REPORT

Selsey Harbour Preliminary Consultation Document

Client: Chichester District Council

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Executive Summary

This Selsey Harbour Preliminary Consultation document mainly reviews technical and environmental matters that will have an impact on planning permission and associated licences necessary to build a small harbour near East Beach Green, Selsey and identifies the most favourable option.

Three options are presented, though none can be viewed as a final solution until further technical, environmental and economic assessments have been undertaken.

A workshop for regulators and key stakeholders was held on the 3rd December 2015. This document has been informed by the conclusions drawn from the workshop, which focussed on 3 key areas in the following order of priority:

1. Issues that relate to obtaining the necessary permissions and licences.
2. Issues that relate to the viable function and operation of the harbour.
3. Issues that relate to the viable construction and maintenance of the harbour.

Of the 15 or so topics considered in the workshop, coastal processes, and in particular sediment transport, were found to be by far the most critical, especially in respect of obtaining the necessary permissions and licences. The major concern is the interruption of sediment transport from the south to the north and its impact on Pagham Harbour which is a very important nature conservation area.

With regards to the other topics such as land impacts, silting-up and ground conditions, these are far less critical and should be manageable.

The most favourable option is the land based harbour because it has the lowest impact on sediment transport. It was also identified that:

- Regular beach by-passing will almost certainly need to be an essential part of the operation of the harbour.
- The southern boundary is limited by the fisheries factory unit.
- The landward boundary will need to be reasonably clear of the adjacent residential properties in order to keep impacts to an acceptable level.
- The northern boundary may need to encroach into the green area in front of the car park.
- The seaward boundary will need to be kept within the footprint of the groyne field and ideally kept as far landward as possible.

1 Introduction

The construction of a small harbour for Selsey has been discussed many times in the past, however the feasibility, costs and implications of such a project have not been investigated.

The construction of a small harbour at Selsey will generate economic opportunities for the town bringing benefits to fishing and recreational boat users, whilst also benefitting the sea defences. It will build on the traditional small boat fishing industry in Selsey, a core economic activity for many generations of fishermen both here and in other coastal towns, while providing a focus for tourism on the Manhood Peninsula.

Benefits and economic opportunities:

- *Fisheries protection* - providing safety, security and protection for the fishing community. Fishermen and their livelihoods will be protected from bad weather and poor working conditions by building a small harbour in which to moor boats in bad weather, and provide a place to unload catches easily and safely.

- *Visitor safety* - the safety of visitors to East Beach will be improved by eliminating winch wires and other working activities on the beach.

- *Selsey economy* - the economy of Selsey will be improved, particularly in the maritime sector, by creating a destination point for tourism and the local economy in the form of a fish landing stage with fishery outlet; fish restaurant and harbour café; aquaculture; retail outlet; and other initiatives.

- *Sea defences* - Constructing a small harbour will improve coast protection for Selsey by protecting the current seawall, and reducing costs associated with its maintenance.

A regulator and key stakeholder workshop was held on the 3rd December 2015 in Selsey to discuss some preliminary conceptual ideas for the development of a small harbour in Selsey. This document summarises the contributions of the regulators and key stakeholders who have explored together the feasibility, opportunities and constraints of constructing such a harbour, especially in respect of gaining the necessary consents. The attendees are listed in Table 1-1 below.

This document presents three preliminary conceptual options that provide a framework for identifying the key issues and assessing their potential impacts, particularly with regard to obtaining the required approvals and licences. The options also provide a basis for assessing the function and operation of the harbour, and its construction and maintenance.

None of the options necessarily represent a final solution but between them they provide a broad basis for evaluation and comparison. Their purpose is to convey the main principles involved without necessarily representing working general arrangements. Later stages will develop outline designs which will give closer attention to positioning, configurations and forms of construction.

The three options are based on best judgement using readily available data. Key aspects of the options are discussed in brief commentaries that are likewise based on best judgement.

This section (**Section 1**) comprises the introduction to the following sections:

- **Section 2:** General description of the preliminary conceptual options, upon which the potential issues, opportunities and constraints are then based;
- **Sections 3-8:** Issues that mainly relate to permissions and licences;
- **Sections 9-15:** Issues that mainly relate to function and operation of the harbour;
- **Sections 16-19:** Issues that mainly relate to construction and maintenance; and
- **Section 20:** Conclusions realised from the workshop, including identification of further work.

There is also an **Appendix**, which comprises the drawings of the three options.

Name	Organisation
Uwe Dornbusch	Environment Agency
Nick Tomline	Natural England
David Lowsley	Chichester District Council
Dominic Henly	Chichester District Council
Roger Spencer	Arun District Council
Christopher Harvey	Selsey Fishermen's Association
John Reeves	Selsey Fishermen's Association
Robert Greenwood	Selsey Fishermen's Association
John Connor	Chichester District Council Cllr. Selsey North
Chris Dean	Selsey Town Council
Michael Bapty	Crown Estate
Steve Harris	Chichester District Council Planning
Andy Perry	Marine Management Organisation
Gordon Chittenden	Marine Management Organisation
Chris Russell	Marine Architect
Iain Shepherd	Coastal West Sussex Partnership
George Smith	Chichester District Council
Jane Cunningham	Manhood Peninsula Partnership
Simon Howard	Royal HaskoningDHV
Thomas Green	Royal HaskoningDHV
Elizabeth Jolly	Royal HaskoningDHV

Table 1-1: List of key stakeholders consulted within the workshop.

2 General Description

2.1 All Options

All three options are located just south of the East Beach car park and green area. Their position coincides with two fisheries compounds and deeper water in the nearshore zone. Also they are relatively close to a residential area set back from the coastline. See Figure 1 below and Location Plan, Drawing No. PB3807/0001 in the Appendix.

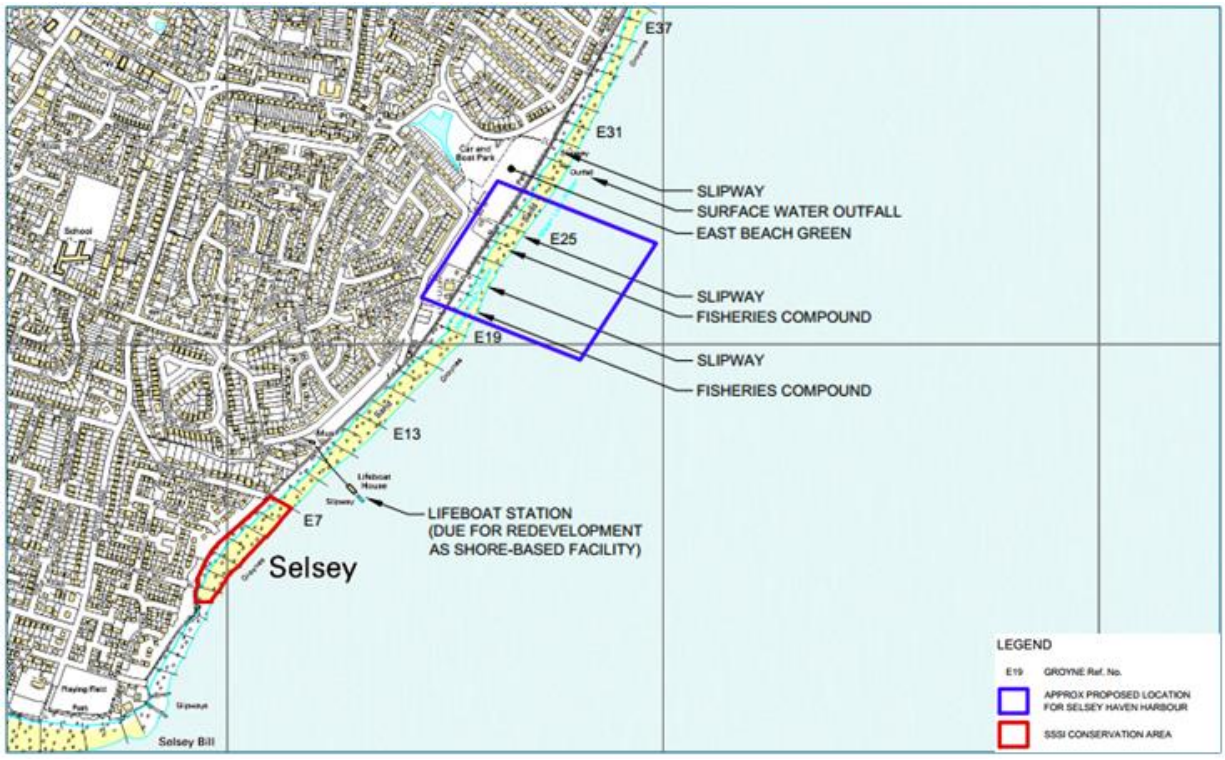


Figure 1: Location Plan

The main difference between the three options is their cross-shore location. Option 1 straddles the land and foreshore, Option 2 straddles the foreshore and nearshore, and Option 3 is entirely located within the nearshore zone. See Drawing Nos. PB3807/0002 – 0004 in the Appendix.

Each option is designed to accommodate 75 No. craft (25 No. 15 metres in length and 50 No. 10 metres in length). The size of the mooring basin is based on guidance provided by The Yacht Harbour Association Ltd. In order keep overall impacts and costs to a minimum the area has been kept as compact as possible. The mooring basin anticipates the use of floating pontoons, a modest sized hardstanding and a slipway.

The mooring basin is dredged to a level of 4 metres below Ordnance Datum which compares with a Mean Low Water Spring tide level of 2.3 metres below Ordnance Datum. This is considered to be acceptable for the type of craft using the harbour.

The harbour entrance is located in the South-East corner where the natural seabed levels tend to be at their lowest. The entrance also faces away from the dominant direction of longshore sediment movement. It is recognised that a well-designed entrance is key to the success of the harbour.

The typical top level of the harbour piers and breakwaters is 5 metres above Ordnance Datum which coincides with the promenade level of the adjacent seawall. This is seen as a reasonable minimum level, again in order to reduce impacts and costs.

