	18.2	375	60.2	103	39.0	298	243	1,703.6
S4 0.0m	90.6	17.3	145	25.9	108	38.1	81.6	124	1,151.3
S4a 0.0m	72.0	13.1	101	15.1	91.6	28.1	57.1	97.9	888.40
S5 0.0m	84.2	18.1	120	22.4	93.0	34.1	64.0	113	1,037.10
S6 0.0m	120	19.2	167	27.6	147	42.2	73.8	167	1,503.0
S7 0.0m	106	18.5	154	26.4	117	35.2	87.7	139	1,217.2
S8 0.0m	51.5	<5	78.0	14.9	62.6	50.8	43.6	76.0	<710.10
S9 0.0m	105	17.7	143	23.5	147	40.5	69.4	136	1,354.80
S10 0.0m	98.6	14.6	169	23.6	98.3	32.0	77.6	147	1,180.1
S11 0.0m	159	24.1	339	21.8	136	41.2	117	267	1,875.2
S12 0.0m	56.8	<5	86.2	15.6	64.2	28.3	45.9	74.6	<686.80
S13 0.0m	53.0	<5	89.1	17.7	65.3	26.8	49.9	77.0	<695.70
S14 0.0m	84.8	<5	112	21.8	84.2	37.6	60.4	107	<968.3
S15 0.0m	52.4	<5	72.1	15.6	53.7	23.9	50.9	65.1	<281.3
S16 0.0m	74.1	<5	102	19.1	85.0	27.1	60.3	87.4	<381
S17 0.0m	37.2	<5	59.2	13.3	45.7	22.0	40.9	53.0	<520.1
S18 0.0m	69.2	13.5	97.7	16.7	81.9	30.3	53.4	95.7	896.3
S19 0.0m	28.3	<5	42.4	<5	29.8	16.1	32.8	39.8	<354.7
S4a 2.2m	144	30.1	240	33.2	160	48.2	121	211	1,840.17
S4a-1.2m	88.3	22.3	141	25.8	127	44.5	75.9	135	1,250.73
S4 2.2m	142	28.3	224	30.1	158	48.6	117	193	1,711.44
S4 1.2m	107	23.5	162	30.2	134	46.4	85.8	152	1,394.2
S3 1.7m	87.2	19.9	128	24.0	117	38.8	78.5	114	1,113.70
S1 1.8m	119	27.0	176	30.5	158	48.2	100	160	1,539.94
S10 1.3m	26.9	5.15	44.4	5.92	26.8	7.88	26.1	40.8	332.31
S12 1.6m	89.3	22.0	127	21.1	122	38.9	75.8	115	1,178.61
S13 1.0m	129	34.1	190	30.6	190	53.2	99.1	186	1,788.10
S14 1.4m	207	33.3	375	40.4	171	34.1	239	332	2,464.33

Table A3.8 Sediment Contamination: PCBs (μg.kg^{-1} dry weight) compared to Republic of Ireland Action Levels

