SOUTH HAYLING ISLAND BEACH MANAGEMENT PLAN 2017 - 2022

Technical Report

Working together - protecting our coastline

January 2017

Havant BOROUGH COUNCIL

EASTERN SOLENT | COASTAL PARTNERSHIP

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Project Name	**South Hayling Island Beach Management Plan**
Author(s)	**Samantha Cope (PM) and Emily Last**
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Reference	**SHBMP1722_TechReport**
Prepared by	**Samantha Cope (PM) and Emily Last**
Checked by	**Clare Wilkinson (BMA Project Manager)**
Date/initials check	**CW 20/01/2017**
Approved by	**Andrew Pearce (PE)**
Date/initials check	**AP 20/01/2017**

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GLOSSARY AND ACRONYMS

Term	Definition
Alarm Level	The level pre-cedes (and is less severe than) the Crisis Level. This is usually a predetermined threshold where the monitored beach parameter (e.g. beach crest level or volume) falls to a value within the range defined. Increased monitoring would be required when an Alarm Level is compromised and intervention undertaken if deemed necessary. Managing Alarm Levels can be planned in advance.
Accretion	Accumulation of sediment due to the natural action of waves, currents and wind.
APO	Annual probability of occurrence. The chances of a flood of a certain magnitude happening in any given year, as a percentage. For example, a 1 in 100 year flood as a 1% APO.
ATT (Admiralty Tide Table)	.Daily times and heights of tidal high and low waters.
Backwash	The seaward return of the water following the up-rush (swash) of the waves. For any given tide stage the point of farthest return seaward of the backwash is known as the limit of backwash. For destructive waves backwash is stronger than swash, and vice-versa for constructive waves.
BAP (Biodiversity Action Plan)	A strategy for conserving and enhancing wild species and wildlife habitats in the UK.
Barrier Beach	A sand or shingle bar above high tide, parallel to the coastline fronting a low-lying hinterland or lagoon.
Beach	A deposit of non-cohesive material (e.g. sand, gravel) situated on the interface between dry land and the sea (or other large expanse of water) and actively 'worked' by present day hydrodynamic processes (i.e. waves, tides and currents) and sometimes by winds.
Beach Bypassing	The transfer of material from areas of accretion, usually updrift of shoreline structures (which have interrupted longshore drift) to downdrift areas of eroding shoreline.
Beach Nourishment	A term to describe the addition of material to areas of eroding shoreline, encompassing beach bypass, recharge and recycling.
Beach Profile	Cross-section perpendicular to the shoreline, usually repeatedly surveyed (from the same start point and bearing) for regional monitoring purposes, or used to describe the 1-dimensional characteristics of a beach. A profile typically extends seawards from any selected point on the landward side or top of the beach into the nearshore.
Beach Recharge	Artificial process of replenishing a beach with material from another source outside of the local littoral system.
Beach Recycling	The movement of sediment along a beach area, typically from areas of accretion to areas of eroding shoreline within the same littoral system.
Beach Re-profiling	The shaping of the beach profile to have a desired crest height, width or slope.

Term	Definition
BMP (Beach Management Plan)	. This provides a basis for the management of a beach primarily for coastal defence purposes, taking into account coastal processes and the other uses of the beach.
Breaching	Lowering (often termed failure) of the beach crest or other coast protection structure due to hydrodynamic loading (e.g. extreme sea level or waves) allowing increased overtopping or even flooding of the hinterland.
BODC (British Oceanographic Data Centre)	The British Oceanographic Data Centre (BODC) is a national facility for looking after and distributing data concerning the marine environment.
CCC (Canterbury City Council)	Coastal Operating Authority as defined under the Coast Protection Act 1949 with permissive powers to provide defence against coastal erosion.
CCO (Channel Coastal Observatory)	Based at the National Oceanography Centre in Southampton, the CCO are responsible for the distribution of data collected through the South-East Strategic Regional Coastal Monitoring Programme.
CHIMET	Nearshore metocean, wave and water level station from Chichester Bar Beacon approximately 0.5 miles out to sea from Chichester Harbour entrance.
CIRIA (Construction Industry Research and Information Association)	As a neutral, independent and not-for-profit body that aims to link organisations with common interests and facilitate a range of collaborative activities that help improve the industry.
Coastal Protection Act (1949)	An Act to amend the law relating to the protection of the coast of Great Britain against erosion and encroachment by the sea; to provide for the restriction and removal of works detrimental to navigation; to transfer the management of Crown foreshore from the Minister of Transport to the Commissioners of Crown Lands; and for purposes connected with the matters aforesaid [24th November 1949].
Climate Change	Long term changes in climate. The impact of climate change along the coast is usually associated with changes in sea level and wave climate
Coastal squeeze	The reduction in habitat area which can arise if the natural landward migration of a habitat under sea level rise is prevented by a fixation of the high water mark.
Crest	Highest point on a beach face, breakwater or seawall.
Crest level/height	The vertical level of the crest (see above), relative to a datum (usually mOD).
Crest width	A term adopted for the nourished frontage to describe the horizontal distance from the beach crest (where the beach slope angle drops down towards the sea) to the seaward edge of the promenade.
Crisis Level	The level at which the function being monitored, such as the stability of the beach and/or any backing structures (seawall/promenade), could be compromised and emergency remedial action becomes necessary.