2.2 Option 1

This option straddles the land and foreshore in respect of its cross-shore location. Its working principle is to remain within the influence of the groyne field and not encroach any further seaward, with the intention of restricting its additional impact on the natural coastal processes.

Its southern boundary is limited by a fisheries factory unit, its landward boundary is governed by its proximity to the residential area, buts its northern boundary has a measure of freedom to encroach into the East Beach green area in front of the car park. Also there may be a case for some seaward realignment of the seawall on the north side of the harbour.

This option involves a deep excavation between the seafront road and the seawall, the removal of the seawall and the re-location of many of the buildings in the fisheries' compounds. The harbour walls are in vertical sided structures, piled into the underlying ground. The excavated materials are used to locally raise ground levels to accommodate quayside facilities.

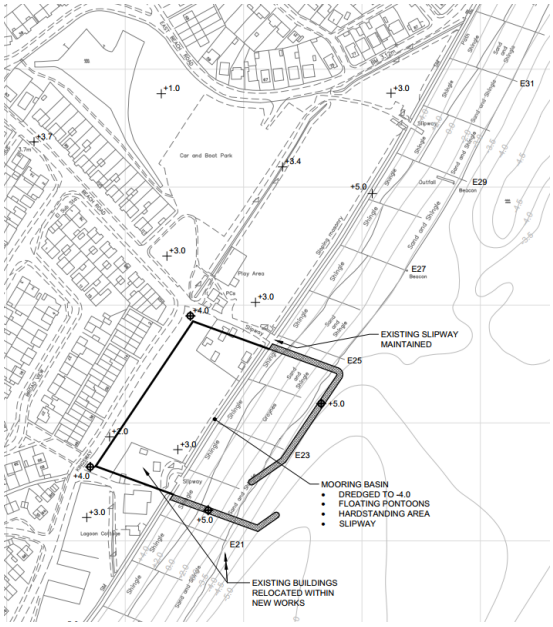


Figure 2: Option 1 Plan

This option is the most compact of the three and provides a quay wall facility around its full perimeter. It is also the lowest cost option due in part to the use of vertical sided solid piers throughout. These are considerably less expensive than rock breakwaters and although they have a poorer hydraulic performance they may be acceptable in this situation due to the presence of the existing groyne field. In addition this option generates surplus excavation and demolition materials which could be used beneficially elsewhere, such as for improving the sea defences elsewhere along the East Beach frontage.

However, the harbour is particularly close to the residential area, and it involves a significant land take with the need to divert the promenade footpath.

2.3 Option 2

This option straddles the foreshore and nearshore in respect of its cross-shore location. Its working principle is to represent a 'classic' artificial harbour on an open coastline.

It's southern, northern and seaward boundaries have some degree of freedom. There may be a case for some seaward realignment of the seawall immediately to the north of the harbour.

This option involves the enclosure of a length of the frontage and the strengthening of the seawall.

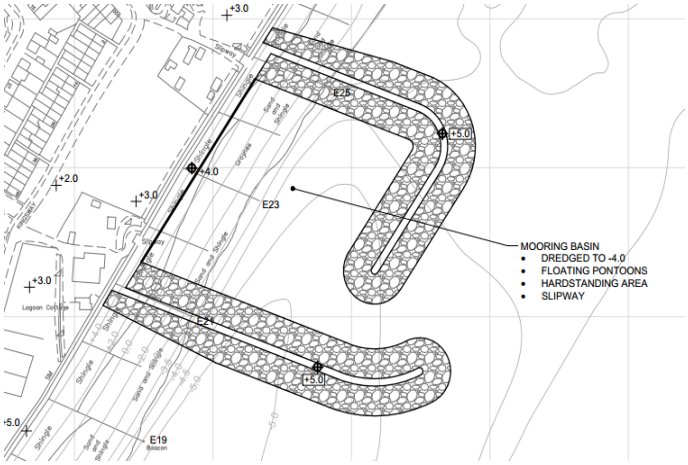


Figure 3: Option 2 Plan

The enclosure is achieved by means of two rock breakwaters, and the wall strengthening by means of a vertical quay wall installed in front of the seawall.

The option provides the best balance between accessibility and low impact on the existing infrastructure and land area.

However, it does represent the biggest impact on the coastal processes which in turn affects the conservation areas.

2.4 Option 3

This option is entirely situated within the nearshore zone in respect of its cross-shore location. Its working principle is to allow the longshore inter-tidal sediment transport to continue unhindered.

All of its boundaries have a degree of freedom in their final location and would be adjusted to eliminate any significant impacts on the inter-tidal sediment transport.

This option involves the enclosure of an area of seabed offset from the shoreline, and an access link to the shoreline.

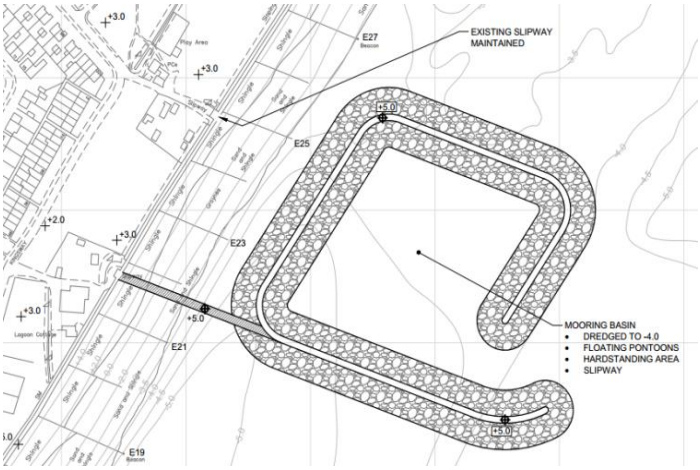


Figure 4: Option 3 Plan

The enclosure is achieved by means of a rock breakwater, and the shoreline link by means of an open pier structure that allows free movement of the foreshore beach material.

The option represents the least impact on the land area, infrastructure and foreshore.

However, it is the least accessible of the three options, it is the most expensive and has the biggest potential impact on the nearshore zone.

3 Coastal Process Impacts

3.1 All Options

The coastal processes along this frontage are dominated by a net longshore sediment transport from south to north. With the existing groyne field in place the average net transport rate is estimated to be about 10,000 cubic metres per year, and without the groyne field, 30,000 cubic metres per year. Although designed to hold the beach in place, the groynes do allow some transport of sediment over them and around them.

It is widely accepted that the littoral drift is a major characteristic of this frontage and that the beaches are continually changing due to a very dynamic environment. Also it is recognised that there are still unknowns about the behaviour of this frontage, especially in the nearshore zone and in respect of onshore / offshore sediment movement which may be very significant. In addition there are some uncertainties about the bathymetry, particularly in the proposed area for the harbour.

The frontage is also influenced by pulses of shingle that are believed to emanate from Kirk Arrow Spit, near Selsey Bill, and by very strong tidal currents in the nearshore zone. Also the possibility of some circulatory patterns of shingle movement in the nearshore zone cannot be ruled out. Again, there are unknowns concerning these processes.

Due to the different cross-shore extents of the potential harbour, each of the options is likely to have a different impact on coastal processes, in particular, sediment transport.

All options must consider how the potential impacts can be avoided or mitigated, especially the risk of sediment 'starvation' to the north which would be critical to both Pagham Harbour as an important environmental designated site (see Section 5) and the coastal defences to the north and onwards to the east. For this reason it is likely that these potential impacts will be the main factor in gaining approvals for the proposed works.

It is recognised that avoidance of sediment 'starvation' will be unrealistic and that at least some mitigation measures will be necessary. Based on similar situations elsewhere in the country, notably Shoreham Port, routine beach by-passing should be feasible. Such an approach would include careful and ongoing monitoring of the beaches to the south and north of the harbour in order to determine the correct frequencies and quantities of beach by-passing. In the event of evidence of permanent losses to the nearshore zone the need for some beach recharge from external sources may be necessary.

3.2 Option 1

For Option 1 the additional impact to the wider coastal processes is likely to be modest because the piers are largely contained within the groyne field and do not extend by any significant amount into the nearshore zone.

However, due to their height they will form a greater barrier to sediment transport along the beach. Sediment will build up in the lee of the south pier, until at some point it will be deflected into the nearshore zone in front of the harbour, allowing it to eventually naturally bypass the harbour mouth. The barrier presented by the harbour will therefore initially result in some beach starvation to the north. Once bypass has started, it is anticipated that the majority of the sediment will continue to feed the beaches to the north. However, there is a risk that a shingle bar will form across the harbour entrance and a proportion of the material will be lost to the nearshore zone.

Notwithstanding the potentially modest impact of Option 1 it will almost certainly be necessary to carry out artificial beach by-passing post-construction which may in the event prove to be a significant undertaking. However, beach monitoring will allow this process to be optimised in terms of frequency and quantities.

The vertical nature of the piers has the potential to cause local beach drawdown due to wave reflection but this could be attenuated by using semi-porous structures or by adding localised wave absorbing rock revetments.

Subject to the amount of available land, this option has the potential to further reduce its impacts on coastal processes by moving its seaward boundary closer to the line of the existing seawall. However, the entrance would still need to extend to the nearshore zone and therefore such impacts cannot be eliminated altogether.

3.3 Option 2

For Option 2 the impact on sediment transport is likely to be very significant. Due to the height and length of the breakwaters there would be a major build-up of beach sediment to the south of the harbour, in a similar fashion to Option 1 but on a larger scale. However, given the additional length of the southern breakwater, it is likely to form a total barrier to sediment transport to the north. This would result in a long-term interruption in the sediment feed to the beaches to the north and a significant risk of long term permanent sediment loss.

Regular artificial beach sediment by-passing by excavating beach sediment from south of the harbour and placing it to the north would significantly reduce the impact on sediment transport. However, this option still has a significant impact on the nearshore zone and this represents a significant risk due to the complexities and uncertainties of the coastal processes. Even with further investigations and studies it may prove difficult to identify mitigation measures that would satisfy the regulators.

