Best Practicable Environmental Option Assessment

Montrose Port Authority Maintenance Dredging

August 2021

HARRIS HOLDEN

Contents

Appendices

Document history

Version	Date	Notes
P2018-18-BPEO-R1	27 July 2021	Draft issued for review
P2018-18-BPEO-R2	4 August 2021	Final issue

1. Introduction

Montrose Port is a leading support, logistics and service hub for the North Sea energy industry and the general cargo market.

As a statutory harbour authority of a Trust Port, Montrose Port Authority (MPA) undertakes regular maintenance dredging of the navigation channels and berths (shown on Figure 1) to maintain safe navigable depths and support customers' business needs. MPA has powers to dredge under the Montrose Harbour Acts and Orders 1837 to 2003, subject to consent from Scottish Ministers. For over 30 years, dredged material has been deposited at the sea disposal site Montrose FO 010 (Lunan Bay) as authorised by a marine licence from Marine Scotland – Licensing Operations Team (MS-LOT).

This report presents the Best Practicable Environmental Option (BPEO) assessment for material arising from maintenance dredging activity within MPA's port limits. BPEO assessment is a method for identifying the option that provides the *most environmental benefit* or *least environmental damage*. It assesses the performance of different options using a range of criteria such as environmental impact, technical feasibility and cost.

This BPEO assessment will support an application to MS-LOT for a sea disposal licence under the Marine (Scotland) Act 2010, Part 4, Marine licensing.

2. Description of dredging activity and dredged material

2.1. Dredging activity

Maintenance dredging is carried out to remove fluvial silt and fine sand from the inner harbour, and sand from the navigation channel which is typically transported into the harbour during easterly storms. Dredging occurs for approximately 15 days per year, split between up to three campaigns per annum. Dredging is responsive depending on the rate of accretion, as measured by regular bathymetric surveys. During a severe easterly storm, navigational depth can be lost very quickly: for example, in 2014 2.2 m of depth was lost in 4 days.

Dredging is typically undertaken using a trailer suction hopper dredger (TSHD) with a hopper capacity of approximately 2,500 m^3. Each dredging campaign usually takes place over 4 to 7 days of neap tides when current speeds are lower: the South Esk is one of the fastest flowing rivers in the UK, making it challenging to dredge effectively or safely during flood tides.

Since 2010 the average annual maintenance dredging volume has been approximately 60,000 m^3, varying from no dredging in 2013 to approximately 108,000 m^3 in 2016.

