

Ardersier Port Sediment Transport Monitoring Plan



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1 INTRODUCTION

This plan has been produced to ensure that the recommendations made for sediment transport monitoring as part of the assessment of sediment transport undertaken during the planning stages of this project, and further refined during subsequent consultation, are implemented during the construction and operational phase of the port.

This plan was produced initially in 2017, and was updated in 2018 as part of the Environmental Impact Assessment report (EIAR). A further addendum update was issued in 2021, in response to changes in the proposed dredge method. The monitoring plan has been active during capital dredging works completed to date. A summary report detailing the findings of monitoring undertaken was issued in March 2023 (EnviroCentre Report No.13193). This present version represents the latest update to the Sediment Transport Monitoring Plan developed in response to a further revision in the proposed dredge design and method, and accounting for proposed sediment nourishment activities to surrounding depositional features. Sediment nourishment activity locations are detailed on Drawing ArdPhase1-HAV-WP3-ZZ-DR-C-0006 in Appendix A. The key aspects of the new dredge design include a change to dredge extents and an increased depth of dredge to -12.9 mCD, the proposed dredge extent is shown in Drawing 1, Appendix A.

This plan will remain an active document during the construction and future operation of the port to inform forward management decisions potentially impacting coastal processes.

The Draft Construction Environment Management Plan (CEMP) submitted as part of the Environmental Statement (ES) produced in 2013 stated within the Draft Scheme of Mitigation for coastal processes that:

“Monitor the circulation of capital dredge material around Whiteness Sands through further bathymetric surveys to confirm modelling predictions for dredged material deposited at the spoil ground. Adopt a dynamic monitoring and mitigation approach which can adapt to consider deposition of maintenance dredged material at other locations (including along the line of the Spit) to protect designated features as required and with the approval of Marine Scotland in consultation with SNH.”

The Coastal Processes Assessment included within the ES (Vol. 3 Appending 11.1) recommended:

To confirm the findings of the coastal processes review, and to inform future modelling at the site, a sediment transport monitoring plan will be implemented. This will be agreed with Marine Scotland and SNH and it is recommended that this would include:

- *Regular (2 to 3) bathymetric/topographic surveys of Whiteness Sands, access channel and Whiteness Spit during the first year post capital dredge. Ideally one of the surveys would be carried out after a storm event. These should include at least one detailed survey along with agreed transects.*
- *Monthly visual inspections of the disposal area at low tide, incorporating fixed point photography for visual comparison to document sediment dispersal.*
- *A monitoring buoy will be deployed for a three month period post capital dredge to gather wave and tidal data, this would provide site specific data to inform any future modelling.*
- *Installation of a mechanical bed-load trap samplers such as booner tubes to record sediment transport in the intertidal zone and also include foreshore sand traps for aeolian transport.*

The present 2023 dredge strategy does not include for placement of capital dredge material on the Whiteness Sands spoil disposal ground, or along the outer shore of Whiteness Spit. As a result, the aeolian transport sampling noted in the final bullet point above is not considered necessary.

Subsequent to the assessment undertaken as part of the ES, the Scottish Government has recently completed the National Coastal Change Assessment (NCCA). The NCCA establishes historic coastal change by comparing Ordnance Survey maps (1892-1905) to both the 1970's and current coastal position in order to estimate past erosion/accretion rates. These historic coastal change rates are then projected into the future using a Coastal Erosion Susceptibility Model (CESM) to limit erosion to areas where the hinterland is susceptible to erosion. The NCCA aims to inform existing strategic planning and also identify those areas which may remain susceptible in the coming decades and require supplementary support through the development of future management policies and adaptation plans robustly based on a strategic and objective evidence base. Whiteness Head is identified as an area susceptible to erosion and the sediment data collected as part of this plan will contribute to future management and adaptation plans.

2 AIMS AND OBJECTIVES

The plan is intended to provide relevant information on sediment transport, erosion and deposition within the area of Whiteness Spit, Whiteness Sands and Ardersier Port, to inform future maintenance dredge works, and associated sediment nourishment activities.

The sediment transport monitoring information collected will be used support future assessment and modelling, including consideration of volumes of material to be dredged, and options for sediment disposal or re-use.

The wider aims of this plan are to:

- Monitor the movement of natural material around Whiteness Spit and Sands;
- Provide a dataset of sediment transport information to inform future maintenance dredging and sediment nourishment activities; and
- Provide supporting information to the Habitat Management Plan in relation to Whiteness Head and Whiteness Sands.