3.4 Option 3

For Option 3 the impact on sediment transport has the potential to be minimal provided the harbour is carefully positioned and orientated to suit. This is because the predominant sediment transport along the beach will not be interrupted by the open pier structure, and sediment will be able to move freely along the foreshore from south of the harbour to the north, although it may be necessary to also carefully manage the groyne field in order to facilitate this movement.

However, this option has a major impact on the nearshore zone being further offshore than Option 2 and this represents a significant risk due to the complexities and uncertainties of the coastal processes, especially currents. Even with further investigations and studies it may prove difficult to identify mitigation measures that would satisfy the regulators.

4 Numerical Modelling

4.1 All Options

Numerical modelling is a key tool in developing a better understanding of the performance of the design and impacts on physical and ecological environment of the various options.

For numerical modelling, basic input data such as bathymetry, offshore wave heights, wave periods, wind speeds, and type of boundaries would be required. It is important that all of the datasets used are the most up to date. Additional surveys may be required to update existing datasets, for example the local bathymetry.

It is possible to simulate the growth, decay and transformation of wind-generated waves and swells in offshore and coastal areas. Various physical phenomena can be captured, these include but are not limited to; wave growth by action of wind, on-linear wave-wave interactions, dissipation due to white capping, dissipation due to bottom friction, dissipation due to depth-induced wave breaking and refraction and shoaling due to depth variations. Typical numerical modelling software to use for this would be Mike 21-SW.

It is possible to determine and assess wave dynamics within the harbour and understand the disturbance within for each option. This can help determine the optimum harbour layout in relation to predefined criteria for acceptable wave disturbance, vessel movements, mooring arrangements and handling down-time for example. The following combined effects of all important wave phenomena of interest in harbour engineering can be captured. These include but are not limited to; shoaling, refraction, diffraction, wave breaking, bottom dissipation, wave transmission and directional spreading. Typical numerical modelling software to use for this would be Mike 21-BW – Boussinesq Wave Module.

Wave overtopping assessment can be undertaken in order to identify a required crest level of the harbour breakwaters and piers in terms of pedestrian safety, vehicle safety and property safety (including buildings and boats) for all options. Overtopping assessment can be undertaken for both vertically faced pier structures and breakwaters with side slopes.

Hydrodynamic modelling can be undertaken to help understand complex applications within coastal environments such as the assessment of hydrographic conditions for design, construction and operation of structures in waters. Typical numerical modelling software to use for this would be Mike 21 Flow Model FM.

It is possible to simulate littoral drift and coastline evolution (including subtidal transport) in which the flow and transport can be assumed to be in mainly one direction. Therefore, it would be possible to model each option to help understand the relative potential impacts on sediment transport. Typical numerical modelling software to use for this would be LITPACK. To improve certainty additional site investigations would be necessary (such as a tracer study).

4.2 Option 1

There are no unique numerical modelling techniques that can be applied specifically to this option alone.

4.3 Option 2

There are no unique numerical modelling techniques that can be applied specifically to this option alone.

4.4 Option 3

There are no unique numerical modelling techniques that can be applied specifically to this option alone.

5 Environmental Designations

5.1 All Options

The following issues are applicable to all three options.

Conservation Areas

The proposed location of the new harbour does not lie within the boundary of any areas currently designated for the protection of nature conservation (see Drawing Number PB3807/0001 in the Appendix). The intertidal area comprises of a shingle beach interspersed with timber groynes. It should be noted there is no known vegetated shingle along the foreshore within the proposed footprint or within 250m either side. Vegetated shingle is a UK Biodiversity Action Plan (BAP) habitat, and can be used by Little Terns (as designated Special Protection Area (SPA) / Ramsar feature) for nesting (see below for further information).

The proposed harbour is located within the **proposed Solent and Dorset Coast SPA**, which has been designated for foraging habitat used by internationally important bird species, notably little and common terns. The supporting habitats include mudflats, sandflats, marshes and shallow water over intertidal areas and shingle beach. It is likely that the footprint of the proposed harbour is unlikely to support significant quantities of such birds, as the habitat i.e. shingle / sand beach is likely to be highly disturbed by fishing and tourism activities. It will need to be assessed as part of an EIA, as required to gain the necessary consents and approvals – this applies to all the designations given below.

The nearest site of conservation importance is **Pagham Harbour**, which lies approximately 2.2km to the north east of the proposed development. Pagham Harbour is a highly designated site, with varying levels of designations for different features:

- An **SPA** designated due to the numbers of breeding, over-wintering and migratory bird species that qualify for protection under the European Birds Directive (79/409/EEC).
- A **Ramsar** site, recognised as a wetland of international importance under the Ramsar Convention;
- A **Site of Special Scientific Interest** (SSSI) designated for its wetland habitats, vegetated shingle community, woodland, over wintering birds, sand invertebrates and its geomorphology and geological outcrops.

For all options, it will be necessary to ensure there are no significant impacts (most importantly from indirect changes to coastal processes) upon this designation and its features otherwise it will be very difficult to get consent unless there is an ‘Imperative Reason of Overriding Public Interest’ that would stand up in court – which is unlikely for this scale of project.

In addition, approximately 1km to the south west of the proposed harbour location is **Selsey East Beach SSSI**. The site at Selsey East Beach should be seen in conjunction with Selsey West Beach (to be included within the **Bracklesham Bay SSSI**). Together they form a key Quaternary site for a sequence of freshwater and estuarine deposits of Ipswichian Interglacial age. The deposits at Selsey East Beach are of unique importance in providing Pleistocene vertebrate faunas from the very early part of the Ipswichian Interglacial.

Further to this is **Bognor Reef SSSI**, which is designated for its variety of geological, geomorphological and biological features, but is believed to be at some distance, and the key would be to ensure that there are no significant indirect impacts from any potential changes in coastal processes. The exact location of the reef should be identified.

The land behind the beach at Selsey, as well as part of the foreshore is characterised as 'South Coast Plain' **The South Coast Plain National Character Area (NCA)** is a flat, coastal landscape with an intricately indented shoreline lying between the dip slope of the South Downs and South Hampshire Lowlands and the waters of the English Channel, Solent and part of Southampton Water.

The **Selsey Bill and The Hounds recommended Marine Conservation Zone (rMCZ)** is situated approximately 1km to the south of the proposed harbour location encompassing the coastline around Selsey Bill and into Bracklesham Bay. Situated to the south-east of Selsey Bill is an area known as the Mixon Hole. Thought to be a segment of an ancient river gorge, this almost vertical 20 metre high clay cliff has numerous ledges and crevices which provide homes for many marine species. Species include short-snouted seahorses, squat lobsters and crabs along with red algae and kelp in the shallower parts. Selsey is a foraging area for three species of tern and seals also regularly use this area for foraging. Bottlenose dolphins have also been recorded here (Wildlife Trusts, 2014). There are no known reef features immediately off of Selsey. In order to gain consent, it would need to be investigated and shown as part of the EIA process, that the features of this designation would not be significantly indirectly impacted by any changes to coastal processes, construction impacts (e.g. sediment plumes from dredging and emplacement of harbour arms) and future operations (e.g. increase in fishing activity, pollution and decrease in water quality, etc).

Finally, the **Utopia Marine Conservation Zone**, designated as of January 2016, is situated approximately 8km to the south of the proposed harbour location off the east coast of the Isle of Wight. The site covers an area of just under 3km^2 and is designated for rock and sediment features as well as fragile sponge communities. As the proposed harbour is at some distance from the site the potential impact to the site is very low.

Important Habitats

UK BAP priority habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The original list of UK BAP priority habitats was created between 1995 and 1999, and was revised in 2007.

Two types of BAP habitat are dominant on the stretch of coastline at the location of the proposed harbour: 'coastal vegetated shingle' and 'maritime cliff and slope'.

The communities in '**coastal vegetated shingle'** depend on the amount of finer materials mixed in with the shingle, and on the hydrological regime. Shingle structures may support breeding birds including gulls, waders and terns. Diverse invertebrate communities are found on coastal shingle, with some species restricted to shingle habitats. *It should be noted that there is no vegetated shingle at the proposed site for the development at Selsey or up to 250m either side as the foreshore is backed by a hard seawall.*

'**Maritime Cliffs and Slopes**' is also listed as a habitat of Principal Importance for Biodiversity in England. Comprising sloping to vertical faces on the coastline where a break in slope is formed by slippage and/or coastal erosion, 'Maritime Cliffs and Slopes' constitutes a cliff with the zone defined as cliff-top extending landward to at least the limit of maritime influence (i.e. limit of salt spray deposition), which in some exposed situations may continue for up to 500 m inland. Maritime cliffs are often significant for their populations of breeding seabirds, many of which are of international importance. *There are no 'cliffs or slopes' at the proposed project site.*

The entire stretch of coastline around the proposed harbour location is identified by the Joint Nature Conservation Committee (JNCC) as '**potential reef**' habitat. These are areas where JNCC believe, from the best available evidence, that Annex I reef (as defined under the Habitats Directive) might be present.

However, it is believed that there are no known reefs off of Selsey town in the location of the harbour, as it is all sedimentary.

Water Framework Directive

The Water Framework Directive (WFD) was introduced in 2000. Its purpose is to establish a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater, and to ensure that all aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands meet 'good status' by 2015.

The coastal waters in and around the proposed location of the new harbour lie within the Sussex Coastal water body (waterbody ID GB640704540003). Classified as 'heavily modified', the Sussex coastal water body is currently considered to be at 'good' status for chemical parameters and at 'moderate potential' status for ecological parameters.

There are no protected shellfish waters in the vicinity of the proposed harbour location, the nearest being within Chichester Harbour.