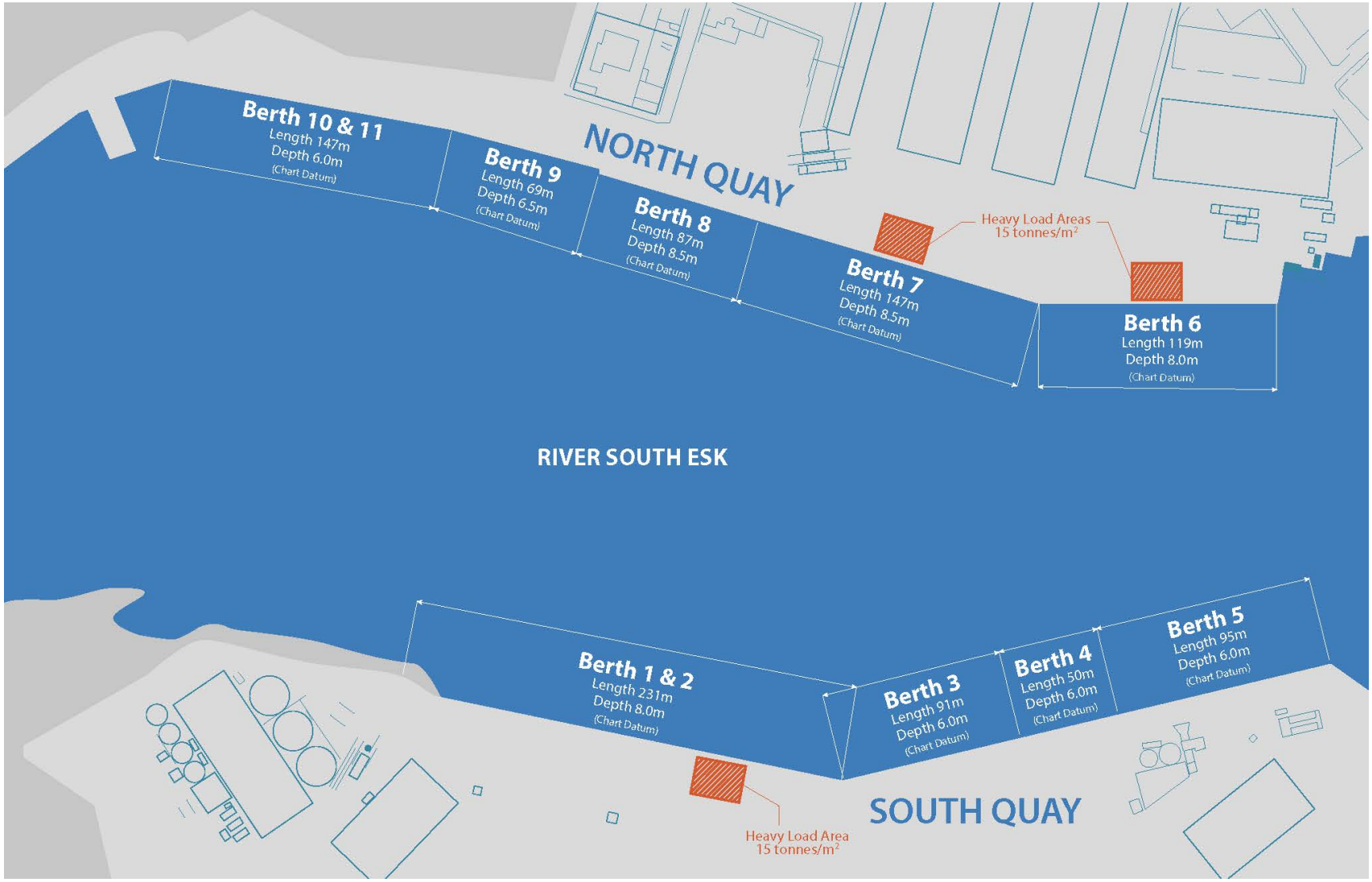

Figure 1 Map of Montrose Port

2.2. Material to be dredged

2.2.1. Physical characteristics

Sediment sampling has been undertaken periodically for many years to support marine licence applications to deposit dredged material at sea. Analysis of sediment samples collected between 2012 and 2021 reveals that in the navigation channel the dredged material is predominantly sand (up to 99%) whereas within the inner harbour the material is more mixed, comprising approximately 38% silt/clay, 54% sand and 8% gravel.

2.2.2. Chemical characteristics

The chemical analysis results of sediment samples collected between 2012 and 2021 have been compared to the Marine Scotland Revised Action Levels, which are used to determine the contaminant loading of the material and its suitability for deposition at sea. The results from samples taken in 2012, 2013 and 2014 are briefly summarised below, and the results from samples taken in 2018 and 2021 are considered in greater detail as they are considered more representative of the material to be dredged.

2012, 2013 and 2014 samples

Sediment samples from 2012 revealed no contaminant concentrations greater than Revised Action Level 1 for heavy metals, tributyltin (TBT), polychlorinated biphenyls (PCBs) or polycyclic aromatic hydrocarbons (PAHs). In 2013, a small amount of TBT was recorded within a berth sample along with the PAH Anthracene, but these only marginally exceeded Revised Action Level 1. The samples from 2014 indicated a small elevation in concentrations of PAHs and heavy metals (mainly lead and zinc), but again only marginally exceeding Revised Action Level 1, with no other contaminant elevations of concern.

2018 samples

Ten sediment samples collected in January 2018 revealed no elevations above Revised Action Level 1 for TBT, PAHs and PCBs. Some heavy metals marginally exceeded Revised Action Level 1 at Berth 1 (chromium (61.5 µg/kg); copper (47.3 µg/kg); and nickel (57.8 µg/kg) but the results were well below Revised Action Level 2. The full results are provided in Appendix A.

2021 samples

Four sediment samples collected in March 2021 revealed no elevations above Revised Action Level 1 for heavy metals, organotins, PAHs or PCBs. The full results are provided in Appendix B.

3. Scoping of potential options

This section describes potential options for the dredged material. Where an option is not considered feasible, the reason is given and it is not taken forward to the assessment stage. Options that are considered practicable are considered in Section 4.

3.1. Option 1: Landfill

The most common use of dredged material within landfill sites is as capping or restoration material. Material would need to be brought ashore within the port estate and dewatered before being transported to trucks and taken by road to a landfill site. Suitable land for drying lagoons is not available within the port estate.

There are no suitable sites in the immediate vicinity of Montrose Port that could cope with a large volume of material on an annual basis. The closest operational landfill site to the port is the Prettycur Landfill, approximately 7.5 km to the north by road (Scottish Environment Protection Agency (SEPA), 2021).

Existing landfill sites must cope with large volumes of domestic and industrial waste, and marine dredgings on the present scale would place an intolerable burden on such sites. Dredged material is relatively inert by landfill standards, so disposal at a landfill site is not usually necessary or recommended unless it is significantly contaminated, which it is not in this case (see Section 2.2.2).

Transportation of material from the harbour to a landfill site would generate significant vehicle movements on local roads, contributing to traffic congestion and air and noise pollution.

This option has been discounted.

3.2. Option 2: Deposition at sea

The dredged material meets the chemical requirements for deposition at sea (see Section 2.2.2).

Deposit sites in the marine environment are designated by MS-LOT. The closest licensed sea deposit site to Montrose Port is Montrose FO 010 (Lunan Bay). Dredged material from Montrose Port has been deposited at this site using a split hopper barge for over 30 years.

This option is considered feasible and is explored in more detail in Section 4.

3.3. Option 3: Agriculture use

The north-east of Scotland is a rural farming area with an abundance of good arable land and there is no known requirement for a supply of imported material. The dredged material would have to be de-watered and desalinated to make it suitable for soil conditioning or spreading, and no land is available within the port estate to locate a drying lagoon.

This option has been discounted.

3.4. Option 4: Use in land reclamation

Dredged material can be suitable for land reclamation. The material grade and quality are critical: material suitable for reclamation is generally medium to coarse sands and gravel fractions, typically in large volumes. The dredged material within the navigation channel may be suitable for land reclamation due to its high sand content (see Section 2.2.1) but the material in the inner harbour has a higher clay/silt content and so is unlikely to be suitable.

No land reclamation projects have been identified within the Port of Montrose or the local vicinity which require dredged material for land reclamation purposes. This option is therefore discounted for the 2021-22 marine licence application; however, the sand and gravels dredged from the navigation channel may be suitable for future land reclamation projects should there be a local need that aligns with the timescale required for maintenance dredging.

3.5. Option 5: Use as construction material

The saline content of the dredged material makes it unsuitable as a construction material. The grading and washing required coupled with the drying and storage challenges previously identified makes this option uneconomical and unpractical.

This option has been discounted.

3.6. Option 6: Beach recharge

The use of dredged material for beach recharge is a sustainable beneficial use: it generates a purpose for the material that benefits a local amenity. Material is typically deposited direct from the dredging vessel via a pipeline or by 'rainbowing' onto the beach, where it is reprofiled using land-based plant.

