REPORT

Boston Alternative Energy Facility

Wharf Construction Outline Methodology

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1 Introduction

1.1.1 This 'Wharf Construction Outline Methodology' for the Boston Alternative Energy Facility (the Facility)) supports the application for a Development Consent Order (DCO) (the DCO application) that has been made to the Planning Inspectorate under Section 37 of the Planning Act 2008 (the Act) by Alternative Use Boston Projects Ltd. (the Applicant).

1.1.2 As part of developing the parameters for the DCO, the Applicant has developed the marine facilities, comprising a multi-purpose wharf, required for receiving the Refuse Derived Fuel (RDF) and clay and exporting the lightweight aggregates from the Facility to a level commensurate with a DCO application. This report sets out technical aspects of these marine facilities. This report forms an addendum to Chapter 5 Project Description of the Environmental Statement (ES) (document reference 6.2.5, APP-043).

2 Construction Method

2.1.1 This section describes the proposed construction method. The key activities are:

1. Form New Flood Defence: Install new flood defence [concrete backed sheet pile wall].
2. Form New Wharf Structure: Install supporting piles [tubular steel piles]
3. 1st Phase Dredging: Dredge slope under suspended deck (including removing existing flood defence)
4. Form New Wharf Structure: Construct suspended deck [reinforced concrete deck supported on piles].
5. 2nd Phase Dredging: Complete dredging of the berth pocket and widened channel.

2.1 New Flood Defence

2.1.1 Approximately 500 m of the existing tidal defences would need to be relocated by pre-positioning a complete new structure (sheet wall piling and cast in place concrete backing), i.e. moved inland to the rear of the new wharf structure. Because of the arrangement of the wharf and the proposed form of construction using a suspended deck structure, this will require relocating the flood defence barrier between 10 m and 30 m further away from the river. The proposed methodology is described below.

Site Preparation:	Clear area of vegetation, remove topsoil as necessary. Relocate drainage ditch as required.
Piling platform	Install granite gabions (approx. 30,000 Te) supported on a geo-tech membrane and wired together to form a stable piling platform that will later be added to with technical infill material.
New Flood Wall:	Install sheet pile flood protection wall. Connect to existing flood defence bank at the north and south ends of the wall.

2.1.2 The installation of the sheet pile wall will require the use of a large excavator or crane to lift and place the piles. The piles are pitched into a guide frame, and then driven with a pile hammer into the ground. The piles will need to be driven sufficiently deep to withstand the forces acting on the wall due to the retained material and also to ensure that water cannot flow under the wall. There are a number of different hammer types to install sheet piles, typically these are vibrating or hydraulic type. The sheet wall will be installed in approximately four phases of piling activity which start consecutively roughly at two week intervals.

2.1.3 In order to ensure the wall is water tight, a reinforced concrete facing will be provided to the landward side of the sheet piles, this concrete facing may have to extend a short distance into the ground to ensure water tightness is achieved.

2.2 New Wharf Structure: Install Supporting Piles

2.2.1 The suspended deck would be constructed by first driving the tubular steel piles and then constructing the deck. It is understood that a Sennebogen 6140 crawler crane with a 41.1 m long boom will be used to install the piles (or equivalent). The contractor would work from the shore outwards, using the installed piles to support the piling plant. Temporary works will be required to support the piling plant on the piles, this is quite a common technique. It is planned to progress the pile installation using multiple sets of piling equipment (so that effectively continuous piling will take place[1]), this will enable rapid pile installation progress. As each row of piles is driven the piling crane will move a temporary support frame and pile driving guiding frame forward ready for the next row of piles. In this way the wharf piling works will progress with the cranes and other plant moving forward row by row. The maximum hammer energy of the piling hammer will be

2.3 1st Phase Dredging: Dredge Slope Under Wharf Structure

2.3.1 Once completion of the new flood defence wall is complete and the supporting piles for the wharf structure have been installed the existing flood defence can be

[1] *Piling will only be undertaken Mondays to Fridays between 8am and 8pm (with an option of 7am to 7pm) and Saturdays from 7am to 1pm (limited to a maximum 12 hour window).*

removed.

2.3.2 In general, the dredging activity is likely to be governed by a number of constraints and working considerations, for instance:

- the flood defence level has to be maintained at all times, so the flood defence is constructed first;
- excavation in the dry to form the dredge pocket should be maximised, this will reduce the risk of contamination of the river and ease construction; and
- dredging using land based equipment should be maximised.