The specific objectives of this plan are to:

- Define the scope of the type and frequency of monitoring that will be undertaken;
- Define areas that will be monitored to assess sediment transport;
- Collect data to compare with existing and future coastal modelling predictions;
- Provide data for analysis and/or coastal modelling to inform design of future maintenance dredge operations and sediment nourishment activities; and
- Inform the Spit Habitat and Protection and Enhancement Plan within the Natural Heritage Management Plan.

As outlined in Section 1, active sediment monitoring has been undertaken during capital dredge works completed to date. This current monitoring plan will build on these existing datasets and will continue to expand the baseline dataset, before continuing monitoring during the next phase of capital dredge works, and through the subsequent operation of Ardersier Port.

Reporting will include a post-dredge factual report and update reports in relation to subsequent maintenance dredge operations. The update reports will include a review of the type, extent and frequency of monitoring. Any changes proposed will be considered in consultation with the Marine Directorate (MD) and Ardersier Port Ecological Management Group (EMG).

3 MONITORING

3.1 Overview

The sediment transport monitoring plan is designed to monitor the circulation of natural material around Whiteness Spit and Sands prior to, during and after the capital dredge phase at Ardersier, in accordance with the commitments made during the planning and licencing process.

The extent of the monitoring will include the harbour access channel, Whiteness Spit, Whiteness Sands and immediate surrounds.

The anticipated maintenance dredge interval is approximately 1-3 years following capital dredge, so the monitoring plan is designed for commencement prior to the pre-capital dredge phase and will continue through the operation of the port while dredging activities are planned. The monitoring plan will therefore cover anticipated maintenance dredge activities, including associated dredge arising disposal or re-use where it occurs within the monitoring area. Reuse of dredge arisings is proposed through sediment nourishment, by reinstatement of the inner harbour facing (western) edge of Whiteness Spit, and by targeted placement to the north-eastern intertidal and subtidal edge of Whiteness Sands, to the west of the proposed harbour navigation channel.

The proposed dredge volume is 3,900,000 m³ as per the Marine Licence (reference MS-00010583). This material is intended to be disposed of as shown in Table 3-1. It is likely the material will be dredged by a cutter suction dredger and deposited by means of a discharge pipeline. This method will be confirmed following procurement.

Table 3-1: Dredge Disposal and Reuse Summary

Option	Sub-option	Estimated Volume (m ³)	Comments
Sea Disposal –	Total	2,500,000	The sea disposal Total Volume includes a contingency of 400,000m ³ to accommodate the volume earmarked for coastal replenishment should there be any issues arising with this.
Sutors and Burghead	Sutors	200,000	
	Burghead	2,300,000	
Beneficial Reuse – Site Profiling	-	Up to 600,000	This would focus on material already onshore.
Recycling – Aggregate as a Resource	-	1,400,000	Potential for up to 1.5M m ³ of material to be retained but to be confirmed. Licenses in place and pending outcome of commercially confidential discussions.
Beneficial Reuse – Coastal replenishment –	2018 Spit Reinstatement Area	280,000	Already agreed

Option	Sub-option	Estimated Volume (m ³)	Comments
Spit and Whiteness Sands	Spit Reinstatement West		Area of thinning west of “scalped” area to be restored in same manner as scalped area to protect spit as requested by NatureScot.
	Whiteness Sands East	120,000	Area immediately west of dredge channel as detailed on Drawing ArdPhase1-HAV-WP3-ZZ-DR-C-0006in Appendix A. .
	Whiteness Sands Disposal Area		Existing disposal area on northern edge of Whiteness Sands as detailed on Drawing ArdPhase1-HAV-WP3-ZZ-DR-C-0006in Appendix A.

The sediment transport monitoring plan comprises of routine monitoring, completed at regular frequencies as outlined in Table 3.2. Where practicable, the routine monitoring activities will be carried out during suitable tidal conditions to allow observation of potential changes between monitoring events. The monitoring plan and associated frequencies will be reviewed at least 3 months prior to the commencement of capital dredge, taking consideration of proposed dredge programme, and latest bathymetric and topographic survey data. The proposed monitoring extents and locations are shown in Appendix A.