This option is considered feasible and is explored in more detail in Section 4.

3.1. Summary of options scoping

The scoping of potential options concludes that options 1 (landfill), 3 (agricultural use), 4 (use in land reclamation) and 5 (use as construction material) are not viable for the reasons described above. The following options will be taken forward to assessment:

- Deposition at sea
- Beach recharge

4. Assessment of options

In this section, deposition at sea and beach recharge are assessed further for strategic, environmental and financial considerations.

4.1. Assessment methodology

MS-LOT's general licensing guidance (MS-LOT, 2015) states the following in relation to BPEO assessment: *'consideration must be given to the availability of practical alternatives when considering any applications involving disposal of material at sea. In order for MS-LOT to assess the available alternative options, all sea disposal licence applications must be supported by a detailed assessment of the alternative options. This should include a statement setting out the reasons, including financial, that have led to the conclusion that deposit of the materials at sea is the BPEO*.'

There is no formal guidance available in Scotland on BPEO assessment for disposal of dredged material. This BPEO adopts an approach that considers three aspects: strategic, environmental and financial. The strategic and environmental considerations for each option are described in Sections 4.2 and 4.3, and an evaluation of the relative operating costs of each option is provided in Section 4.4. Section 5 then summarises the option assessment and concludes the BPEO.

4.2. Deposition at sea

4.2.1. Strategic considerations

Operational considerations

The operational practicalities of depositing dredged material at a licensed sea deposit site are straightforward: a split hopper barge would discharge material directly at the deposit site. No preparation of the material is required prior to deposition.

Availability of suitable sites

The closest licensed sea deposit site to Montrose Port is Montrose FO 010 (Lunan Bay). Dredged material from Montrose Port has been deposited at this site for over 30 years.

MS-LOT have previously stated their position that continued deposition at Lunan Bay is not the BPEO for maintenance dredged material from Montrose Port as they consider there could be other practicable uses such as nourishment of Montrose Bay/Beach. Since 2019, MPA has been working in collaboration with MS-LOT, NatureScot and Angus Council to identify a new deposit site within Montrose Bay. The aspiration is that deposition at a new site within the bay would retain material in the nearshore area so that it may contribute to protecting the beach and dune system, although the processes influencing coastal erosion are wide-ranging and complex, and it is not universally accepted that maintenance dredging within Montrose Port is a significant contributing factor (ABPmer, 2019a).

Following initial hydrodynamic modelling undertaken in 2020, MPA has identified a number of potential deposit sites within Montrose Bay and is currently undertaking additional modelling to determine their suitability. If a suitable site is identified, a characterisation exercise will be undertaken in accordance with MS-LOT's requirements.

If/when the characterisation exercise identifies a suitable new deposit site within Montrose Bay, and this site is designated as open by MS-LOT, the BPEO will be updated to reflect this additional option for the dredged material. At the present time, Lunan Bay remains the only available licensed sea deposit site within a reasonable sailing distance of Montrose Port.

To inform the potential suitability of deposition within Montrose Bay, during the 2020 maintenance dredging campaign MPA deposited a proportion of the dredged material at a 'trial' site in Montrose Bay, within the area bounded by the coordinates provided in Table 1, as required by the marine licence. 22,986 m^3 of material was deposited at the trial site between 12 – 14 June 2020. As agreed with MS-LOT, a drone survey was carried out which covered: a) Montrose Beach at low tide pre- and post-deposition to monitor any evidence of dredged material build-up on the beach; and b) the dredger at the trial site during a deposition event. The weather during the drone surveys was windy and misty which affected the quality of the images. The pre- and post-deposition surveys do not reveal any evidence of dredged material

accreting in the intertidal zone. The dredger deposition survey images and videos do not reveal a significant surface plume during a deposition event.

Table 1 Coordinates of trial deposit site in Montrose Bay

56° 45.039' N	002° 25.416' W
56° 45.017' N	002° 24.139' W
56° 42.448' N	002° 26.660' W
56° 42.446' N	002° 25.269' W

Legislative implications

MPA has powers to dredge under the Montrose Harbour Acts and Orders 1837 to 2003, provided that the activity is approved by the Scottish Ministers. A marine licence is required from MS-LOT to deposit material at sea.

Section 34 of the Environmental Protection Act 1990 (as amended) makes it a duty to take all measures available as are reasonable in the circumstances to apply the waste hierarchy set out in Article 4(1) of the Waste Directive. The waste hierarchy ranks waste management options according to the best environmental outcome taking into consideration the lifecycle of the material. In its simplest form, the waste hierarchy gives top priority to preventing waste. When waste is created, it gives priority to reuse, then recycling, then other recovery, and last of all disposal. The option to deposit the dredged material at sea ranks poorly on the waste hierarchy as it is classed as disposal.

4.2.2. Environmental considerations

Safety implications

Deposition at sea has negligible implications for safety providing that standard navigation and maritime safety procedures are observed.

Public health implications

There are no threats to public health associated with deposition of uncontaminated dredged material at sea.

Pollution/contamination implications

As described in Section 2.2.2, the material to be dredged is considered to be suitable for deposition at sea according to the Marine Scotland Revised Action Levels, so the risk of pollution/contamination of the marine environment is very low.

Interference with other legitimate interests

The Lunan Bay deposit site is located in open water outwith shipping channels. There is the potential for interference between the dredging vessel and other users of the sea (e.g. fishing or recreational vessels), which can be managed through compliance with harbour byelaws and standard communications between the dredging crew, MPA and other users. The risk of interference with other legitimate interests is low.

Amenity/aesthetic implications

There are no amenity or aesthetic implications of depositing material at a designated offshore site.