Bathing Waters

The proposed harbour location sits within the Selsey Bathing Water which extends between Pagham Harbour and Selsey Bill. The bathing water faces southeast and is primarily a groyned, shingle beach but with some sand exposed at low water. To the north of the bathing water there are underwater rock formations which are exposed at low water. Between 2012 and 2015 this bathing water was assessed as being either 'sufficient' or 'good' in terms of quality. There is a storm overflow just north of the proposed harbour called East Beach Road storm overflow. Also, the Bognor Long Sea Outfall (6 km offshore) is now a storm overflow. Discharges occur when heavy rainfall overwhelms the sewerage system but are designed not to affect bathing water compliance.

For all three options consideration will need to be given to implications for the WFD Coastal Waterbody as well as the nearby Bathing Water. Should regular dredging be required to maintain the depth of the new harbour this will need to be explored to demonstrate WFD compliance.

Fisheries Interest

Data available from the Centre for Environment Fisheries and Aquaculture Science (Cefas) indicate that in 2010 the waters off of the Selsey frontage were used as spawning grounds for cod, plaice, sandeel and sole. Data from 1998 indicate that Lemon sole and sprat were also spawning in this location.

As well as fish spawning grounds, this area is also used as nursery areas for fish; the 2010 data indicates that plaice, sole, thornback ray and undulate ray made use of the area, whilst in 1998 Lemon sole was also present.

5.2 Option 1

As identified in **Section 3**, this option is likely to result in some beach starvation to the north of the harbour and possibly some permanent sediment loss in the nearshore zone; however the majority of sediment is considered likely to continue to be deposited on the beaches to the north, complemented by artificial beach by-passing as necessary. Implications for the designated sites to the north and south of the proposed harbour location are therefore considered to be minor but cannot be ignored.

Due to its location on the foreshore this option could possibly result in the indirect loss of some of the SPA mudflat and sandflat habitat that extends southwards from Pagham Harbour due to changes in coastal

processes. Consideration will need to be given to the implications of this in relation to the management of Pagham Harbour SPA. Impacts on coastal vegetated shingle at Pagham will also need to be considered.

In addition, the loss of any intertidal habitat would be of potential concern to the Environment Agency and Natural England as it has implications for their targets of no net loss of intertidal habitats. However, it should be noted that the available intertidal habitats at the proposed harbour location are unlikely to support any significant features or, if they do, not in any significant quantities.

This option would require an EIA to be undertaken as part of the planning process and application for consents and approvals.

5.3 Option 2

As this option (without artificial beach by-passing) will significantly impact on sediment supply to the north of the proposed harbour location (see **Section 3**), there is a strong potential for impacts on the sediment supply to Pagham Harbour. A significant risk has also been identified in relation to the long term permanent loss of sediment from the nearshore zone which could have implications for invertebrates in the sediment and larger fauna that may be foraging around this location.

Loss of intertidal habitat (including the proposed SPA) could also be an issue with this option within the footprint of the breakwaters, quay wall and the dredged area, although the available sand / shingle beach quality is thought to be minimal at this location.

This option would require an EIA to be undertaken as part of the planning process and application for consents and approvals.

5.4 Option 3

This option is likely to have a lower potential impact (than Option 2) on the designated sites to the north in the short term due to a minimal anticipated impact on inshore sediment transport. However, it is clear that there are a number of unknowns in this system in terms of both the nearshore, offshore and cross-shore sediment transport pathways, and would be very difficult to ascertain with certainty that there would be little or no indirect impacts in the long term, which is what would be required to gain consent. The loss of infralittoral is likely to be an impact, and consideration will need to be given to the potential for impact on any nearby reef features.

This option would require an EIA to be undertaken as part of the planning process and application for consents and approvals.

6 Land Impacts

6.1 All Options

Due to their different cross-shore locations each of the options have a different impact on the land.

It is recognised that for a viable and thriving harbour ample space is required for quayside developments and at the outset allowance should be made for future growth. Often it takes many years for a harbour of this nature to become fully developed.

For any land encroachment north of the existing slipway, land use would have to be balanced with other demands:

- Green recreational area
- 'Buffer' zone for wave overtopping
- Car and boat park
- Drainage pond

For planning permission from the Council (with jurisdiction down to low water) the following matters would need to be taken into account:

- Land take (e.g. CDC, fishermen's areas, 'public' foreshore)
- Coastal footpath
- Public footpaths
- Traffic & parking
- Flood risk
- Noise
- Light

As owners of the seabed, the Crown Estate is an important stakeholder but would not be part of the regulating process. The Crown Estate will in principle enable the development and would need to lease the footprint of the structures on the foreshore (from below Mean High Water Springs) by way of a lease. The current arrangements with existing tenants / licensees will be taken into account in any new lease. Any lease is granted on the basis that all consents and approvals are in place for the development. The lease can be granted to Chichester District Council as head tenant.

It is vital that the local residents and general public are made aware of any reasonably firm proposed plans as soon as possible so that potential misunderstandings can be avoided and early 'buy-in' can be achieved. Such plans would need to be well presented in order to give a clear representation of the likely impacts, including the positive impacts of having a small harbour and its associated economic benefits.

6.2 Option 1

Of the three options this option has by far the largest impact both in terms of land take and in creating a discontinuity in the 'green' zone immediately behind the seawall.

In terms of land take, the physical proximity of the quayside and mooring basin to the residential area is a critical matter but it should be possible to find an offset distance that would suit all parties involved. Also this option involves the relocation of many of the existing fisheries buildings but this was not seen to be a problem but rather an opportunity for improvement.

The coastal footpath is an important feature and this option would involve a short diversion around the harbour. However, this has the potential to enhance the footpath and coastal access, and should be considered at an early stage.

There are potential issues of noise, odour, light, and vehicle disruption to the local residents from fisheries activities. Careful design and management of the harbour should be able to mitigate these issues. The design of the harbour and the location of its constituent parts should be based on rigorous assessments which should in turn be underpinned by establishing current baseline levels.

6.3 Option 2

This option in effect has a positive impact due to the additional quayside area created in front of the seawall.

6.4 Option 3

This option has a neutral impact as it neither decreases nor increases the available land area. However, the landward approach to the access pier may involve some land take.

7 Visual Impacts

7.1 All Options

The existing ground levels behind the seawall are typically 3 metres above Ordnance Datum. The approximate top level of the existing seawall is 6 metres AOD and the typical proposed top level of the harbour works is 5 metres AOD. Therefore, from behind the seawall at ground level none of the options have a significant visual impact, however there would be an impact on the views from the upstairs of the seafront properties.

When viewed from the seaward side of the seawall all of the options have a significant visual impact although at Mean High Water Spring tide level (2.4 metres above Ordnance Datum) the impact is considerably reduced.

A visual impact assessment would be required to obtain planning permission. This is not perceived to be a major issue but does require the appropriate planning into the programme.

It is vital that the local residents and general public are made aware of any reasonably firm proposed plans as soon as possible so that potential misunderstandings can be avoided and early 'buy-in' can be achieved. Such plans would need to be well presented in order to give a clear representation of the likely impacts.

7.2 Option 1

This option to some extent blends in with the existing topography and existing groyne field. However, the landward quay wall is close to and approximately 2 metres above the road level and is therefore visually intrusive.

7.3 Option 2

This option represents a major change to the foreshore landscape. At high tide the visual impacts would be modest. At low tide the harbour structure would protrude upwards and seawards resulting in a considerable visual impact. However, the side slopes and surface texture of the breakwaters could soften the visual impact.

7.4 Option 3

This option represents a major change to the nearshore landscape. At high tide the visual impacts would be modest. At low tide the harbour structure would protrude upwards resulting in a considerable visual impact. However, the side slopes and surface texture of the breakwaters could soften the visual impact.

8 Sea Defence Impacts

8.1 All Options

The sea defences along East Beach comprise a shingle beach controlled by timber groynes with a concrete seawall at the back of the foreshore. For the frontage in question the land behind is low lying and therefore the sea defences act as a flood defence.

Drainage of the low lying area is managed by a pond and tidal outfall located to the north of the harbour.

Although the current defences are performing satisfactorily their structural factor of safety and standard of protection are borderline. Under extreme conditions the seawall can overtop. The green area immediately behind the seawall currently acts as a 'buffer' zone during such incidents.

The Coastal Defence Strategy for this frontage is 'Hold the Line' to a 'Sustain' standard which involves raising and strengthening the defences to suit sea level rise thereby maintaining the same level of protection against flooding.

Each of the options provides a net improvement to the local sea defences both by virtue of their presence and the opportunities they bring for including modest additional measures to improve the situation. Such improvements may well go beyond what is required or fundable from Flood Defence Grant in Aid.

8.2 Option 1

For this option the piers act as an outer defence thereby creating more sheltered conditions at the land interface. This option also generates surplus excavation material that could be used to improve the sea defences elsewhere along this frontage.

Although the piers are largely contained within the existing groyne field, and will perform in a similar way, there is still likely to be some natural reduction in the beach levels to the north of the harbour. Also the vertical nature of the piers has the potential to cause local beach drawdown due to wave reflection but this can be attenuated as discussed in Section 3. It is anticipated that beach by-passing will be necessary to compensate for the increased disruption to the sediment transport.

This option encroaches into the low lying area and therefore due consideration will need to be given to land drainage matters.

8.3 Option 2

For this option the rock structures act as both an offshore breakwater and a substantial groyne. These will create more sheltered conditions at the land interface of the harbour and result in a larger beach, and therefore improved defences, to the south of the harbour.

However, the rock structure will also give rise to a natural reduction in the beach levels to the north of the harbour, which in turn will reduce the performance of the sea defences. To maintain the sea defences it will be necessary to artificially recharge the beach probably by by-passing beach material from south of the harbour to north of the harbour.

8.4 Option 3

For this option the rock structure acts as an offshore breakwater which creates more sheltered conditions at the adjacent coastline. Due to its detached nature it has less effect on the beach levels to the north and south of the harbour, and by careful positioning of the harbour and careful management of the local groyne field it should be possible to keep these effects to a minimum.