2.3.3 The dredging will be broken down into separate phases. The first phase being the excavation of the dredged slope (which will also remove the existing flood defence) under the multi-purpose wharf. This would be followed by the dredging of the berth area and the river bank between the berth and the deep river channel. The Indicative Wharf Plans (document reference 4.11, APP-021) show a side profile of the indicative wharf design including the dredged slope and berthing pocket.

2.3.4 It is envisaged that much of the dredging of the slope under the suspended deck, will be undertaken using land-based long reach arm hydraulic excavators and/or suitable cranes equipped with a grab (we understand the piling crane, Sennebogen Type 6140 may be used for this project to undertake both dredging and piling works) which would sit both in front and behind the new flood defence and excavate the slope. Because the new flood defence wall is higher than the land/ river either side, excavator plant cannot straddle this wall. Therefore, much of the excavation will need to be undertaken from the river side of this new wall, with plant located on top of the existing flood embankment. It is envisaged that the embankment will be removed starting at one end of the new wharf and working north or south, or in both directions depending on how much plant is deployed.

2.3.5 The methods used to dredge the existing river will need to minimise the generation of the sediment plumes. This will necessitate, whenever possible, excavating the river bank in the “dry” when the tide is low, and the banks exposed. It will not be possible to complete all of the dredging in this manner, lower areas to be dredged will always be below low water level.

2.3.6 Excavated material will be removed using large articulated dumper trucks or similar, with temporary roadway formed on the embankment to ensure these vehicles can safely operate. The dredging will have significant interfaces with other construction activities, this is briefly discussed below.

2.3.7 Any protection required to stop erosion of the dredged slope under the wharf, would need to be completed prior to placing the concrete deck. Typically, this slope protection would be placed after the piles have been driven and before the deck is formed, as this allows easy access to the area using cranes, and or excavators to place the scour protection mattress.

2.3.8 Temporary ramps up / over the new flood defence wall (plus possibly partially constructed wharf) will be required to allow construction plant, such as dumper trucks, to cross the new flood wall or existing embankment. Consent from the Environment Agency will be required for all temporary and permanent works to the existing flood defence bank.

2.4 Form New Wharf Structure: Construct Suspended Deck

2.4.1 Once any scour protection for the dredged slope under the suspended deck has been completed the construction of the reinforced concrete deck can commence. It is envisaged that the deck will be constructed from one end of the wharf to the other, along the line of the river. This will require the use of some temporary works which are moved along as construction progresses.

2.4.2 The deck will be formed of reinforced concrete, and consideration will be given to how much precast concrete is required. There are three main options:

A. No precast concrete, all concrete is in-situ;
B. In-situ beams with precast deck slabs, all tied together with an in-situ topping; or
C. Precast beams and deck slabs, all tied together with in-situ concrete.

2.4.3 Option A is rarely used, as it requires a lot of work over water erecting formwork and pouring concrete, this approach is slower and has greater potential for delays and site accidents. The other extreme is Option C, which requires no formwork to be erected over water, minimising the amount of working over water. It is therefore preferred on safety grounds, with less potential for delays. However, this approach does require a large construction works area for the forming and storage of the precast concrete units; the precast concrete units have to be stored in order they gain sufficient strength before being placed. If space is an issue, Option B is a good compromise, because it provides a balance between the amount of precast concrete and in-situ concrete construction.

2.4.4 If a precast concrete option is adopted, the amount of space required for the storage of the precast concrete elements will depend on the option and construction programme. It is considered that if a good proportion, e.g. 50% to

60% of the future external bale storage area were set aside for the construction and storage of precast concrete elements, this should be sufficient for Option B and possibly Option C.

2.5 2nd Phase Dredging: Complete Dredging of the Berth Pocket and Widened Channel

2.5.1 Dredging of the berth pocket and extending the width of the river will require the use of floating plant. If the wharf can be used as a platform, some of the dredge for the berth pocket will be undertaken from the 'land'. However, areas to be dredged which are further from the wharf will be beyond the reach of excavators and will require the use of floating (marine) plant.

2.5.2 The use of floating plant will need to be coordinated around traffic in the river to avoid any disruption to the existing port, fishing and leisure vessels. This work will require the use of barges to transfer the dredged material to the shore. This operation will also be subject to tidal movement, so it is likely that some allowance will need to be built into the programme for this.

2.5.3 At the northern portion of the wharf site it may be necessary to use marine dredging plant as the distance from the wharf edge and the channel is up to 80 m, unless the dredging plant can operate from the existing river bank. It is unlikely the river bank will be able to support heavy tracked plant, without either placing mats on the river bank or using specially adapted plant with wide tracks to spread the load and reduce the bearing pressures. If the bank material is firm, or specialist plant can be utilised, it may be possible to dredge this area entirely, or in part, without the use of marine plant.