Table 3-2: Monitoring schedule and frequency

Item	Frequency	Timing (in relation to dredge)		
		Pre	During	Post
Site inspection including fixed point photography	Monthly*	✓	✓	✓
Bathymetric survey	Annual*	✓		✓
Topographic survey	Twice yearly*	✓		✓
Aerial photography	Twice yearly*	✓		✓
Weather station	Sub-hourly	✓	✓	✓
Tide level monitoring	Sub-hourly	✓	✓	✓
Wave buoy	Once (3 month period)			✓
Intertidal sediment sampling	Individual event (1 month period)	✓	✓	✓
Suspended sediment sampling	Individual event	✓	✓	✓

* Year 1, then frequency reviewed.

In addition to routine monitoring, provision is made for event monitoring, which is considered to be required following the occurrence of an event (such as a large storm) which may require management intervention prior to the next planned maintenance dredge. This monitoring would be expected to involve some, but not all of the routine monitoring activities. The events that are considered likely to trigger such a monitoring event are as follows:

- Offshore wave swell waves greater than 2.5 m, as available from websites including magicseaweed and swellmap, based on Met Office offshore wave data from previous analysis showing 1 in 2 year return period, or 50% annual exceedance probability (AEP), significant wave height as 2.56 m;
- Sustained wind speed recorded at Kinloss in excess of 18 m/s, which is approximately the 1 in 2 year return period (or 50% AEP) and 75% of the predicted 1 in 50 year return period average hourly wind speed of 24 m/s as predicted in BS 6399; and
- End of spit visibly encroaching into the navigation channel.

3.2 Site Inspection

Site inspections will be undertaken monthly, where practicable, at key locations within the study area and will include ground-based fixed-point and direction photographs. Locations are shown in Drawing 3, Appendix A. These photographs will provide a continuous record of the coastline. Site inspections will be used to assist the identification of changes to the intertidal and shoreline areas. The key inspection locations will include:

- Proximal end of the spit;
- Representative mid section of the spit;

- Distal end of the spit (at navigation channel);
- Island to west of navigation channel (former distal end of spit cut off by channel dredge);
- Restored area of spit on inner channel;
- Head of the inner channel; and
- Identified larger scale intertidal bedforms within accessible areas (informed by topographic survey).

A geomorphic inspection of key coastal features will be completed biannually by an experienced practitioner to identify coastline condition at regular intervals along the shoreline. Observations will be recorded on a standard proforma and include information on erosion or accretion, sediment characteristics, the extent of sedimentary features and any transient features identified.

3.3 Topographic and Nearshore Hydrographic Survey

The proposed extents of the topographic and nearshore hydrographic surveys are shown in Drawing 2, Appendix A. These extend west to east across Whiteness Sands and Whiteness Head and north to south from the centre of the South Channel to the head of the inner channel saltmarsh.

Topographic surveys will be obtained twice yearly to quantify changes in the coastal features from the inter-tidal area and upwards to the dunes and spit crest within the study area. Topographic surveys will be captured using a technique (or combination of techniques) capable of generating a comprehensive digital surface elevation model (DEM). It is anticipated that an Unmanned Aerial Vehicle (UAV) will be deployed to increase data capture across the inter-tidal sands. The minimum spatial resolution of the DEM will be 1.0 m, which is considered sufficient to capture the topographic variations across the intertidal and landward areas.

Nearshore hydrographic surveys will be undertaken annually to record the inter-tidal to sub-tidal conditions. The hydrographic surveys will include the inner channel and dredge area seawards to the centre of the South Channel, including the disposal ground. The hydrographic survey will extend to meet the extent of the topographic survey coverage to provide an integrated ground model and the timing of the surveys will ensure that they are undertaken at or very close to the same time to ensure consistency of conditions.

The reporting of this survey data will comprise of:

- DEM data as surveyed;
- Change in level dataset when compared to previously surveyed DEM;
- At least two fixed transects at the Spit and across Whiteness Sands (where possible) extracted from the DEM for comparison; and
- Volumetric change provided for the sub-tidal, inter-tidal and landward zones.

3.4 Aerial Photograph Survey

Using UAV techniques to collect the ground model data will allow aerial photographs to be captured at the same time.

3.5 Weather Monitoring

Weather data recording for the site comprising a minimum of wind speed and direction, rainfall and temperature will be set up prior to the pre-dredge sediment sampling commencing. This will be

provided either through installing a weather station on site or obtaining weather data from nearby weather stations at Inverness Airport or Kinloss.