9 Silting Up

9.1 All Options

The existing bathymetry of the mooring basin within the harbour will be deepened to a level of 4 metres below Ordnance Datum. The depression formed by the dredge will create extra accommodation space and a potential sink for deposition of sediment. Given the enclosed nature of the harbour and its relatively small entrance, and the lower energy environment created by this enclosure, it means that siltation is more likely to occur as a result of deposition of sediment settling out of suspension (rather than as bedload transported sediment). The magnitude of siltation will depend on suspended sediment concentrations in the water entering the harbour and the settling velocity that is achieved within the harbour.

Siltation rates on the intertidal areas in Pagham Harbour (the much larger natural tidal embayment north of Selsey) have been between about 4mm/year and 8mm/year over the 20th century. Sediment is imported into Pagham Harbour from offshore during the flood tide and storm events, after which deposition takes place within the landward sheltered environments. It is possible that accretion rates of this magnitude could take place in the proposed harbour at Selsey if the conditions dictate. Given the similar orientations and sizes of the three options, the siltation rates in each are likely to be similar.

For later studies Brighton Marina may be a useful reference for siltation rates.

9.2 Option 1

In terms of silting up there are no significant unique issues that apply to this option.

9.3 Option 2

In terms of silting up there are no significant unique issues that apply to this option.

9.4 Option 3

In terms of silting up there are no significant unique issues that apply to this option.

10 Seaweed Pollution

10.1 All Options

This stretch of coast is prevalent to receiving large quantities of decaying seaweed deposited on the beaches due to a combination of the high biodiversity of infralittoral and, strong currents and wave action (Jolley, 2008[1]). This is a natural phenomenon and typically the seaweed is deposited along what is known as the 'strandline' along the high water mark. In small quantities this is not regarded as an issue as it is usually washed back offshore in the next few tidal cycles. If longshore drift and wave action are interrupted, i.e. by defences or other man-made structures, this can result in the trapping of seaweed on beaches, as the wave and tidal action is not strong enough to remove the algae. This thereby results in the stagnation of decaying seaweed on the beach, and if this occurs during the summer and autumn months, the summer temperatures increase the rate of decay, which can then cause an excessive release of sulphurous gas and natural oils as the seaweed decays and the underlying sediments on the beach become anoxic, resulting in a very unpleasant odour. Depending on the proximity of residential or commercial properties this could be a serious nuisance and impact upon local activities.

The relevance of this natural phenomenon to this consultation is ensuring that detailed planning and design takes into consideration the risk of enhancing seaweed deposition and entrapment, and also considers any necessary measures to reduce this risk.

Seaweed pollution has been a problem at a number of harbours, such as Ventnor Harbour on the Isle of Wight and Elizabeth Harbour on Jersey. If this occurs, it can cause significant unpleasant odour in often tourist areas, result in the requirement of difficult and sometimes expensive removal techniques and the requirement to dispose of the waste in a licensed manner. It may not be possible to prevent this phenomenon, however if it is known to be a problem during the design and planning phase, the risk can be factored in by modifying the harbour's design and understanding the costs for any removal requirements to ensure the harbour is cost effective.

As stated in **Section 9**, the options have the potential to attract deposition of silt, and therefore this will be the same for deposition of detached seaweed. However, based on the modest rate of siltation at Pagham Harbour the problem of seaweed pollution should be reasonably manageable. The degree of the problem is not likely to be that different between the three options, as the main difference is the cross-shore location, rather than the orientation or any difference in function. Therefore these options, if there is an existing seaweed pollution problem in the area already, is likely to result in some build-up of seaweed on the basin floor.

The potential for seaweed deposition is not thought to be a problem as there is little knowledge of Selsey beach suffering (presently or historically) from significant deposits of seaweed, nor around the Selsey Lifeboat Station either. It is however advised that there are significant deposits west of Selsey and around Pagham, and further to the east towards Bognor Regis and Littlehampton. Furthermore, there are no reefs immediately offshore of Selsey, and the only seaweed that was commented upon was large brown algae such as kelp and oarweed. It would seem that this is not a factor that requires significant consideration as part of the design process. It would be prudent though to undertake a small amount of research (through a data review) to determine whether what has been discussed through consultation has been documented for evidence.

[1] *Jolley, E.C. (2008). The Role of Coastal Defence Structures in Channeling Production in Coastal Ecosystems. Thesis for the degree of Doctor of Philosophy. University of Southampton. June 2008.*

10.2 Option 1

Of the three options this would have had the potential to be the least effected by any build-up of seaweed because of the use of vertical sided piers rather than rock breakwaters. They are likely to increase the flushing effect of the ebb tides and they lack horizontal surfaces and local recesses where seaweed can be trapped.

10.3 Option 2

For this option there are more significant changes to the longshore drift, and therefore this could result in the deposition of algae along and within the outside edges of the breakwaters.

10.4 Option 3

Although this option allows longshore drift to continue, the reduction of waves allowed to reach the beach behind the harbour may result in the trapping of seaweed between the existing groynes as it is washed in. If the currents and waves are not strong enough to pick up and carry off any deposited materials, there would be the potential for seaweed pollution effects to occur.

11 Internal Wave Heights

11.1 All Options

The wave heights occurring within the harbour are mainly a function of the incoming wave energy through the harbour entrance and the reflective nature of the internal harbour walls, although the shape of the harbour also has some influence, where asymmetrical harbours tend to produce less resonance. For each of the three options the incoming wave energy is similar but the reflected waves would differ.

In order to allow for the safe mooring, loading and unloading of vessels, wave heights within the harbour need to be kept as small as possible and probably to a maximum of 300mm.

It is not anticipated that achieving the required internal wave heights will be an insurmountable problem as the configuration of the harbour, its entrance and internal surfaces can be designed to minimise wave heights.

11.2 Option 1

For this option the potential degree of wave reflection is likely to be high due to the presence of vertical sided structures along each edge of the harbour. However, the problem can be reduced by using an asymmetrical configuration and structures with a porous face which reduce the amount of wave reflection by partially absorbing wave energy.

11.3 Option 2

For this option the problem of reflected waves is considerably reduced due to the use of porous rock breakwaters with side slopes which would have the capacity to absorb most of the incident wave energy. However, the vertical quay wall along the landward edge would result in some wave reflection.

11.4 Option 3

For this option there is likely to be a negligible problem with wave reflection due to the full construction in rock breakwaters.

12 Sea Access

12.1 All Options

For the harbour entrances, the orientation, minimum width and seabed levels are identical or very similar for all three options.

From experience of launching from the frontage it has been found that sea conditions from the South / South East can be particularly difficult and therefore the harbour entrance should avoid facing this direction. A harbour entrance facing North East is probably the best solution especially when taking into account sediment transport issues.

However it is accepted that there are still likely to be prevailing conditions that prevent safe negotiation of the harbour entrance regardless of its orientation. If access is restricted by approximately 40 days a year this would be acceptable to the local fishing industry.

It is recognised that a relatively narrow harbour entrance, as currently shown, can be more demanding for recreational users.

During low tides, if access into the harbour is restricted for a maximum of between 2-3 hours this would be acceptable to the local fishing industry.

To accommodate access issues the local fishermen would probably maintain their 'offshore' moorings.

12.2 Option 1

The entrance is between two vertically sided pier structures, and the entrance width remains constant for all states of the tide. The pier structures will give rise to some wave reflection which may well make navigation of the entrance more difficult under certain wave conditions. Also proximity to the shoreline will make wave conditions more difficult to negotiate.

It is recognised that wave absorbing features at the entrance will almost certainly be necessary in order to achieve the required level of all-year round accessibility.

12.3 Option 2

The entrance is between two rock breakwaters with side slopes. Although the entrance width at seabed level is the same for all options, with the rock breakwaters the effective width increases with higher tide levels. Also due to their porous nature the breakwaters will absorb wave energy and considerably reduce any local wave reflection.

12.4 Option 3

The harbour entrance arrangements are very similar to Option 2. Although the entrance for Option 3 is further offshore, the seabed levels on the approach remain very similar and therefore conditions at the entrance are also likely to be very similar.

13 Land Access

13.1 All Options

In terms of access to the seafront through the town there is no difference between the three options.

There is a potential issue with traffic flow and access to the harbour along the local roads as the presence of the harbour will increase usage. Also there is a general need for an improved access to the harbour facility especially to accommodate heavy goods vehicles.

In addition, holding facilities and manoeuvring space will be required for heavy goods vehicles using the processing plant. Only 10% of the throughput is directly from the sea via the Selsey fishermen, the rest is brought in by road from elsewhere.

With regards to the on-site issues it is anticipated that the harbour can be designed so that potential problems can be dealt with. This may include moving the preliminary concept boundaries.

13.2 Option 1

By virtue of the landward encroachment of the harbour this is the most accessible of all the options, both for fisheries and recreational purposes.

13.3 Option 2

This option allows ongoing use of the two access routes alongside the fisheries compounds. This may give rise to issues with residential neighbours and early consultation with the residents is important.

13.4 Option 3

Of the three options this option has the most restricted access due to the need for a pier structure from the shoreline to the harbour.

Also there may be issues with the height of the pier above the foreshore and it may prove necessary to raise its level to improve foreshore access. However, this could lead to further complications with the pier structure.

14 Renewable Energy

14.1 All Options

The ability to utilise renewable energy to 'self-power' the harbour is a key objective for the operation of the harbour.

In terms of being able to harvest energy from tidal water entering and leaving the harbour, the available energy largely depends on the size of the tidal storage of the harbour and the tidal range. At Spring tide the total energy (assuming 100%) extraction of tidal water would be less than 300 kWh per day given the relatively small size of the harbour. The energy consumption of a typical UK family is 12 kWh per day. Assuming 10% energy can be extracted from the tidal water, it means a tidal turbine would provide energy for 2.5 households. Although this is not significant it may well be sufficient to 'self-power' say the lighting requirements of the harbour.

The ability to harvest wave energy may be feasible and would need further investigation.

The ability to harvest solar energy would be possible, but it will probably be necessary to use rooftops to avoid land take.