Ecological Implications

Deposition at sea can smother marine life on the seabed within the site. As the Lunan Bay site has been in use for many years and is subject to annual deposition of material, it is likely that any benthic species in and around the site can tolerate the periodic disturbance caused by deposition and temporary increases in turbidity.

In accordance with previous marine licences issued for deposition at Lunan Bay, a dedicated Marine Mammal Observer (MMO) watch would be kept by a nominated crew member, following the general guidance for and acting in the role of a MMO, on the dredging vessel to ensure that no marine mammals are within 500 m of the deposit operation. If marine mammals are observed within this area then deposit operations are stopped until the area has been clear for at least 20 minutes.

4.3. Beach recharge

4.3.1. Strategic considerations

Operational considerations

Beach recharge/nourishment would require either a pipeline connected to the dredger to pump material ashore onto the beach, or a dredger capable of accessing the nearshore area to discharge the material directly using a 'rainbowing' technique.

For the pipeline method, the loaded dredger would moor at a suitable point offshore and a floating pipeline would pump material onto the beach, where it would then be reprofiled using land-based mechanical plant.

For the rainbowing method, the dredging vessel must have sufficiently shallow draft to access the shallow nearshore area. This could not be achieved using the current dredging equipment (see Section 2.1); a smaller dredger would be required.

Both the pipeline and rainbowing methods take significantly longer to discharge than the open water bottom-dumping method. Due to the tidal restrictions on the dredging operation (as described in Section 2.1), for a typical dredging campaign it would not be possible to complete the dredging and beach discharge operation over a single neap tidal cycle. As such, dredging would need to be split over two neap tidal cycles, which would require the dredger to demobilise and return to Montrose Port on a future neap tidal cycle. Operationally, this is considerably less efficient than the existing dredging regime. As dredging equipment is typically in high demand in Scotland, it may be challenging to secure the return of a dredging operator two weeks after its departure.

Maintenance dredging at Montrose Port is typically reactive: regular bathymetric surveys identify when navigable depths are reduced, which triggers a dredging campaign. If the dredging is split over two neap tidal cycles as described above, navigable depths may be compromised in the intervening period, which may restrict MPA's operations and ultimately cause a hazard to navigation.

As described in Section 2.2.1, the material dredged from the navigation channel is predominantly sand, which is suitable for beach recharge. Material dredged from the inner harbour is likely to be less suitable for beach recharge due to the higher silt/clay content (approximately 38%).

Availability of suitable sites

Montrose Beach, which is immediately north of Montrose Port, is considered to be a suitable reception site for a beach recharge operation. Coastal erosion, beach and sand dune recession has occurred throughout Montrose Bay in common with much of Eastern Scotland. Shoreline change analysis back to 1903 has identified morphological variability across Montrose Bay through time, with both phases of erosion and accretion (ABPmer, 2019a). The overall trend across the Bay is erosion. Erosion (represented by recession of the dune front) has dominated during the last 30 years in the area of the Montrose Golf Links.

Legislative implications

Standing advice from SEPA states that waste material, which includes dredged material, deposited above the low water mark is subject to Waste Management Licensing controls regulated by SEPA unless it is subject to a licence issued under Part 4 of the Marine (Scotland) Act 2010, in which case it is excluded from such controls (SEPA, 2016), provided that it does not constitute a landfill. As beach recharge would require a marine licence, it is assumed that a separate Waste Management Licence would not be required.

The option to reuse the dredged material for beach recharge ranks favourably on the waste hierarchy; it negates the need to otherwise dispose of the material.

Dredged material to be used for beach recharge requires a licence from the Crown Estate Scotland, and a royalty is payable for use of the material.

4.3.2. Environmental considerations

Safety implications

The use of a floating pipeline presents a potential hazard to navigation which will require marking and lighting in accordance with standard industry practices.

Pumping or rainbowing material onto the beach and subsequent reprofiling may present a hazard to beach users. It will be necessary to cordon off areas of the beach during the recharge operation.

Public health implications

As described in Section 2.2.2, the material to be dredged is considered to be suitable for deposition at sea according to the Marine Scotland Revised Action Levels, so the use of the material on the beach is highly unlikely to present issues for public health.

Pollution/contamination implications

As described in Section 2.2.2, the material to be dredged is considered to be suitable for deposition at sea according to the Marine Scotland Revised Action Levels, so the risk of pollution/contamination of the beach environment is very low.

Interference with other legitimate interests

As described above, during the beach recharge operation it will be necessary to restrict access to areas of Montrose Beach and the inshore waters around the dredger. This is unlikely to be a significant concern due to the short term nature of the operation and the wider perceived benefit to the local community of recharging an eroding beach.

Amenity/aesthetic implications

The beach provides a valuable local amenity. As described above, it will be necessary to cordon off areas of the beach during the recharge operation. This is unlikely to be a significant concern due to the short term nature of the operation and the wider perceived benefit to beach users of recharging an eroding beach.

Ecological Implications

There are no significant ecological issues associated with using dredged material for beach recharge. It is preferable for the source material to match the existing beach material, so material from the inner harbour is likely to be less suitable due to the higher silt/clay content (approximately 38%).

4.4. Operational cost evaluation

Table 2 is reproduced from the 2019 BPEO Assessment (ABPmer, 2019b), and provides an estimate of the relative operating costs of deposition at sea and beach recharge. For beach recharge, two sub-options are presented: material pumped ashore by pipeline attached to the dredging vessel; and material 'rainbowed' ashore from the dredging vessel.

Dredging costs can vary considerably year-to-year depending on dredger availability, fuel prices and other factors, so Table 2 presents a range of estimated costs based on the consultant's knowledge of the UK dredging industry.