Term	Definition
Defra (Department for Environment, Food and Rural Affairs)	Before 2001 known as the Ministry of Agriculture, Fisheries and Food – MAFF). Defra are the government department responsible for environmental protection, food production and standards, agriculture, fisheries and rural communities in the UK.
ESCP (Eastern Solent Coastal Partnership)	A formal partnership between four Maritime Local Authorities (HBC, PCC, GBC and FBC) which manages the coastal flooding and erosion risk across these s areas
EA (Environment Agency)	A UK non-departmental government body responsible for delivering integrated environmental management including flood defence, water resources, water quality and pollution control.
Erosion	Removal of sediment due to the natural action of waves, currents and wind.
FDGiA	Flood Defence Grant in Aid. Money awarded by the Environment Agency to implement schemes and strategies to reduce flood risk to people and property.
Fetch length	The distance that a constant direction of wind can (or has already) pass across a water body (such as an ocean) . Longer fetch creates higher energy waves. Fetch length, along with the wind speed (or wind strength), determines the size (sea state) of waves produced.
Flood Zone	Land area designated by the Environment Agency as at risk of flooding. The categorisations include 'Flood Zone 2' (between a 1 in 200 and 1 in 1,000 annual probability of sea flooding) and 'Flood Zone 3' (3a: 1 in 200 or greater annual probability of flooding from the sea; 3b: land where water has to flow or be stored in times of flood). The categorisations differ according to whether river or sea floods.
Gabion	Steel or plastic wire-mesh basket containing stones or crushed rock, held tightly together to form blocks or walls. These serve as coastal defences, usually aimed at mitigating local erosion.
Geomorphology/ morphology	The scientific study of the nature and history of the landforms on the surface of the Earth and other planets, and of the processes that create them.
GIS (Geographical Information System)	Software which can capture, store, manipulate, and display data related to positions on the Earth's surface. GIS can show many different kinds of data on one map, hence has a range of applications in coastal analysis.
HBC (Havant Borough Council)	Coastal Operating Authority as defined under the Coast Protection Act 1949 with permissive powers to provide defence against coastal erosion.
HISC (Hayling Island Sailing Club)	Sailing club located at Sandy Point (the peninsula on the southeast of Hayling Island, on the western entrance of Chichester Harbour).
Hold the Line	One of the Shoreline management Plan (SMP) policy types, This recommends (for any given frontage) that is it preferable to hold the existing defence line, by maintaining or changing the standard of protection.