3.6 Tide Monitoring

Prior to the capital dredge operations commencing, a tide gauge will be installed within the harbour. This will be installed 4 weeks prior to the capital dredge to provide a period of pre-dredge conditions.

3.7 Wave Monitoring

The coastal modelling previously undertaken in support of the ES for the development of Ardersier Port relied on offshore wave data. One of the recommendations was to collect an inshore wave dataset to provide a calibration dataset for future modelling that may be required to inform maintenance dredging activities.

A monitoring buoy will be deployed for a three month period during the winter period post capital dredge to gather wave data (wave height and direction) which will provide site specific data to inform any future modelling.

3.8 Sediment Transport Monitoring

Sediment transport monitoring will be undertaken using a combination of field sampling, field survey measurements and comparison of wider scale topographic survey/aerial photographs.

Inter-tidal Sediment Sampling

Sediment transport in the intertidal zone will be monitored pre-, during and post capital dredge through the installation of mechanical bed-load trap samplers (such as Booner tubes) to record sediment processes in the intertidal zone

The Booner tubes will be located at several (3 – 4) fixed point intertidal locations, within the area shown in Drawing 3, Appendix A. During installation location selection consideration will be given to potential future re-use of maintenance dredge arisings, in order to enable future monitoring of such events. The deployment will extend for between a minimum of one neap to spring or spring to neap cycle and a full tidal cycle range. Where the number of days differ between deployment durations, they will be standardised to a consistent time period.

Sediment samples taken from the tubes will be measured and subject to particle size analysis (PSA). These will be compared to sediment samples taken at each location prior to installing the tubes and samples taken from the dredged material at source.

At each monitoring location, the pre-, during and post- dredge results will be compared in terms of total solids collected and PSA.

Suspended Sediment Sampling

As a minimum, on a single day during a spring high tide cycle, suspended sediment samples will be collected from up to five locations pre- and post- capital dredge to characterise the suspended sediment load and provide correlation with the bed sediment sampling. Proposed sample locations are shown in Drawing 3, Appendix A.

During the capital dredge works, suspended sediment samples will be taken at regular intervals appropriate to the length of capital dredge programme. The samples will be analysed by mass and PSA.

4 REPORTING

The monitoring information will be reviewed as required with a monitoring data report produced, which will be reviewed by the Ardersier Port Ecological Management Group. This will inform the Spit Habitat Protection and Enhancement Plan within the Habitat Management Plan.

The annual report will be a factual report containing the following:

- Monthly inspection reports;
- Fixed point photographs;
- Aerial photographs;
- Topographic surveys;
- Bathymetric surveys;
- Relative change in survey plots;
- Inter-tidal sediment sampling and measurement data;
- Weather (and wave when deployed) information;
- Tide data;
- Any event monitoring undertaken in addition to routine monitoring; and
- Recommendations for any change to type/extent/duration of monitoring.

Updates will be provided when new survey data has been collected to ensure that the most recent data is available for the EMG to consider (anticipated typical 6 month basis).