The ability to harvest wind energy would be possible but there would be a significant visual impact and an adverse impact on birds. This would most likely not be acceptable to the regulators.

The ability to harvest geothermal cannot be ruled out and would need further investigation.

14.2 Option 1

In terms of renewable energy there are no unique aspects that apply to this option.

14.3 Option 2

In terms of renewable energy there are no unique aspects that apply to this option.

14.4 Option 3

In terms of renewable energy there are no unique aspects that apply to this option.

15 Aquaculture

15.1 All Options

Chichester District Council are keen to explore opportunities to co-locate aquarium production within the proposed harbour and therefore maximise the economic return for the local area.

Shellfish is usually farmed in UK waters in one of two ways: suspended on supporting structures or confined in nets or cages in lakes or coastal waters. The type and intensity of farming depends on the species and on market demand. The most commonly cultivated shellfish species are described below:

- **Oysters** are common in the UK in both pacific and native species. Oyster production techniques depend on factors including seed supply, environment and region, and can be either entirely sea-based or rely on hatcheries for seed supply.
- **Mussels** can be harvested from either wild or cultivated stocks. They can be grown either on the seabed or on ropes. Mussels grown in different environments will have different characteristics in terms of meat content, shell strength, shelf life etc.
- **Clams** have so far had limited success as a cultivated species. Only a very small number of Manila clams are grown in the UK.
- **Scallops** are cultivated widely across the UK, particularly in king and queen varieties though this site is unlikely to be suitable due to the lack of water depth and suitable substrate.

The table below summarises the key requirements of the different shellfish species along with an overview of the growing techniques recommended by Seafish (2015)[2] and key factors for consideration.

Species	Physical Requirements	Growing Techniques	Key Factors
Oyster	Seawater temperature above 8°C for most of the year; salinity above 30ppm; area sheltered from extreme tidal flows and wave action; tidal flow of 1-2 knots preferable	Usually grown on the seabed or on mats laid on very soft substrate; alternatively grown in mesh bags of varying sizes as the oysters grow.	Cannot cope with high silt burden or poor water exchange leading to reduced oxygen levels; prefers high levels of water flow for food supply
Clam	Seawater temperature above 8°C for most of the year; salinity above 25ppm; intertidal and sub-tidal locations are best; tidal flow of 1-2 knots preferable	Clams live buried in the substrate; survival is better in sand or gravel substrates but it is possible to grow them in muddy areas too.	Take at least 3 years to reach harvest size
Mussel	Seawater temperature above 8°C for most of the year; salinity above 20ppm; tidal flow of 1-2 knots preferable	Can be grown on any substrate they can gain anchorage to, or on ropes suspended from rafts/pontoons	Water depths in excess of 12 m at extreme low water on spring tides are preferable, although shallower sites can also be utilised.

In reality, the enclosed nature of the harbour would limit any aquaculture to shellfish growth as there is unlikely to be sufficient water movement for the successful farming of mobile fish or crustacean species. More importantly, aquaculture on the scale mentioned above would require considerable planning and consent, and is likely to be a competitive business for the fishermen rather than complimentary. Furthermore,

[2] www.seafish.org 'Key Documents for Culturists' 2015

it more often than not causes environmental degradation and is unlikely to be accepted in an environmentally sensitive area such as Selsey / Pagham.

Another option is the potential for seaweed aquaculture, which is a large sector in France. This would require further investigation in the future, though due to the environmental designations in the area, it would potentially be quite difficult unless it was shown to be a 'sustainable' business.

In reality the type of business that would be better suited to the proposed development, would be the presence of an education / aquarium centre that was in collaboration with the fishermen (e.g. sourcing species in accordance with legislation). This would bring tourism to the area, alongside education, which would allow various different grants to be sought. This idea is viable and could be investigated further for all the options below.

If it was still regarded as being something Selsey want to invest into then advice should be sought from Seafish on the viability of pursuing aquaculture options within the proposed harbour when more is known about the detailed design. Advice from www.seafish.org recommends avoiding areas close to boatyards, marinas, industrial developments or large urban areas to minimise the risks from pollutants or other anthropogenic inputs. Potential inputs from within the wider water catchment area (eg land-based farming activity, both arable and livestock, forestry, horticulture, chemical industry etc) should also be investigated.

15.2 Option 1

At this stage there are no obvious unique aspects that apply to this option.

15.3 Option 2

At this stage there are no obvious unique aspects that apply to this option.

15.4 Option 3

At this stage there are no obvious unique aspects that apply to this option.

16 Ground Conditions

16.1 All Options

Given the amount of existing works that are performing satisfactorily, including piled structures and gravity structures, it is not anticipated that there will be any major difficulties with the proposed works. Also, the rock breakwaters are in a flexible form of construction and have a large footprint, both of which should reduce the likelihood of geotechnical problems arising.

However, it is known that the ground conditions are variable along the frontage including the presence of made ground and low lying areas. Therefore detailed ground investigations would be advisable before any significant design work is undertaken. For preliminary design work a desk study should be sufficient.

16.2 Option 1

The main potential issue with this option is the relatively close proximity (30 metres) of the landward quay wall to the seafront residential properties along Kingsway (road). However, it is anticipated that careful attention to the detailed design should be able to overcome any difficulties arising. It is believed that the properties are constructed on strip foundations.

16.3 Option 2

The main potential issue with this option is the need to support the existing seawall by means of the new quay wall in order to allow the mooring basin to be dredged down to its design level. However, again it is anticipated that careful attention to the detailed design should be able to overcome any difficulties arising.

16.4 Option 3

The main challenge for this option is the access pier from the shoreline to the rock breakwater. However, a not dissimilar structure has been in operation at the nearby lifeboat station for some decades and therefore no major difficulties are anticipated.

17 Development Costs

17.1 All Options

These costs relate to the development of the scheme from this preliminary consultation stage up to obtaining all of the necessary permissions and licences ready for detailed design and construction.

These costs include the following:

- Initial site investigation;
- Numerical modelling;
- Development of preferred concept option;
- Development of outline design;
- Method statements;
- Environmental reporting;
- Stakeholder consultation; and
- Consent applications.

The initial site investigation would include further data collection in respect of the bathymetry and possibly the commissioning of a new survey. However it is understood that the Channel Coastal Observatory have already planned to undertake a new survey and it may be necessary to ask them to bring it forward to suit this project.

These costs focus on the actual construction of the harbour itself and do not include such matters as the business case, obtaining the necessary funds, and putting in place the management arrangements for the operation of the harbour.

The development costs for each of the options is reasonably similar although Option 2 is likely to be the most costly due to its higher impacts on the environment and the need for a higher level of analysis. For different sizes of mooring basin there is unlikely to be any significant differences in the costs involved.

17.2 Option 1

The development costs are as follows:

- £250K - £500K

17.3 Option 2

The development costs are as follows:

- £300K - £600K

17.4 Option 3

The development costs are as follows:

- £250K - £500K

18 Construction Costs

18.1 All Options

The construction costs relate to the following:

- Further site investigation;
- Detailed design;
- Construction project management;
- Construction works;
- Health and safety management;
- Site supervision, and
- Temporary accommodation works for beach users.

The construction works themselves represent the largest element of the costs. These are heavily influenced by the nature of the works. In particular a rock breakwater compared with a vertical sided solid pier that performs a similar function is very approximately three times more expensive. This is due to a number of factors including a much longer lifespan and a much better hydraulic performance.

For this reason Option 1 is the lowest cost option by a significant margin. Option 3 is the highest cost option due to the full use of rock breakwaters and its 'offshore' location.

For the cost variations of larger and smaller mooring basins it is assumed that 30% of the base-line cost is fixed and the remaining 70% is proportional to the number of berths.

18.2 Option 1

The construction costs are as follows:

- 75 berths £8M - £13M
- 50 berths £6M - £10M
- 100 berths £10M - £16M

18.3 Option 2

The construction costs are as follows:

- 75 berths £15M - £24M
- 50 berths £12M - £19M
- 100 berths £19M - £30M

18.4 Option 3

The construction costs are as follows:

- 75 berths £23M - £37M
- 50 berths £18M - £29M
- 100 berths £28M - £45M

19 Operational Costs

19.1 All Options

These costs relate to the 'technical' operation of the harbour and include:

- Maintenance of the structures;
- Maintenance of the pontoons;
- Artificial bypassing of beach material, and
- Periodic dredging.

The costs relate to the average annual maintenance over the short term (10 years).

Management costs of the harbour such as supervision, administration, services charges, Crown Estate fees etc are not included. Also longer term maintenance costs are not included which could include periodic refurbishment costs especially where steel sheet piling is used.

On balance and within the defined tolerances the operational costs are broadly similar for each option and for each size of mooring basin.

19.2 Option 1

The average annual short term maintenance costs are as follows:

- £150K - £300K

19.3 Option 2

The average annual short term maintenance costs are as follows:

- £150K - £300K

19.4 Option 3

The average annual short term maintenance costs are as follows:

- £150K - £300K

20 Conclusions

Of the various topics discussed in this consultation document coastal processes (in particular sediment transport) is by far the most critical, especially in respect of obtaining the necessary permissions and licences. The main concern is the interruption of sediment transport from the south to the north of the new harbour and the impact on Pagham Harbour which is a very important natural conservation area. Also an interruption in the sediment transport would have an adverse impact on the coastal defences to the north of the new harbour and eventually onwards to the east.

For this reason, the land based harbour is seen as the most favourable option because it has the lowest impact on sediment transport.

In addition, it is recognised that the coastal processes between Selsey Bill and Pagham Harbour are complex with a number of uncertainties, and for this reason is it considered advisable to avoid as far as possible construction in the nearshore zone.

However, it is also recognised that the land based option may still have some impact on sediment transport due to its encroachment into the foreshore zone. Although this can be minimised by reducing the footprint within the groyne field as far as possible, it is still anticipated that regular beach by-passing will be required to avoid any reduction in beach feed to the north.