Term	Definition
H_s	Significant wave height. Traditionally known as the 'mean wave height' (trough to crest) of the highest third of waves (in a spectrum). Statistically, it is possible to encounter waves much higher than the H_s value.
Inshore	Areas where waves are transformed by interaction with the seabed.
Import	Material 'imported' from outside the sediment cell. For this BMP import refers to material brought in my road or from an offshore dredge.
Joint probability	The probability of two (or more) variables (e.g. wave height and sea level) occurring simultaneously.
Joint Probability Analysis (JPA)	Method to generate joint probability values, by calculating the joint probability distribution of two (or more) variables – typically based on Extreme Value Theory
Joint return period	Average period of time between occurrences of a given joint probability event.
LiDAR (Light Detection and Ranging)	This is a remote (e.g. airborne) mapping technique which uses a laser and other instruments to measure ground elevation at high spatial resolution..
Listed Building	A building or other structure judged to be of national importance in terms of architectural or historic interest and included on an official register (' the List of Buildings of Special Architectural or Historic Interest').
Longshore transport	Movement of material parallel to the shore, also referred to as longshore drift.
mCD (metres Chart Datum)	This is referenced to approximately the lowest astronomical tidal level at a given location. It is typically a reference datum used for navigation purposes.
mOD (Metres Ordnance Datum)	. A vertical datum used in the UK, equal to the mean sea level at Newlyn in Cornwall between 1915 and 1921. It is typically a reference datum used for terrestrial purposes.
Management Unit	The BMP frontage is split into 7 Management Units (MU's) within which slightly different management approaches are required. This includes differentiating between the main extraction and deposition areas.
Met Office	UK Meteorological Office.
MLWS (Mean Low Water Springs)	The height of mean low water springs represents average low water during spring tides (i.e. when the range of the tide is greatest over a fortnightly period). It can be the average (throughout a year) of the heights of two successive low waters during a 24 hour period on spring tides. It is approximately -2mOD along the Hayling Island frontage.
MSL (Mean Sea Level)	This is the average sea level, usually over an annual period, taken from recorded data (e.g. a tide gauge). It is approximately 0.1 m OD at Chichester Entrance)
Nearshore	The zone that extends from the swash zone to the position marking the start of the offshore zone.

Term	Definition
No Active Intervention	An SMP policy where there is no investment in coastal defences or operations. This assumes that existing defences are no longer maintained and will fail over time or undefended frontages will be allowed to evolve naturally.
NTSLF	National Tide and Sea Level Facility. This is the UK centre of excellence for sea level monitoring, coastal flood forecasting and the analysis of sea level extremes.
Offshore	The zone beyond the nearshore zone where sediment motion induced by waves alone effectively ceases and where the influence of the seabed on wave action has become small in comparison with the effect of wind.
Overtopping	Water carried over the top of a coastal defence due to wave run-up exceeding the crest height.
Overwashing	The effect of waves overtopping a coastal defence, often carrying sediment landwards.
Percolation	The process by which water flows through the interstices of a sediment. This infiltration of water during swash into the unsaturated beach material, reduces the wave run-up level. However it can also lead to water seepage at the landward side, potentially causing instability or flooding.
Policy Unit	A Policy Unit relates to the policy area defined by the Shoreline Management Plan (SMP).
Ramsar	Designated under the "Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat." 1971 (UNESCO). The objective of this designation it to stem the progressive encroachment onto, and loss of wetlands. This intergovernmental environmental treaty came into force in 1975.
Relict	Geomorphological feature formed of sediment deposited under past processes and climatic regimes (but no longer considered active as a sediment sink or source in the system).
Recharge	Material brought in for beach nourishment from outside the sediment cell. For the purposes of the BMP, this includes material imported by road and material dredges from licenced offshore sites.
Recycling	Material brought in for beach nourishment from within the sediment cell. For the purposed of the BMP, this includes The Ness, West Beach, Open Beach, Coastguard Revetment and Gunner Point and Chichester Harbour Entrance Channel.
Return Period	A statistical measurement denoting the average probability of occurrence of a given event (e.g. sea level or wave height) over time (usually the annual probability per year).
Revetment	A sloping surface of stone, concrete or other material used to protect an embankment, natural coast or shoreline against erosion.
SANDS	Shoreline and Nearshore Data System – a facility through which data can be analysed to establish links between forcing and response. Data can be stored centrally and are references to a mapping system. SERCMP data sets are stored in SANDS.