Sample ID	PCB28	PCB52	PCB101	PCB118	PCB138	PCB153	PCB180	Sum of ICES 7
S1 0.0m	0.20	0.25	0.15	0.29	0.10	0.23	0.10	1.32
S2 0.0m	0.30	0.33	0.13	0.24	0.17	0.19	0.11	1.47
S3 0.0m	0.18	0.22	0.14	0.30	0.09	0.18	<0.08	<1.19
S4 0.0m	0.36	0.65	0.71	1.00	0.62	0.76	0.53	4.63
S4a 0.0m	0.17	0.19	0.10	0.32	0.16	0.18	<0.08	1.20
S5 0.0m	0.16	0.14	0.09	0.18	0.15	0.14	0.09	0.95
S6 0.0m	0.19	0.22	<0.08	0.21	0.14	0.21	0.14	1.19
S7 0.0m	0.34	0.70	0.55	0.79	0.55	0.57	0.60	4.10
S8 0.0m	0.13	0.15	0.10	0.15	0.12	0.18	0.11	0.94
S9 0.0m	0.15	0.11	<0.08	0.28	0.21	0.19	<0.08	<1.10
S10 0.0m	0.10	0.09	<0.08	0.18	<0.08	0.11	<0.08	<0.72
S11 0.0m	0.11	0.10	<0.08	0.18	0.12	0.14	<0.08	<0.81
S12 0.0m	0.09	0.09	<0.08	0.08	0.08	0.12	<0.08	<0.62
S13 0.0m	0.15	0.13	<0.08	0.22	0.17	0.12	<0.08	<0.95
S14 0.0m	0.12	0.12	0.12	0.12	<0.08	0.15	0.08	<0.79
S15 0.0m	0.09	0.10	<0.08	0.09	0.10	0.11	<0.08	<0.65
S16 0.0m	0.10	0.11	0.16	0.31	0.24	0.23	0.08	<1.23
S17 0.0m	0.19	0.23	0.10	0.19	0.14	0.20	<0.08	<1.13
S18 0.0m	<0.08	<0.08	<0.08	0.09	<0.08	<0.08	<0.08	<0.49
S19 0.0m	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.56
S4a 2.2m	0.23	0.13	0.14	0.22	0.15	0.21	0.11	1.19
S4a-1.2m	0.21	0.10	0.12	0.21	0.20	0.17	<0.08	<1.09
S4 2.2m	0.18	0.12	0.15	0.15	0.26	0.29	0.15	1.30
S4 1.2m	0.19	0.10	0.10	0.23	0.21	0.30	<0.08	<1.21
S3 1.7m	0.23	0.11	0.13	0.22	0.15	0.19	0.09	1.12
S1 1.8m	0.58	0.44	0.38	0.44	0.33	0.54	0.35	3.06
S10 1.3m	0.17	0.09	0.10	0.14	0.19	0.25	<0.08	<1.02
S12 1.6m	0.22	0.15	0.12	0.19	0.25	0.30	0.08	1.31
S13 1.0m	0.21	0.14	0.19	0.22	0.19	0.31	<0.08	<1.34
S14 1.4m	0.21	0.12	0.13	0.22	0.22	0.26	<0.08	<1.24

Table A3.9 Sediment Contamination: PAHs (µg.kg^{-1} dry weight) compared to Gorham-Test Effects Ranges

Sample ID	Acenaphthene	Acenaphthylene	Anthracene	Benz[a]anthracene	Benzo[a]pyrene	Benzo[b]fluoranthene	Benzo[g,h,i]perylene	Benzo[k]fluoranthene
S1 0.0m	<5	<5	20.0	68.9	99.8	101	92.5	110
S2 0.0m	<5	<5	23.6	60.8	79.5	101	86.0	117
S3 0.0m	28.1	<5	29.4	57.7	77.5	109	81.7	101
S4 0.0m	<5	<5	19.8	73.6	88.6	124	97.8	107
S4a 0.0m	<5	<5	<5	57.3	76.6	102	75.5	86.1
S5 0.0m	<5	<5	19.2	66.6	91.0	108	89.5	104
S6 0.0m	<5	<5	26.2	105	140	159	135	164
S7 0.0m	<5	<5	21.4	84.4	95.4	116	98.2	108
S8 0.0m	<5	<5	14.6	45.2	51.4	79.6	60.5	66.4
S9 0.0m	<5	<5	15.0	88.7	138	148	132	141
S10 0.0m	<5	<5	22.2	90.3	89.5	113	89.4	105
S11 0.0m	<5	16.2	42.9	151	139	146	117	153
S12 0.0m	<5	<5	<5	48.3	58.3	67.1	55.4	66.1
S13 0.0m	<5	<5	<5	44.6	56.3	69.3	56.3	70.4
S14 0.0m	<5	<5	15.2	74.0	82.4	83.2	79.7	111
S15 0.0m	<5	<5	35.0	40.7	52.9	61.5	53.3	66.9
S16 0.0m	<5	<5	14.8	60.1	65.3	118	69.9	85.3
S17 0.0m	<5	<5	10.6	32.6	40.1	61.1	42.4	47.0
S18 0.0m	<5	<5	13.7	54.6	72.3	123	84.0	80.3
S19 0.0m	<5	<5	9.17	21.7	27.5	35.1	27.8	24.2
S4a 2.2m	9.17	11.6	35.9	124	155	170	143	204
S4a-1.2m	9.31	9.22	22.0	70.8	87.6	137	114	141
S4 2.2m	8.24	11.4	33.8	111	152	166	130	158
S4 1.2m	18.0	11.0	26.5	78.8	121	113	112	173
S3 1.7m	6.73	8.07	20.9	62.1	89.9	115	96.6	107
S1 1.8m	8.44	12.7	26.5	89.6	129	159	131	165
S10 1.3m	2.03	2.88	7.85	22.2	29.5	33.2	24.0	26.7
S12 1.6m	5.53	7.58	20.4	66.4	93.6	146	105	123
S13 1.0m	8.60	15.2	34.3	105	157	206	168	182
S14 1.4m	8.13	22.4	46.0	179	204	205	150	218