Beach by-passing may also be required to reduce the risk of beach material building up in front of the harbour entrance thereby reducing its navigable depth.

Any reduction in the footprint of the harbour within the groyne field will involve a greater encroachment into the East Beach Green area and a more elongated mooring basin.

With regards to the other topics under consideration these are seen to be far less critical and those of any significance should be manageable by careful design. Of the more significant, the two most notable are land impacts and sea access.

For land impacts, the landward boundary of the harbour will need to be reasonably clear of the adjacent residential properties in order to keep the impacts to an acceptable level. This should be achievable by leaving sufficient space and by suitable landscaping.

For the sea access, the harbour entrance will need to be carefully designed in order to maximise its accessibility under a range of operating conditions. Beach by-passing may have a critical role to play in this regard.

Having reached the above conclusions there is now a need to examine more closely the key issues especially where there is a degree of uncertainty. A next stage modest feasibility study could include the following:

- A review of the available bathymetric data due to some uncertainties concerning the accuracy of the information currently being used.

- Numerical modelling of the cross-shore sediment transport distribution in order to gain a better understanding of the relative foreshore and nearshore shingle movement.

- A review of the location, orientation, configuration and nature of the harbour entrance in order to maximise its accessibility under a range of operating conditions.
- A review of the feasibility and acceptability of regular beach by-passing from the south side of the harbour to the north side.
- A review of the ground conditions due to their variable nature and the impacts of deep excavations for the mooring basin.
- A review of the feasibility and acceptability of constructing the harbour close to a residential area.
- The preparation of a preliminary business case for the development, construction and operation of the harbour in order to determine its optimum size and capacity. The business case would include an update of the costs based on the additional information available. Operational matters would include associated cafés, shops, fish retail outlets and other businesses.
- The preparation of an updated concept layout plan of the harbour taking into account the above investigations.

As far as possible the feasibility study will be based on existing available data. The need to collect new data will be identified in the study with recommendations for the following stage as appropriate. These recommendations will take into account latest developments in this area.

Subject to a satisfactory outcome from the above feasibility study it is anticipated that the following stage would be to proceed to a scoping study and formal consent applications together with supporting technical, environmental and economic reports. This would include the development of an outline design that would go into greater detail and take into account other issues such as sea level rise, internal layouts, and associated infrastructure. It would also take into account long term issues relating to the coastline and the development of the Manhood Peninsula.

It is vital that the local residents and general public are made aware of any reasonably firm proposed plans as soon as possible so that potential misunderstandings can be avoided and early ‘buy-in’ can be achieved. Such plans would need to be well presented in order to give a clear representation of the likely impacts, both positive and negative.

Appendix - Drawings

DO NOT SCALE

Pagham Harbour

Selsey

SELSEY CP

Norton

Church Norton

B2146

SLIPWAY
SURFACE WATER OUTFALL
EAST BEACH GREEN
SLIPWAY
FISHERIES COMPOUND
SLIPWAY
FISHERIES COMPOUND
LIFEBOAT STATION
(DUE FOR REDEVELOPMENT
AS SHORE-BASED FACILITY)

E37
E31
E25
E19
E13
E7

250m 0 500m 1km

SCALE IN METRES
1:12,500

GENERAL NOTES

1. ALL DIMENSION ARE IN METRES.
2. ALL LEVELS ARE IN METRES RELATIVE TO ORDNANCE DATUM.
3. TIDE LEVELS :-
   MHWS = +2.4
   MLWS = -2.3

LEGEND

- E19 GROYNE Ref. No.
- APPROX PROPOSED LOCATION FOR SELSEY HAVEN HARBOUR
- SSSI CONSERVATION AREA
- SSSI, SPA & RAMSAR CONSERVATION AREAS

REV	DATE	DESCRIPTION	BY	CHK	APP

REVISIONS

CLIENT

CHICHESTER DISTRICT COUNCIL

PROJECT

SELSEY HAVEN PRELIMINARY CONCEPTS

TITLE

LOCATION PLAN

Burns House, Harlands Road
Haywards Heath, RH16 1PG
Tel: +44(0)1444 458551
Email: info@rhdhv.com
www.royalhaskoningdhv.com

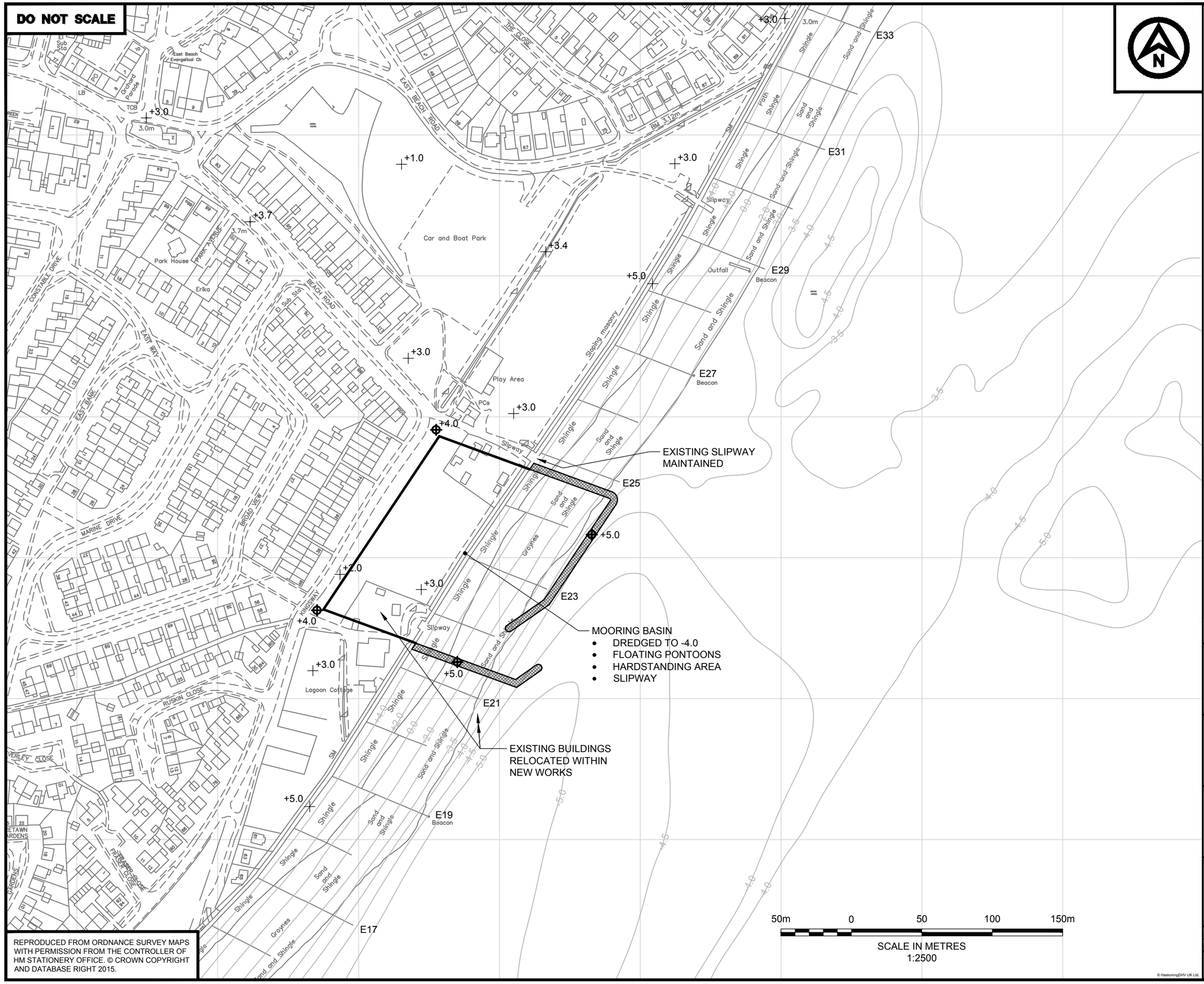
Royal HaskoningDHV
Enhancing Society Together

DRAWN	CHECKED	APPROVED
A.I.K	TG	SPH
DATE	SCALE AT A3	REF.
15.10.2015	1:12,500	PB3807-0001

DRAWING No. PB3807/0001

REVISION

DO NOT SCALE



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50m 0 50 100 150m

SCALE IN METRES
1:2500

GENERAL NOTES

1. ALL DIMENSION ARE IN METRES.
2. ALL LEVELS ARE IN METRES RELATIVE TO ORDNANCE DATUM.
3. FORESHORE AND NEARSHORE LEVELS OBTAINED FROM CHANNEL COASTAL OBSERVATORY.
4. TIDE LEVELS :-
   MHWS = +2.4
   MLWS = -2.3
5. MOORING BASIN TO ACCOMMODATE 25 No. 15m LONG CRAFT AND 50 No. 10m LONG CRAFT.