Term	Definition
Scheduled Monument	Scheduled Monument: formerly referred to as Scheduled Ancient Monuments. Scheduled Monuments are nationally important archaeological sites which have been awarded scheduled status in order to protect and preserve the site for the educational and cultural benefit of future generations. The main legislation concerning archaeology in the UK is the Ancient Monuments and Archaeological Areas Act 1979. This Act, building on legislation dating back to 1882, provides for nationally important archaeological sites to be statutorily protected as Scheduled Monuments.
Scour	Permanent or temporary erosion due to waves or currents in proximity to coastal structures.
(Mean) sea level change	The rise and fall of mean sea level in relation to the land level throughout geological and historic time in response to global climate and local tectonic changes.
Seawall	Structure built along the shore to prevent overtopping and / or erosion.
Sediment transport	The movement of a mass of sedimentary material by the forces of currents, waves or wind.
SERCMP	South East Regional Coastal Monitoring Programme. This provides a consistent regional approach to coastal process monitoring which provides information for the development of SMPs, strategies and schemes and the operational maintenance and management of existing flood protection infrastructure. Some of the information provided and surveys undertaken include topographic beach surveys, LiDAR, aerial photography and wave buoy data. Reports are produced on the analysis of some of this data.
Significant wave height	The average height of the highest of one third of the waves in a given sea state.
SINCs (Sites of Importance for Nature Conservation)	Every local authority in England has a system for identifying local sites which are of substantive nature conservation value. In Hampshire these are called SINCs. The designation helps to conserve important and distinctive habitats and species on sites that fall outside of European or national conservation designations such as Sites of Special Scientific Interest (SSSIs).
SMP (Shoreline Management Plan)	It provides a large-scale assessment of the risks associated with coastal processes and presents a policy framework to manage these risks to people and the developed, historic and natural environment in a sustainable manner.
SPA (Special Protection Area)	These are internationally important sites, being set up to establish a network of protected areas for birds
SSSI (Sites of Special Scientific Interest)	These sites, notified by Natural England, represent some of the best examples of Britain's natural features including flora, fauna, and geology. This is a statutory designation

Term	Definition
Standard of Protection (SoP)	The level of return period (or joint return period event) event which the defence is expected to withstand without experiencing significant failure.
Storm surge	A rise in the sea surface on an open coast, resulting from a storm (from the combined effects of wind stress and low pressure).
Sustainability (in coastal flood and erosion risk management)	The degree to which coastal flood and erosion risk management options avoid tying future generations into inflexible or expensive options for flood defence. This usually includes consideration of other defences and likely developments as well as processes within catchments. It will take account of long term demand for non-renewable materials.
Swash Zone / Swash	The area onshore of the surf zone where the breaking waves are projected up the foreshore / the movement of the wave up the beach face.
Swell waves	See information on 'wind waves'.
SWL (still water level)	The level of the sea surface excluding the effect of high frequency waves. Typically this is mean sea level + tide + surge (but may also include wave set-up).
Tide	Periodic rising and falling of large bodies of water resulting from the gravitational attraction of the moon and sun acting on the rotating earth.
Toe level	The level of the lowest part of a structure, generally forming the transition to the underlying ground.
UKCP09 (UK Climate Projections 2009	This is the UKs leading sources of climate change information, providing projections of variables such as sea surface temperature and sea level rise. An update is due in 2018.
UKHO (United Kingdom Hydrographic Office)	The UK's agency providing hydrographic and geospatial data to mariners and maritime organisations across the world. They are a trading of the Ministry of Defence (MOD), responsible for operational support to the Royal Navy and other defence customers. Located in Taunton, Somerset with a workforce of 1,000 staff.
Wave climate	Average condition of the waves at a given place over a period of years, as shown by height, period, direction etc.
Wave direction	Direction from which a wave approaches.
Wave height	The vertical distance between the crest and the trough.
Wave hindcast	In wave prediction, the retrospective forecasting of waves using measured wind information.
Wave period	The time it takes for two successive crests (or troughs) to pass a given point.

Term	Definition
Wave refraction	Process by which the direction of approach of a wave changes as it moves into shallow water. The process by which the direction of a wave moving in shallow water at an angle to the contours is changed so that the wave crests tend to become more aligned with those contours.
Wave reflection	The part of an incident wave that is returned (reflected) seaward when a wave impinges on a beach, seawall or other reflecting surface.
Wind waves (or surface gravity waves)	Waves in seas, lakes etc. are generated by wind blowing over the surface. They can comprise (1) wind waves -generated by the local prevailing wind, (2) swell waves which are more regular longer period waves generated by the winds of distant weather systems. 'Sea state' describes the combination of wind waves and swell (i.e. can be used to define whether a spectrum is unimodal or bimodal). Swell contains longer period waves which can cause greater run-up and damage at the coast.