Table 2 Comparison of dredging costs

Activity	**Cost per m^3**		
	Deposition at sea	**Beach recharge**	
		Material pumped ashore	**Material rainbowed ashore**
Dredging	£2 - £4	£2.50 - £5	£3 - £6
Pumping ashore	n/a	£5 - £8	£12 - £14
Mooring and floating pipe infrastructure: deployment and removal	n/a	£5 - £10	n/a
Beach profiling	n/a	£2	£2
TOTAL	***£2 - £4***	***£14.50 - £25***	***£17 - £22***

The comparison in Table 2 does not capture the increased mobilisation/demobilisation costs if the dredger were required to carry out the dredging campaign over two separate neap tidal cycles, as described in Section 4.3.1.

5. Best practicable environmental option

Two potential options are considered in the assessment: deposition at sea and beach recharge.

Operationally, both options are technically practicable but deposition at sea is the preferred option as it allows the dredging to be completed within a single neap tidal cycle, maintains the maximum flexibility in terms of dredging equipment that can be used, and utilises an existing licensed sea deposit site (Montrose FO 010, Lunan Bay).

Environmentally, beach recharge is the preferred option according to the waste hierarchy as it uses a material that would otherwise be disposed. Neither option would be likely to cause significant safety, public health, amenity or pollution/contamination issues.

Financially, the costs are in the region of 6-7 times greater for beach recharge than for deposition at sea.

Considering all three aspects, deposition of material at Montrose FO 010 (Lunan Bay) is considered to be the BPEO.

As described in Section 4.2.1, MPA is working in collaboration with MS-LOT, NatureScot and Angus Council to identify a new deposit site within Montrose Bay. The aspiration is that deposition at a new site would retain material in the nearshore area so that it may contribute to protecting the beach and dune system, although the processes affecting coastal erosion are wide-ranging and complex and it is not universally accepted that maintenance dredging within Montrose Port is a significant contributing factor (ABPmer, 2019a). If/when a new deposit site within Montrose Bay is designated as open by MS-LOT, the BPEO will be updated to reflect this additional option for the dredged material.

6. References

ABPmer (2019a). Coastal Process Assessment – Montrose and Surrounding Coastline - 2019. ABPmer Report R2848a.

ABPmer (2019b). Maintenance Dredging Best Practicable Environmental Option Assessment. ABPmer Report R2919a.

MS-LOT (2015). Marine Scotland Guidance for Marine Licence Applicants: Version 2 - June 2015. https://www.gov.scot/publications/marine-licensing-applications-and-guidance/ [accessed 20 July 2021].

SEPA (2021) https://www.sepa.org.uk/data-visualisation/waste-sites-and-capacity-tool/ [accessed 20 July 2021].

SEPA (2016) Land Use Planning System SEPA Guidance Note 13: SEPA standing advice for The Department of Energy and Climate Change and Marine Scotland on marine consultations. Issue No. 5. Issued 29/09/2016.

Appendix A
2018 sediment sampling results

Table B11. Sediment Samples – Metals, PCBs and TBT (2018)

Contaminant	Sample Location ID								
	Sample 1 (2018)	Sample 3 (2018)	Sample 4 (2018)	Sample 5 (2018)	Sample 6 (2018)	Sample 7 (2018)	Sample 8 (2018)	Sample 9 (2018)	Sample 10 (2018)
	56° 42.373N 02° 28.249W	56° 42.196N 02° 28.215W	56° 42.212N 02° 28.055W	56° 42.218N 02° 27.914W	56° 42.128N 02° 28.009W	56° 42.151N 02° 27.831W	56° 42.162N 02° 27.270W	56° 42.201N 02° 26.794W	56° 42.196N 02° 26.418W
Arsenic (mg/kg)	9.8	14.9	7.9	9.9	9.0	7.1	7.1	7.2	7.4
Cadmium (mg/kg)	0.17	0.12	0.08	0.10	0.08	0.06	<0.04	0.06	0.07
Chromium (mg/kg)	35.6	61.5	25.5	34.3	31.9	20.9	17.6	17.3	18.9
Copper (mg/kg)	17.4	47.3	14.1	18.5	20.0	11.3	9.1	9.6	11.0
Lead (mg/kg)	19.1	15.8	11.3	18.4	17.2	8.6	7.1	6.5	7.4
Mercury (mg/kg)	0.10	0.07	0.11	0.10	0.09	0.06	0.05	0.05	0.05
Nickel (mg/kg)	25.0	57.8	21.5	24.4	22.0	15.7	13.9	13.8	15.1
Zinc (mg/kg)	61.9	97.3	48.4	61.2	65.3	33.7	27.7	27.9	28.6
Tributyltin (µg/kg)	<1	<5	<1	<1	<1	<1	<1	<1	<1
PCB 28 (µg/kg)	0.3	0.2	0.1	0.2	0.2	<0.08	<0.08	<0.08	<0.08
PCB 52 (µg/kg)	0.2	0.1	0.1	0.1	0.1	<0.08	<0.08	<0.08	<0.08
PCB 101 (µg/kg)	0.1	0.2	<0.08	0.08	0.08	<0.08	<0.08	<0.08	<0.08
PCB 118 (µg/kg)	0.1	0.2	<0.08	0.1	0.1	<0.08	<0.08	<0.08	<0.08
PCB 153 (µg/kg)	0.2	0.95	0.08	0.2	0.1	<0.08	<0.08	<0.08	<0.08
PCB 138 (µg/kg)	0.2	0.8	0.08	0.2	0.1	<0.08	<0.08	<0.08	<0.08
PCB 180 (µg/kg)	<0.08	0.7	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Key									
Below Marine Scotland Action Level 1									
Between Marine Scotland Action Level 1 and Action Level 2									
Above Marine Scotland Action Level 2									