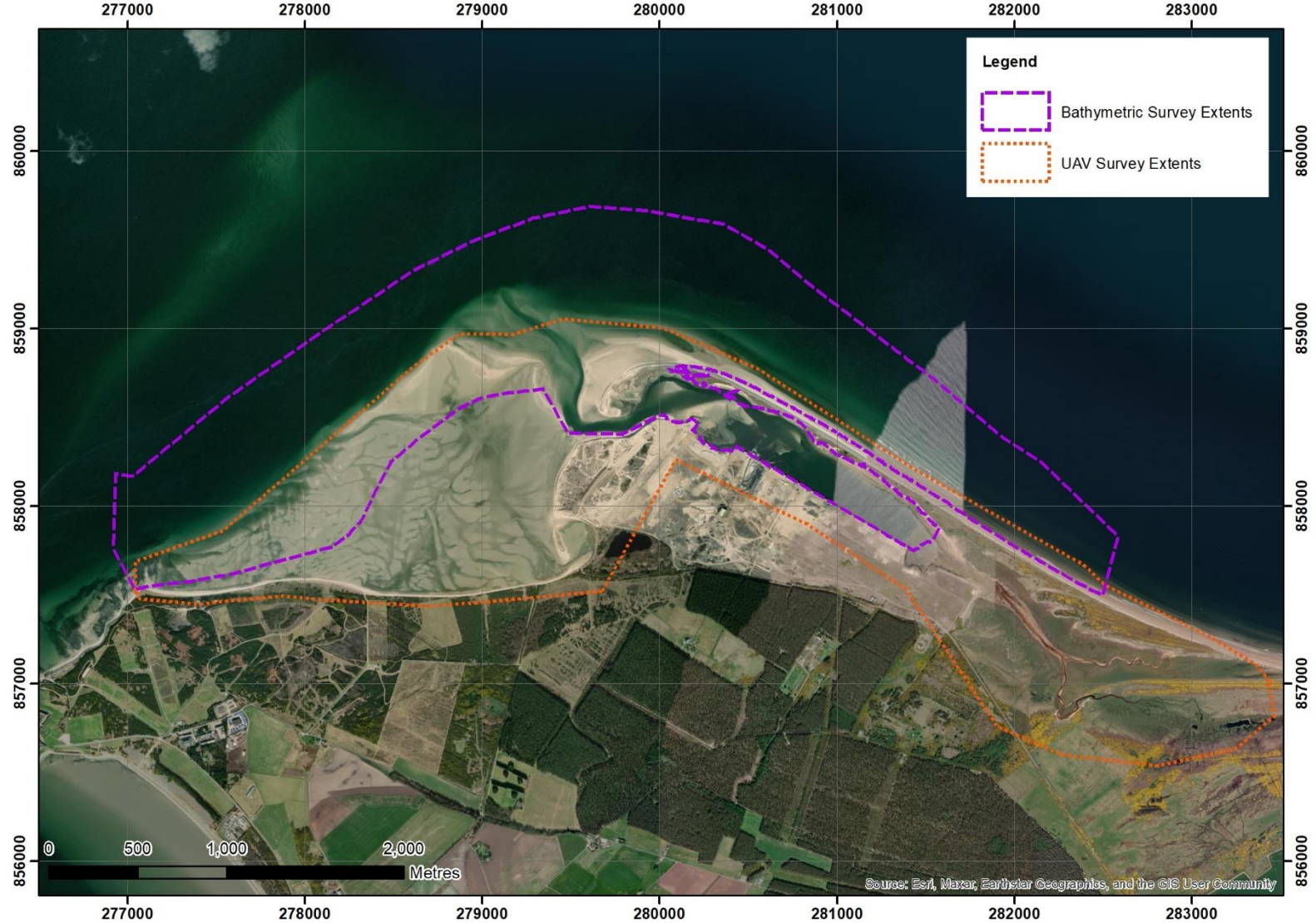
In addition to the factual data report, a summary interpretative report will be produced in advance of any future maintenance dredging planned. This will compare the observed changes to what was expected, taking into account weather conditions and will make any recommendations with regard to the content and frequency of forward monitoring. This will provide a narrative to the monitoring data collected, analysing the changes observed and examining the dispersal and circulation of material from the capital dredge. This report may establish that sufficient information is available to inform the maintenance dredge, or identify recommendations for further data collection or modelling.

APPENDICES

A DRAWINGS



Drawing 1: Proposed Dredge Extent



Drawing 2: Proposed Survey Extents



Drawing 3: Proposed Monitoring Locations



TOTAL APPROX.
VOLUME 120,000m³

WHITENESS SANDS
EAST

WHITENESS SANDS
DISPOSAL AREA

-5.0mCD

MLWS
+0.9mCD

SPIT REINSTATEMENT
WEST

SPIT REINSTATEMENT AREAS
APPROX. VOLUME 280,000m³

2018 SPIT REINSTATEMENT
AREA

PHASE 1 WORKS

PORT BOUNDARY

NOTES:

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
3. ALL LEVELS ARE GIVEN IN METRES ABOVE CHART DATUM (m ACD). CORRECTION FOR ORDNANCE DATUM IS -2.14m (RELATIVE TO ORDNANCE DATUM AT NEWLYN).

P01	18/04/2024	FOR INFORMATION	OM	CF	CF
Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd



Project
ARDERSIER PORT REDEVELOPMENT PHASE 1

Drawing title
BENEFICIAL REUSE AREAS FOR CROWN ESTATES

Drawing status
FOR INFORMATION

Scale: 1:5000 @A1 **DO NOT SCALE**

Drawing number: **ArdPhase1-HAV-WP3-ZZ-DR-C-0006** Rev: **P01**

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