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1. INTRODUCTION

1.1 Background

The Eastoke Peninsula is located on the south east corner of Hayling Island in the Borough of Havant (Figure 1.1). It is a densely populated area, the majority of which is low-lying with a history of serious flood incidents. The properties at risk of flooding (under a 1 in 200 year event with no defences) and erosion over the next 20 years are presented in Figure 1.2 (see the South Hayling Outline Business Case for more information). To manage this flood and erosion risk to the south side of the Eastoke peninsula, the Ministry of Agriculture Fisheries and Food (MAFF) funded the Hayling Island Beach Replenishment Scheme (CPW 24) in 1985. Approximately 500,000 m^3 of material was imported to build the beach to a 1 in 200 year Standard of Protection (SoP). The coastal processes along the frontage result in the longshore transport of the nourishment material away from the Eastoke frontage, therefore Havant Borough Council (HBC) implements a Beach Management Plan (BMP) to retain this material. Without the Beach Management Activities conducted as part of the BMP, the concrete seawall would be exposed, leading to a subsequent return to regular serious flooding of Eastoke, the failure of the seawall and loss of properties.

The North Solent Shoreline Management Plan (SMP) (Ref 1.1) confirmed a Hold the Line policy for the whole of the Southern frontage of Hayling Island. In recognition of the flood and erosion risk from both the northern and southern Eastoke frontages, the Environment Agency and HBC worked together in partnership to produce the approved Hayling Island Eastoke Sectoral Strategy (Ref 1.2). The recommended works to the northern frontage of Eastoke were completed in 2005 raising the level of protection to 1 in 100 year SoP. In addition, the Eastoke Point scheme was completed in 2013, providing a 1 in 200 year SoP (see Section 3.1.3). The Strategy recommends Beach Management for the southern frontage which has involved annual recycling, regular monitoring and periodic recharge operations.

Despite the Beach Management Activities, beach levels had deteriorated at several locations along the Eastoke frontage in 2005, causing a reduction in the standard of protection. A significant storm in November 2005 resulted in overtopping of the vulnerable lengths of this frontage and flooding of a number of properties and disruption of the local transport network. This came as a stark reminder of the real and prominent risk that this area faces and the increased danger without continual management. HBC undertook an urgent beach nourishment operation along the southern shoreline of Eastoke from 2007 – 2009 using

90,000 m^3 of dredged material to bring the beach back to design volume. The Council has undertaken annual beach recycling since the nourishment operation to manage the significant investment by DEFRA (Department for Environment, Food and Rural Affairs), the Environment Agency (EA) and HBC. Since then, there hasn't been a large re-nourishment of material to the frontage, only emergency works in 2014 when 25,000 m^3 was recycled from Gunner Point back to Eastoke. This emergency material was necessary following the persistent 2013/14 storms which resulted in beach draw down and flooding. Still, the rock revetment scheme built at Eastoke Point in 2013 helped to prevent flooding to Eastoke via Bosmere Rd. Beach draw down and overtopping occurred along the frontage again during the high frequency, low magnitude storms of 2015/16 but was less severe than the 2013/14 storms.

The current BMP funding has now come to an end and the Council wish to produce a new BMP (this document) in line with current guidance. Although the main focus of beach management is in front of Eastoke, the nourished material leaving the Eastoke frontage and subsequent recovery from beach recycling, necessitates a BMP encompassing the wider south Hayling frontage (Figure 1.1). This iteration of the BMP, therefore, aims to work with our neighbours by providing a framework through planning to streamline wider recycling operations and movement of material. This document will review the management of the wider frontage in line with the Strategy and the SMP and will also support the Outline Business Case to seek funding approval for the ongoing management of earlier investments in beach recharge for the next five years.