Table B12. Sediment Samples – PAH (2018)

Contaminant	Sample Location ID								
	Sample 1 (2018)	Sample 3 (2018)	Sample 4 (2018)	Sample 5 (2018)	Sample 6 (2018)	Sample 7 (2018)	Sample 8 (2018)	Sample 9 (2018)	Sample 10 (2018)
	56° 42.373N 02° 28.249W	56° 42.196N 02° 28.215W	56° 42.212N 02° 28.055W	56° 42.218N 02° 27.914W	56° 42.128N 02° 28.009W	56° 42.151N 02° 27.831W	56° 42.162N 02° 27.270W	56° 42.201N 02° 26.794W	56° 42.196N 02° 26.418W
Acenaphthene (µg/kg)	4.52	<1	2.99	5.05	4.06	<1	<1	<1	<1
Acenaphthylene (µg/kg)	3.53	1.14	1.54	5.04	2.43	<1	<1	<1	<1
Anthracene (µg/kg)	11.50	2.18	5.90	13.00	8.10	<1	<1	<1	<1
Benzo(a)anthracene (µg/kg)	37.8	9.4	19.2	49.4	30.1	<1	<1	<1	<1
Benzo(a)pyrene (µg/kg)	43.30	9.79	18.30	56.40	36.10	<1	<1	<1	<1
Benzo (g,h,i)perylene (µg/kg)	43.70	8.66	10.80	61.00	41.30	<1	<1	<1	<1
Benzo(b)fluoranthrene (µg/kg)	54.4	10.3	18.3	76.8	48.7	<1	<1	<1	<1
Benzo(k) fluoranthrene (µg/kg)	24.20	4.42	7.67	28.90	18.80	<1	<1	<1	<1
Chrysene (µg/kg)	42.4	10.1	20.1	57.5	34.1	<1	<1	<1	<1
Dibenzo(a,h)anthracene (µg/kg)	8.05	1.45	2.41	**10.90**	6.98	<1	<1	<1	<1
Fluoranthene (µg/kg)	60.8	15.0	31.4	80.5	40.5	<1	<1	<1	<1
Fluorene (µg/kg)	5.81	1.26	3.64	8.18	4.69	<1	<1	<1	<1
Indeno(1,2,3-cd)pyrene (µg/kg)	47.00	8.04	11.10	61.40	42.10	<1	<1	<1	<1
Naphthalene (µg/kg)	12.70	2.45	1.53	13.10	7.89	<1	<1	<1	<1
Phenanthrene (µg/kg)	42.20	7.35	23.20	50.00	32.10	<1	<1	<1	<1
Pyrene (µg/kg)	63.1	14.7	28.3	80.6	40.4	<1	<1	<1	<1

Key	
Below Action Level 1 (Marine Scotland)	Value
Above Action Level 1 (Marine Scotland)	**Value**
Below TEL	
Between TEL and PEL	
Above PEL	

Appendix B
2021 sediment sampling results

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Specialist Chemistry, Etwall House, Bretby Business Park, Ashby Road, Bretby, Burton-upon-Trent DE15 0YZ

Test Report ID	**MAR00975**
Issue Version	2
Customer	Montrose Port Authority, South Quay, Ferryden, Montrose, Angus, DD10 9SL
Customer Reference	Marine Scotland Analysis
Date Sampled	24-Mar-21
Date Received	15-Apr-21
Date Reported	20-May-21
Condition of samples	Cold Satisfactory

This is a revised report and contains the repeated value for Nickel on sample EC21-GB03. This report replaces all previously issued versions.

Authorised by: Marya Hubbard

Position: Laboratory Manager

Any additional opinions or interpretations found in this report, are outside the scope of UKAS accreditation.

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Specialist Chemistry, Etwall House, Bretby Business Park, Ashby Road, Bretby, Burton-upon-Trent DE15 0YZ

Test Report ID	MAR00975
Issue Version	2
Customer Reference	Marine Scotland Analysis

		Units	%	%	%	%	%	Mg/m3
		Method No	ASC/SOP/303	ASC/SOP/303	SUB_01*	SUB_01*	SUB_01*	SOCOTEC Doncaster*
		Limit of Detection	0.2	0.2	N/A	N/A	N/A	N/A
		Accreditation	UKAS	UKAS	N	N	N	N
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Total Moisture @ 120°C**	**Total Solids**	**Gravel (>2mm)**	**Sand (63-2000 µm)**	**Silt (<63 µm)**	**Particle Density**
EC21-GB01	MAR00975.001	Sediment	9.94	90.1	0.2	96.5	3.3	2.57
EC21-GB02	MAR00975.002	Sediment	24.9	75.1	0.9	99.1	0.0	2.53
EC21-GB03	MAR00975.003	Sediment	10.2	89.8	15.5	83.4	1.1	2.53
EC21-GB06	MAR00975.004	Sediment	14.6	85.4	0.5	96.8	2.7	2.55
EC21-GB07	MAR00975.005	Sediment	–	–	61.6	1.1	37.3	–
EC21-GB08	MAR00975.006	Sediment	–	–	64.9	1.8	33.3	–
		Reference Material (% Recovery)	N/A	N/A	N/A	N/A	N/A	N/A
		QC Blank	N/A	N/A	N/A	N/A	N/A	N/A

* See Report Notes

NAIIS - No Asbestos Identified In Sample

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Specialist Chemistry, Etwall House, Bretby Business Park, Ashby Road, Bretby, Burton-upon-Trent DE15 0YZ

Test Report ID	MAR00975
Issue Version	2
Customer Reference	Marine Scotland Analysis