Table A3.9 continued Sediment Contamination: PAHs (µg.kg^{-1} dry weight) compared to Gorham-Test Effects Ranges

Sample ID	Chrysene	Dibenz[a,h]anthracene	Fluoranthene	Fluorene	Indeno[1,2,3-c,d]pyrene	Naphthalene	Phenanthrene	Pyrene	Sum of USEPA 16
S1 0.0m	87.3	16.6	136	24.2	113	44.1	73.6	114	1,111.00
S2 0.0m	79.6	<5	143	26.2	94.9	34.1	68.2	121	<1,049.90
S3 0.0m	77.8	18.2	375	60.2	103	39.0	298	243	1,703.6
S4 0.0m	90.6	17.3	145	25.9	108	38.1	81.6	124	1,151.3
S4a 0.0m	72.0	13.1	101	15.1	91.6	28.1	57.1	97.9	888.40
S5 0.0m	84.2	18.1	120	22.4	93.0	34.1	64.0	113	1,037.10
S6 0.0m	120	19.2	167	27.6	147	42.2	73.8	167	1,503.0
S7 0.0m	106	18.5	154	26.4	117	35.2	87.7	139	1,217.2
S8 0.0m	51.5	<5	78.0	14.9	62.6	50.8	43.6	76.0	<710.10
S9 0.0m	105	17.7	143	23.5	147	40.5	69.4	136	1,354.80
S10 0.0m	98.6	14.6	169	23.6	98.3	32.0	77.6	147	1,180.1
S11 0.0m	159	24.1	339	21.8	136	41.2	117	267	1,875.2
S12 0.0m	56.8	<5	86.2	15.6	64.2	28.3	45.9	74.6	<686.80
S13 0.0m	53.0	<5	89.1	17.7	65.3	26.8	49.9	77.0	<695.70
S14 0.0m	84.8	<5	112	21.8	84.2	37.6	60.4	107	<968.3
S15 0.0m	52.4	<5	72.1	15.6	53.7	23.9	50.9	65.1	<281.3
S16 0.0m	74.1	<5	102	19.1	85.0	27.1	60.3	87.4	<381
S17 0.0m	37.2	<5	59.2	13.3	45.7	22.0	40.9	53.0	<520.1
S18 0.0m	69.2	13.5	97.7	16.7	81.9	30.3	53.4	95.7	896.3
S19 0.0m	28.3	<5	42.4	<5	29.8	16.1	32.8	39.8	<354.7
S4a 2.2m	144	30.1	240	33.2	160	48.2	121	211	1,840.17
S4a-1.2m	88.3	22.3	141	25.8	127	44.5	75.9	135	1,250.73
S4 2.2m	142	28.3	224	30.1	158	48.6	117	193	1,711.44
S4 1.2m	107	23.5	162	30.2	134	46.4	85.8	152	1,394.2
S3 1.7m	87.2	19.9	128	24.0	117	38.8	78.5	114	1,113.70
S1 1.8m	119	27.0	176	30.5	158	48.2	100	160	1,539.94
S10 1.3m	26.9	5.15	44.4	5.92	26.8	7.88	26.1	40.8	332.31
S12 1.6m	89.3	22.0	127	21.1	122	38.9	75.8	115	1,178.61
S13 1.0m	129	34.1	190	30.6	190	53.2	99.1	186	1,788.10
S14 1.4m	207	33.3	375	40.4	171	34.1	239	332	2,464.33