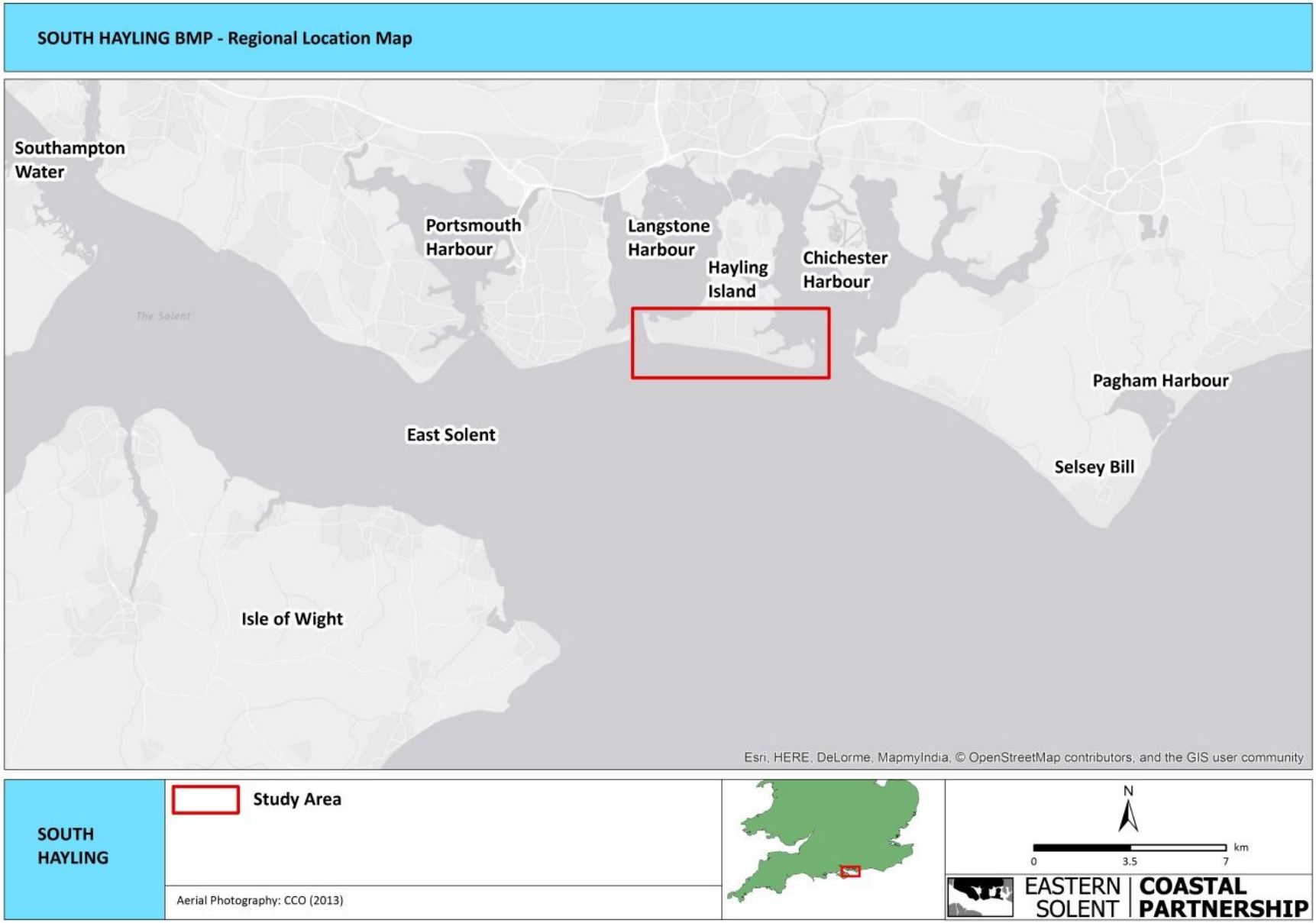

Figure 1.1 The study area in its regional context

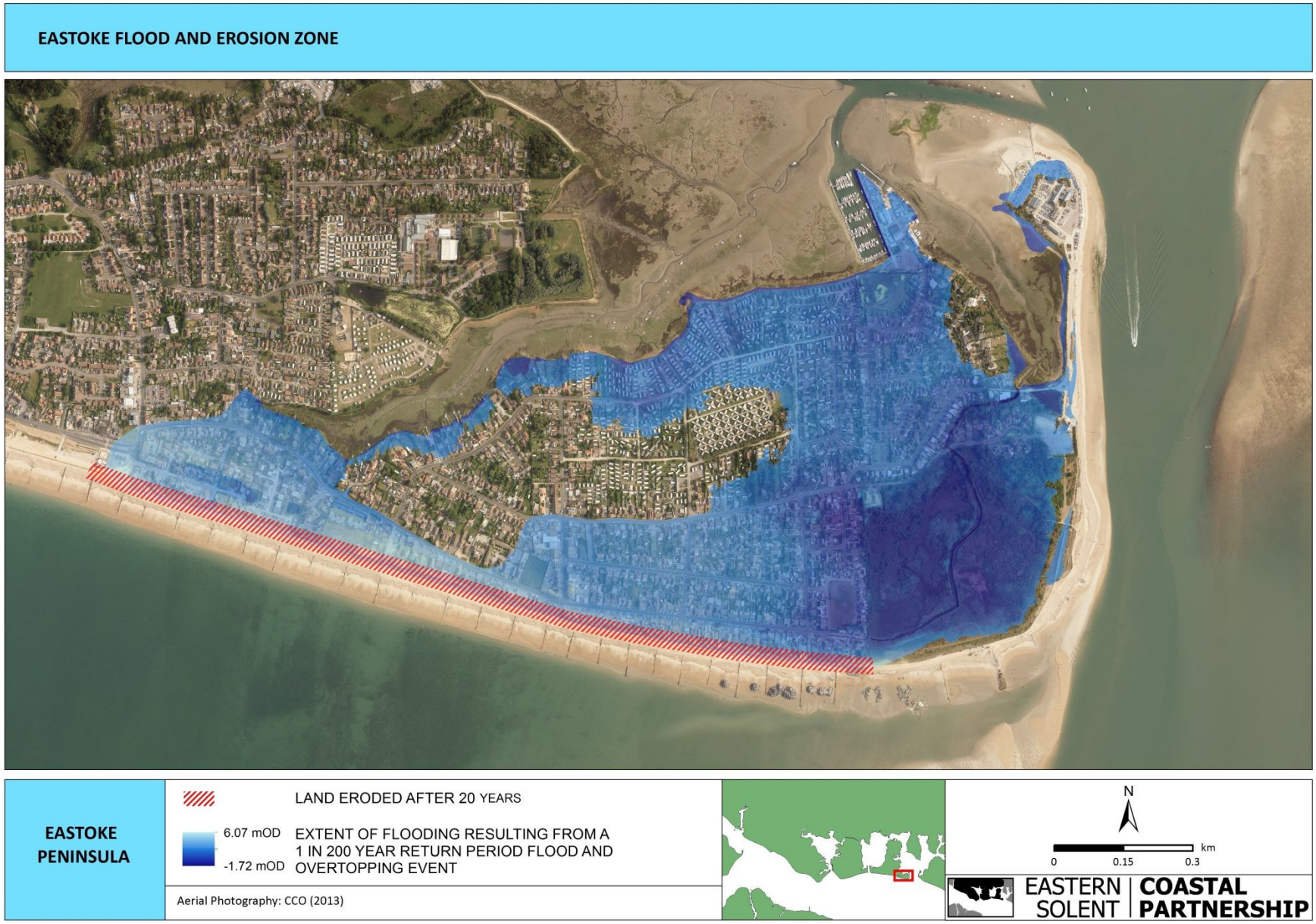

Figure 1.2 The 1 in 200 year flood risk zone and 20 year erosion zone under a 'Do Nothing' scenario.

1.2 Objectives

The key technical objectives (Ref 1.2) of the scheme are as follows:

- To reduce the risk of coastal erosion by providing protection against breaching of the defences and a reduction in coastal flooding.
- To reduce the risk of flooding from extreme surges.
- To provide clearly defined defences with good access for maintenance.
- To limit the impact of the scheme on people and property.
- To provide a scheme which is adaptable to sea level rise and climate change.
- To maintain the amenity benefit of the beach over the whole frontage for both the local population and the holidaymakers who visit the area.

The key environmental objectives (Ref 1.2) of the scheme are as follows:

- Avoid damage to human health and population and where appropriate enhance human environment (human health, population and continued flood and coastal erosion risk management).
- Protect and enhance biodiversity (biodiversity, flora and fauna).
- Protect and enhance land quality (soils).
- Protect and enhance water quality (water).
- Protect existing infrastructure (material assets).
- Protect and enhance cultural heritage features (cultural heritage).
- Protect and enhance landscape character / visual amenity (landscape).
- Minimise disturbance to the community and natural environment through construction activities.
- Ensure no Likely Significant Effect (LSE) on the designated environment and its interest features.
- Work with natural coastal processes.