		Units	N/A	% M/M
		Method No	SUB_02*	SOCOTEC Env Chem*
		Limit of Detection	N/A	0.02
		Accreditation	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Asbestos**	**TOC**
EC21-GB01	MAR00975.001	Sediment	NAIIS	0.11
EC21-GB02	MAR00975.002	Sediment	NAIIS	0.05
EC21-GB03	MAR00975.003	Sediment	NAIIS	1.16
EC21-GB06	MAR00975.004	Sediment	NAIIS	0.09
EC21-GB07	MAR00975.005	Sediment	–	–
EC21-GB08	MAR00975.006	Sediment	–	–
		Reference Material (% Recovery)	N/A	96
		QC Blank	N/A	<0.02

* See Report Notes

NAIIS - No Asbestos Identified In Sample

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Test Report ID	MAR00975
Issue Version	2
Customer Reference	Marine Scotland Analysis

		Units	mg/Kg (Dry Weight)							
		Method No	SOCOTEC Env Chem*							
		Limit of Detection	0.5	0.04	0.5	0.5	0.01	0.5	0.5	2
		Accreditation	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Arsenic**	**Cadmium**	**Chromium**	**Copper**	**Mercury**	**Nickel**	**Lead**	**Zinc**
EC21-GB01	MAR00975.001	Sediment	7.7	0.10	17.0	12.5	0.04	15.3	8.9	31.0
EC21-GB02	MAR00975.002	Sediment	7.2	0.05	15.7	13.3	0.02	12.8	6.9	24.8
EC21-GB03	MAR00975.003	Sediment	8.8	0.10	17.0	20.0	0.08	11.2	7.3	29.2
EC21-GB06	MAR00975.004	Sediment	6.9	0.08	19.7	12.5	0.03	15.4	7.6	36.7
Certified Reference Material SETOC 774 (% Recovery)			100	99	100	104	98	101	98	99
QC Blank			<0.5	<0.04	<0.5	<0.5	<0.01	<0.5	<0.5	<2

* See Report Notes

Certificate of Analysis

Issuing Laboratory SOCOTEC, Marine Department, Specialist Chemistry, Etwall House, Bretby Business Park, Ashby Road, Bretby, Burton-upon-Trent DE15 0YZ

Test Report ID	MAR00975
Issue Version	2
Customer Reference	Marine Scotland Analysis

		Units	µg/Kg (Dry Weight)	
		Method No	ASC/SOP/301	
		Limit of Detection	1	1
		Accreditation	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**Dibutyltin (DBT)**	**Tributyltin (TBT)**
EC21-GB01	MAR00975.001	Sediment	<1	<1
EC21-GB02	MAR00975.002	Sediment	<1	<1
EC21-GB03	MAR00975.003	Sediment	<1	<1
EC21-GB06	MAR00975.004	Sediment	<1	<1
In House Reference Material (% Recovery)~			112	134
QC Blank			<1	<1

~ Indicates result is for an In-house Reference Material as no Certified Reference Materials are avaliable.

Certificate of Analysis

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Test Report ID MAR00975
Issue Version 2
Customer Reference Marine Scotland Analysis

		Units	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)
		Method No	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304
		Limit of Detection	1	1	1	1	1	1
		Accreditation	UKAS	UKAS	UKAS	N*	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**ACENAPTH**	**ACENAPHY**	**ANTHRACN**	**BAA**	**BAP**	**BBF**
EC21-GB01	MAR00975.001	Sediment	<1	1.01	<1	<1	<1	<1
EC21-GB02	MAR00975.002	Sediment	<1	<1	<1	<1	<1	<1
EC21-GB03	MAR00975.003	Sediment	<1	<1	<1	<1	<1	<1
EC21-GB06	MAR00975.004	Sediment	<1	<1	<1	<1	<1	<1
Certified Reference Material Quasimeme QPH100MS (% Recovery)			134	124	110	104	94	96
QC Blank			<1	<1	<1	<1	<1	<1

For full analyte name see method summaries
~ Indicates result is for an In-house Reference Material as no Certified Reference Materials are avaliable.
As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.
* See Report Notes

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Test Report ID MAR00975
Issue Version 2
Customer Reference Marine Scotland Analysis

		Units	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)
		Method No	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304
		Limit of Detection	1	1	1	1	1	1
		Accreditation	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**BENZGHIP**	**BKF**	**CHRYSENE**	**DBENZAH**	**FLUORANT**	**FLUORENE**
EC21-GB01	MAR00975.001	Sediment	<1	<1	<1	<1	<1	<1
EC21-GB02	MAR00975.002	Sediment	<1	<1	<1	<1	<1	<1
EC21-GB03	MAR00975.003	Sediment	<1	<1	<1	<1	<1	<1
EC21-GB06	MAR00975.004	Sediment	1	<1	<1	<1	<1	<1
Certified Reference Material Quasimeme QPH100MS (% Recovery)			96	87	105	101	99	111
QC Blank			<1	<1	<1	<1	<1	<1

For full analyte name see method summaries
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Test Report ID MAR00975
Issue Version 2
Customer Reference Marine Scotland Analysis

		Units	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)
		Method No	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/304	ASC/SOP/303/306
		Limit of Detection	1	1	1	1	100
		Accreditation	UKAS	UKAS	N	UKAS	N
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**INDPYR**	**NAPTH**	**PHENANT***	**PYRENE**	**THC**
EC21-GB01	MAR00975.001	Sediment	<1	<1	<1	<1	531
EC21-GB02	MAR00975.002	Sediment	<1	<1	<1	<1	457
EC21-GB03	MAR00975.003	Sediment	<1	<1	<1	<1	2060
EC21-GB06	MAR00975.004	Sediment	1.1	<1	<1	<1	1460
Certified Reference Material Quasimeme QPH100MS (% Recovery)			101	92	120	102	97~
QC Blank			<1	<1	<1	<1	<100