LEGEND

- E27 — GROYNE Ref. No.
- -3.0 — APPROX FORESHORE AND NEARSHORE CONTOUR
- +3.7 — APPROX EXISTING LEVEL
- +5.0 — APPROX PROPOSED LEVEL
- VERTICAL QUAY
- VERTICAL SIDED SOLID PIER

PRELIMINARY CONCEPT TO INDICATE GENERAL LOCATION, SIZE AND TYPE OF CONSTRUCTION

CLIENT
CHICHESTER DISTRICT COUNCIL

PROJECT
SELSEY HAVEN PRELIMINARY CONCEPTS

TITLE
OPTION 1 PLAN LAND BASED HARBOUR

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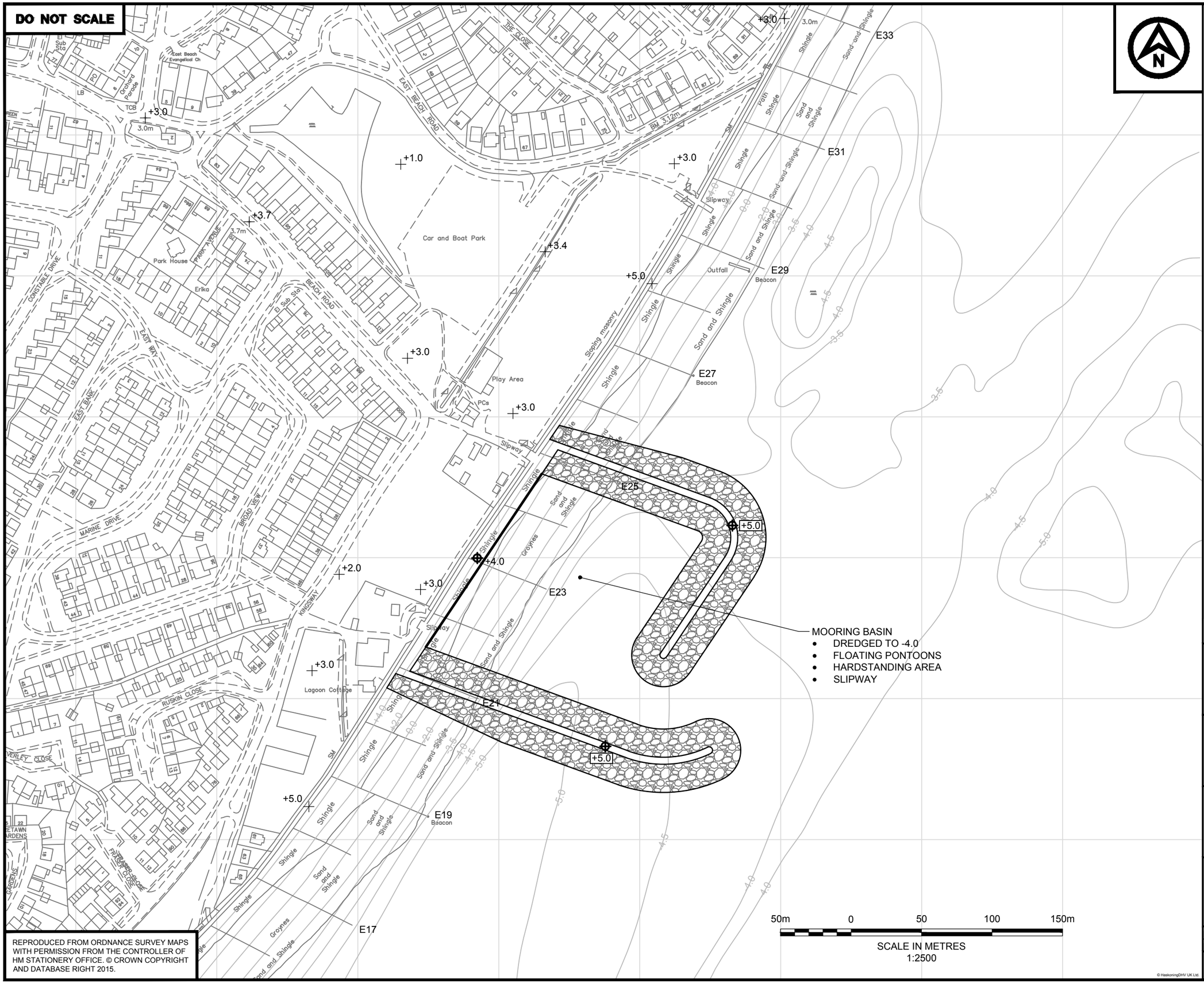
DATE 18.11.2015	SCALE AT A3 1:2500	REF: PB3807-0002

DRAWING No. PB3807/0002 REVISION D1

DO NOT SCALE



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GENERAL NOTES

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2. ALL LEVELS ARE IN METRES RELATIVE TO ORDNANCE DATUM.
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4. TIDE LEVELS :-
   MHWS = +2.4
   MLWS = -2.3
5. MOORING BASIN TO ACCOMMODATE 25 No. 15m LONG CRAFT AND 50 No. 10m LONG CRAFT.

LEGEND

- E27 — GROYNE Ref. No.
- -3.0 — APPROX FORESHORE AND NEARSHORE CONTOUR
- +3.7 — APPROX EXISTING LEVEL
- +5.0 — APPROX PROPOSED LEVEL
- VERTICAL QUAY
- VERTICAL SIDED SOLID PIER
- ROCK BREAKWATER WITH ROCK OR CONCRETE CREST

PRELIMINARY CONCEPT TO INDICATE GENERAL LOCATION, SIZE AND TYPE OF CONSTRUCTION

CLIENT
CHICHESTER DISTRICT COUNCIL

PROJECT
SELSEY HAVEN PRELIMINARY CONCEPTS

TITLE
OPTION 2 PLAN FORESHORE HARBOUR

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Royal HaskoningDHV
Enhancing Society Together

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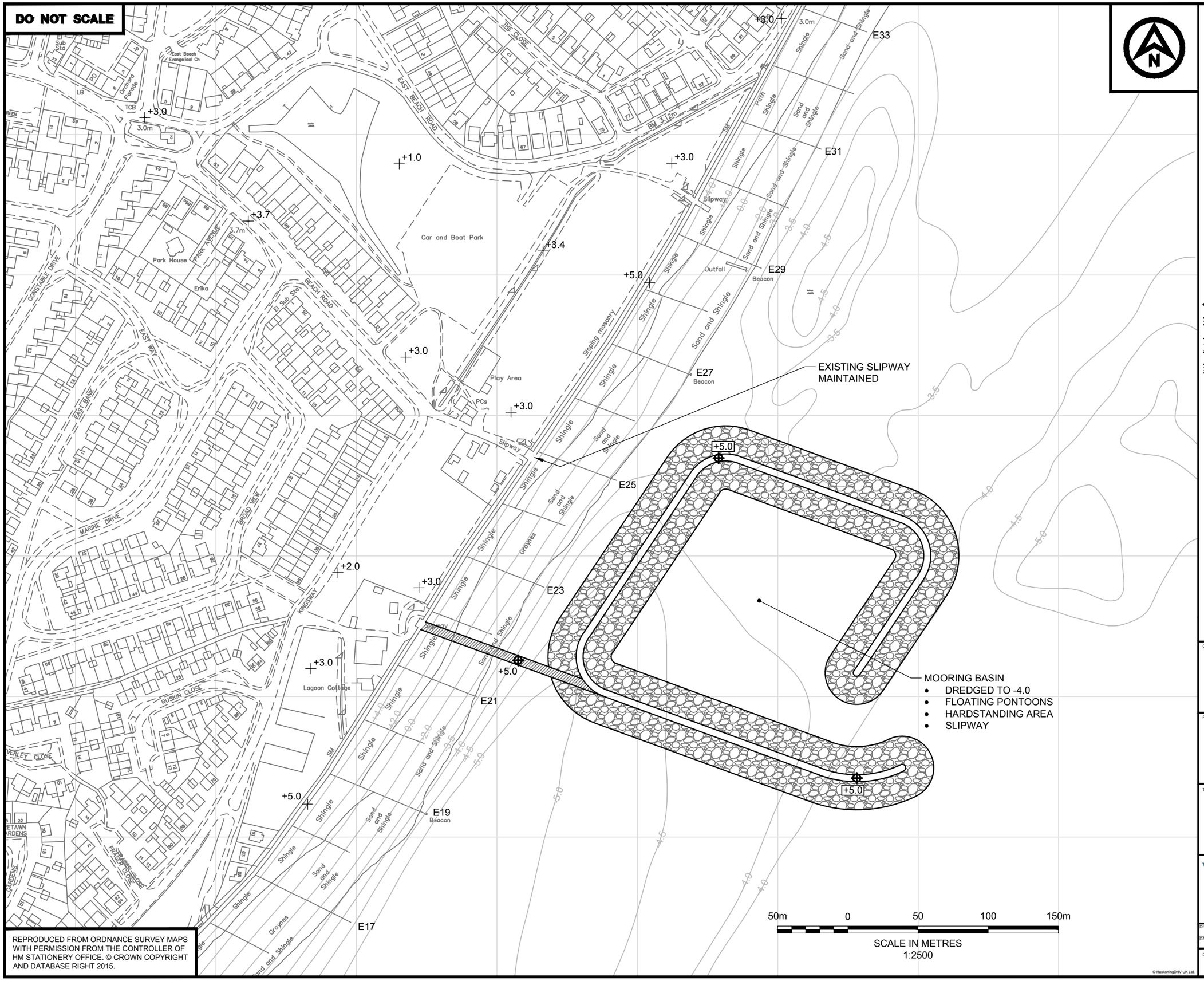
DO NOT SCALE



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GENERAL NOTES

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2. ALL LEVELS ARE IN METRES RELATIVE TO ORDNANCE DATUM.
3. FORESHORE AND NEARSHORE LEVELS OBTAINED FROM CHANNEL COASTAL OBSERVATORY.
4. TIDE LEVELS :-
   MHWS = +2.4
   MLWS = -2.3
5. MOORING BASIN TO ACCOMMODATE 25 No. 15m LONG CRAFT AND 50 No. 10m LONG CRAFT.

LEGEND

- E27 — GROYNE Ref. No.
- -3.0 — APPROX FORESHORE AND NEARSHORE CONTOUR
- +3.7 — APPROX EXISTING LEVEL
- +5.0 — APPROX PROPOSED LEVEL
- VERTICAL QUAY
- VERTICAL SIDED SOLID PIER
- ROCK BREAKWATER WITH ROCK OR CONCRETE CREST
- OPEN PIER (ON PILES)

PRELIMINARY CONCEPT TO INDICATE GENERAL LOCATION, SIZE AND TYPE OF CONSTRUCTION

CLIENT
CHICHESTER DISTRICT COUNCIL

PROJECT
SELSEY HAVEN PRELIMINARY CONCEPTS

TITLE
OPTION 3 PLAN NEARSHORE HARBOUR

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Royal HaskoningDHV
Enhancing Society Together

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DATE: 18.11.2015	SCALE AT A3: 1:2500	REF: PB3807-0004

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