2.6 Dredge Arisings

2.6.1 The dredge material arisings will be considered for reuse on land as part of the construction of the Facility as a whole, where they are considered suitable for use. This will minimise the volumes disposed off-site.

2.6.2 Based on the current geotechnical data available most of the dredge arisings comprise soft clays with high water content; and soft silty layers may also be present. These materials cannot readily be used as a fill material without prior treatment. This is particularly the case because the material will be placed on top of existing strata and will be supporting the new pavement and be subject to heavy vehicle loads. Therefore, dredgings will be placed on impermeable sheets/lined ponds and drained, the leachate will be collected for adding back when the dredgings are added through the soil mixing plant. The treated material will be used as wharf back-fill mix with additional soil/spoil from the site and additions of

aggregates brought by vessel to the site.

3 Wharf Construction Programme

3.1 Overall Timescale

3.1.1 The indicative wharf construction programme is shown below. Based on the envisaged and assumed construction methodology, the construction of the wharf is anticipated to take a minimum of 18 months and a maximum of 24 months.

Activity by month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Mobilisation																		
Sheet pile flood wall in 4 zones																		
Wharf piling																		
Dredge wharf slope																		
Place scour protectiion																		
Wharf concrete deck - excavate using land based long reach crane																		
Dredge Berth pocket & River																		
NAABSA Campshed																		
Wharf Fenders & Bollard																		

3.2 Construction Sequence

3.2.1 The position of the existing flood defence bank close to the new berthing line represents an opportunity to carry out some of the excavation / dredging at an early stage of the construction phase. Taking account of this the following comprises the outline dredging / construction sequence:

- Install new permanent flood protection retaining wall with four areas of piling groups;
- After the sheet pile wall is complete, prepare to cast the concrete backing wall in place;
- Starting from the southernmost zone, start to pile tubular steel piles, again in four zonal areas;
- Using a long reach crane from the gabions, excavate/ dredge the existing river/ flood defence bank to form the slope under the wharf, maintaining a safe profile, one compartment at a time working north;
- Once the piling and dredging works have progressed sufficiently the placing of the scour protection to the dredged slope can follow;
- Once the scour protection has progressed sufficiently the construction of the reinforced concrete suspended deck can commence;

- Dredging of the berth pocket and river, and the construction of the campshed for the not always afloat but safely aground (NAABSA) berth should be delayed until towards the end of the construction period, to reduce the period between completion and operation thereby minimising the amount of sediment deposited before the first vessels arrive; and
- Finally the installation of the bollards and fenders on the wharf.

3.2.2 As described above a number of the activities will be concurrent. In particular the piling works, placing of the scour protection and construction of the suspended deck will overlap as the work progresses from one end of the wharf towards the other.

3.3 Integrity of the Flood Defence

3.3.1 It is appreciated that the current flood defences along The Haven plays a vital role in protecting the area. Therefore, it must be maintained through all stages of the construction.

3.3.2 Because the multi-purpose wharf will cut through the current flood defence embankment, the flood defence will need to be relocated and rebuilt, and a sheet pile wall will be provided as the new flood defence. This new flood defence will be located at the rear of the wharf and immediately behind the suspended deck. The wharf and the flood defence will both be set at +7.2m AOD, which increases the current flood defence level from +6.4m AOD, following advice from the Environment Agency.

3.3.3 This sheet pile wall would be integrated and connected into the suspended deck structure, so the wharf provides the lateral restraint for the wall without the need for any other anchorage system.

3.3.4 The current flood defence embankment varies, however generally it is lower, at +6.4 m AOD, than the proposed relocated flood defence. Therefore, there will be some transition at both ends of the wharf where the sheet pile wall meets the existing flood defence embankment. However, it is understood that the Environment Agency will be raising the level of the existing flood defences to a minimum crest height of +6.5 m AOD before the end of 2021 as part of the Haven Banks project. As the Facility has been requested to set the flood defence wall at +7.2 m AOD from the outset, there is likely to be a difference in level between the Project and the existing defences of 0.7 m.

3.3.5 Construction of this wall will be the first task to be undertaken. Until this new flood defence is in place the existing flood defence embankment cannot be breached,

and no work on the wharf can commence. This will ensure that, as a minimum, the current standard of protection against potential flooding will continue to be provided throughout the construction phase and into operation.

3.3.6 The new proposed construction of a granite gabion piling base will act as a coffer dam if the very unlikely event of a break of the new flood defence occurs. The Applicant will have additional gabions to drop into any breach and all terrain cranes on site to relocate them into any breach, so there is at all times an effective flood defence in place, with additional resilience provided.