For full analyte name see method summaries
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* See Report Notes

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Test Report ID	MAR00975
Issue Version	2
Customer Reference	Marine Scotland Analysis

		Units	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)	µg/Kg (Dry Weight)
		Method No	ASC/SOP/302	ASC/SOP/302	ASC/SOP/302	ASC/SOP/302	ASC/SOP/302	ASC/SOP/302	ASC/SOP/302
		Limit of Detection	0.08	0.08	0.08	0.08	0.08	0.08	0.08
		Accreditation	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS	UKAS
Client Reference:	**SOCOTEC Ref:**	**Matrix**	**PCB28**	**PCB52**	**PCB101**	**PCB118**	**PCB138**	**PCB153**	**PCB180**
EC21-GB01	MAR00975.001	Sediment	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
EC21-GB02	MAR00975.002	Sediment	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
EC21-GB03	MAR00975.003	Sediment	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
EC21-GB06	MAR00975.004	Sediment	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Certified Reference Material Quasimeme QOR142MS (% Recovery)			66	93	73	92	103	100	91
QC Blank			<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08

For full analyte name see method summaries

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Test Report ID MAR00975
Issue Version 2
Customer Reference Marine Scotland Analysis

REPORT NOTES

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
SOCOTEC Env Chem*	MAR00975.001-004	Analysis was conducted by an internal SOCOTEC laboratory. UKAS accredited analysis by this laboratory is under UKAS number 1252.
SOCOTEC Doncaster*	MAR00975.001-004	Analysis was conducted by an internal SOCOTEC laboratory.
SUB_01*	MAR00975.001-006	Analysis was conducted by an approved subcontracted laboratory.
SUB_02*	MAR00975.001-004	Analysis was conducted by an approved subcontracted laboratory.
ASC/SOP/301	MAR00975.001-004	Due to the Assigned Values for the Certified Reference Material ran with this batch being below the LOD for the method , the In House reference material has been reported.
ASC/SOP/303/304	MAR00975.001-004	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. The remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected.However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (BAP, PHENANT) . These circumstances should be taken into consideration when utilising the data.

DEVIATING SAMPLE STATEMENT

Deviation Code	Deviation Definition	Sample ID	Deviation Details. The following information should be taken into consideration when using the data contained within this report
D1	Holding Time Exceeded	N/A	N/A
D2	Handling Time Exceeded	N/A	**N/A**
D3	Sample Contaminated through Damaged Packaging	N/A	N/A
D4	Sample Contaminated through Sampling	N/A	N/A
D5	Inappropriate Container/Packaging	N/A	N/A
D6	Damaged in Transit	N/A	N/A
D7	Insufficient Quantity of Sample	N/A	N/A
D8	Inappropriate Headspace	N/A	N/A
D9	Retained at Incorrect Temperature	N/A	N/A
D10	Lack of Date & Time of Sampling	N/A	N/A
D11	Insufficient Sample Details	N/A	N/A
D12	Sample integrity compromised or not suitable for analysis	N/A	N/A

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Test Report ID	MAR00975
Issue Version	2
Customer Reference	Marine Scotland Analysis

Method	Sample and Fraction Size	Method Summary
Total Solids	Wet Sediment	Calculation (100%-Moisture Content).Moisture content determined by drying a portion of the sample at 120°C to constant weight.
Particle Size Analysis	Wet Sediment	Wet and dry sieving followed by laser diffraction analysis.
Total Organic Carbon (TOC)	Air dried and ground	Carbonate removal and sulphurous acid/combustion at 1600°C/NDIR.
Metals	Air dried and seived to <63µm	Aqua-regia extraction followed by ICP analysis.
Organotins	Wet Sediment	Solvent extraction and derivatisation followed by GC-MS analysis.
Polyaromatic Hydrocarbons (PAH)	Wet Sediment	Solvent extraction and clean up followed by GC-MS analysis.
Total Hydrocarbon Content (THC)	Wet Sediment	Solvent extraction and clean up followed by GC-FID analysis.
Polychlorinated Biphenyls (PCBs)	Air dried and seived to <2mm	Solvent extraction and clean up followed by GC-MS-MS analysis.

Analyte Definitions

Analyte Abbreviation	Full Analyte name	Analyte Abbreviation	Full Analyte name	Analyte Abbreviation	Full Analyte name
ACENAPTH	Acenaphthene	C2N	C2-naphthalenes	THC	Total Hydrocarbon Content
ACENAPHY	Acenaphthylene	C3N	C3-naphthalenes	AHCH	alpha-Hexachlorcyclohexane
ANTHRACN	Anthracene	CHRYSENE	Chrysene	BHCH	beta-Hexachlorcyclohexane
BAA	Benzo[a]anthracene	DBENZAH	Dibenzo[ah]anthracene	GHCH	gamma-Hexachlorcyclohexane
BAP	Benzo[a]pyrene	FLUORANT	Fluoranthene	DIELDRIN	Dieldrin
BBF	Benzo[b]fluoranthene	FLUORENE	Fluorene	HCB	Hexachlorobenzene
BEP	Benzo[e]pyrene	INDPYR	Indeno[1,2,3-cd]pyrene	DDD	p,p'-Dichorodiphenyldichloroethane
BENZGHIP	Benzo[ghi]perylene	NAPTH	Naphthalene	DDE	p,p'-Dichorodiphenyldicloroethylene
BKF	Benzo[k]fluoranthene	PERYLENE	Perylene	DDT	p,p'-Dichorodiphenyltrichloroethane
C1N	C1-naphthalenes	PHENANT	Phenanthrene		
C1PHEN	C1-phenanthrene	PYRENE	Pyrene		