The BMP aims to identify how to deliver the above objectives in the most cost effective and environmentally acceptable manner with the minimum of disruption to the public and the environment. The BMP is written to last 5 years, commencing April 2017 and ending March 2022, setting out the strategy for maintenance, monitoring and intervention to maintain the beach and structures to the required SoP along the Eastoke southern frontage. It also includes consideration of the likely options available for carrying out Emergency Works (Section 5.2) should defences be overtopped, overwashed or even breached during a large storm event, threatening the low-lying urban area of Eastoke.

This strategy will align to the Shoreline Management Plan policies for this frontage that are set for a 100 year planning horizon, and which aim to ‘Hold the Line’ of existing defence along the length of the BMP frontage (Section 1.6.1).

The BMP also recommends further studies which may be appropriate to aid future coastal

flood and erosion risk management in this area. Recommendations are contained throughout the BMP, and are identified with **bold underlined text**. These are also summarised in an Action Plan presented in Section 7.

1.3 Location

This BMP covers the whole southern frontage of Hayling Island, Hampshire, extending from the Ferry Boat Inn in the west to the Hayling Island Sailing Club (HISC) in the east (Figure 1.3). Although the section of beach from Eastoke Corner Car Park to Eastoke Point is the only area which is actively managed by HBC, the impact the nourished material and subsequent recycling operations have on the wider Hayling Island coastline necessitate a BMP covering a wider area. The length of the managed frontage is 2.2km of the 8.3km Southern Frontage.

Figure 1.3 Map showing the Management Units to be used for this BMP

The previous BMP used the SMP 1 Management Units (MUs) as boundaries, which divided the coastline into seven units. Since 1995, the coastline has altered in terms of areas of accretion and erosion, such that 8 new units have been created for this BMP revision as shown by Figure 1.3. The boundaries for the BMP units (BMP Us) are based on the current management approach, and are influenced by a range of factors including coastal processes, existing structures and land ownership (Figure 1.4). A summary of the key features in each BMP Management Unit in Figure 1.3 is shown in Table 1.1.

Table 1.1 Summary of the BMP Unit features

BMP unit	Extent	Beach	Structures	Hinterland	Landownership
1	Hayling Island Sailing Club to Eastoke Point Scheme	Mixed sand and gravel barrier beach feeding into a distal sand spit at Black Point	Privately owned timber groynes, rock revetment and pontoon	Sandy Point Nature Reserve (low lying)	Main landowners include Hampshire County Council and Hayling Island Sailing Club
2	Eastoke Point Scheme (Groynes 3 - 11)	Dynamic mixed sand and gravel barrier beach	Rock revetment and rock groynes	Sandy Point Nature Reserve (low lying)	Havant Borough Council and Hampshire County Council
3	Eastoke Beach and Eastoke Corner (Groynes 11 – 35)	Nourished mixed sand and gravel barrier beach with areas of vegetated shingle	Timber groynes, buried concrete seawall, concrete splash wall to rear of promenade	Eastoke Peninsula (low lying), Eastoke Corner (low lying into relic shingle ridges)	Havant Borough Council
4	Open Beach (Groyne 35 to Inn-on-the-Beach)	Mixed sand and gravel barrier beach	Timber sloping revetment, timber groynes, timber splash wall, surface water outfall	South Hayling residential area. Central Beachlands (relic shingle ridges)	Havant Borough Council Private ownership at Beachlands

5	Inn-on-the-Beach to the eastern end of Hayling Golf Club driving range (West Beach)	Mixed sand and gravel beach	Timber groynes and sloping timber revetment	South Hayling residential area.	Main landowner Havant Borough Council
6	Hayling Golf Club driving range to start of Gunner Point accretion zone	Mixed sand and gravel beach	None	Golf Club, Sinah Common	Hayling Golf Club
7	Gunner Point accretion zone	Mixed sand and gravel beach with areas of vegetated shingle	None	Gunner Point (shingle ridges) and Sinah Common and Golf Club	Hayling Golf Club
8	Northern end of Gunner Point to Ferry Boat Inn	Mixed sand, gravel and shell beach	Concrete structures, rock filled gabions, quay walls, concrete slipways	Car park and Hayling Golf Club (relic shingle ridges)	Main landowner Hayling Golf Club

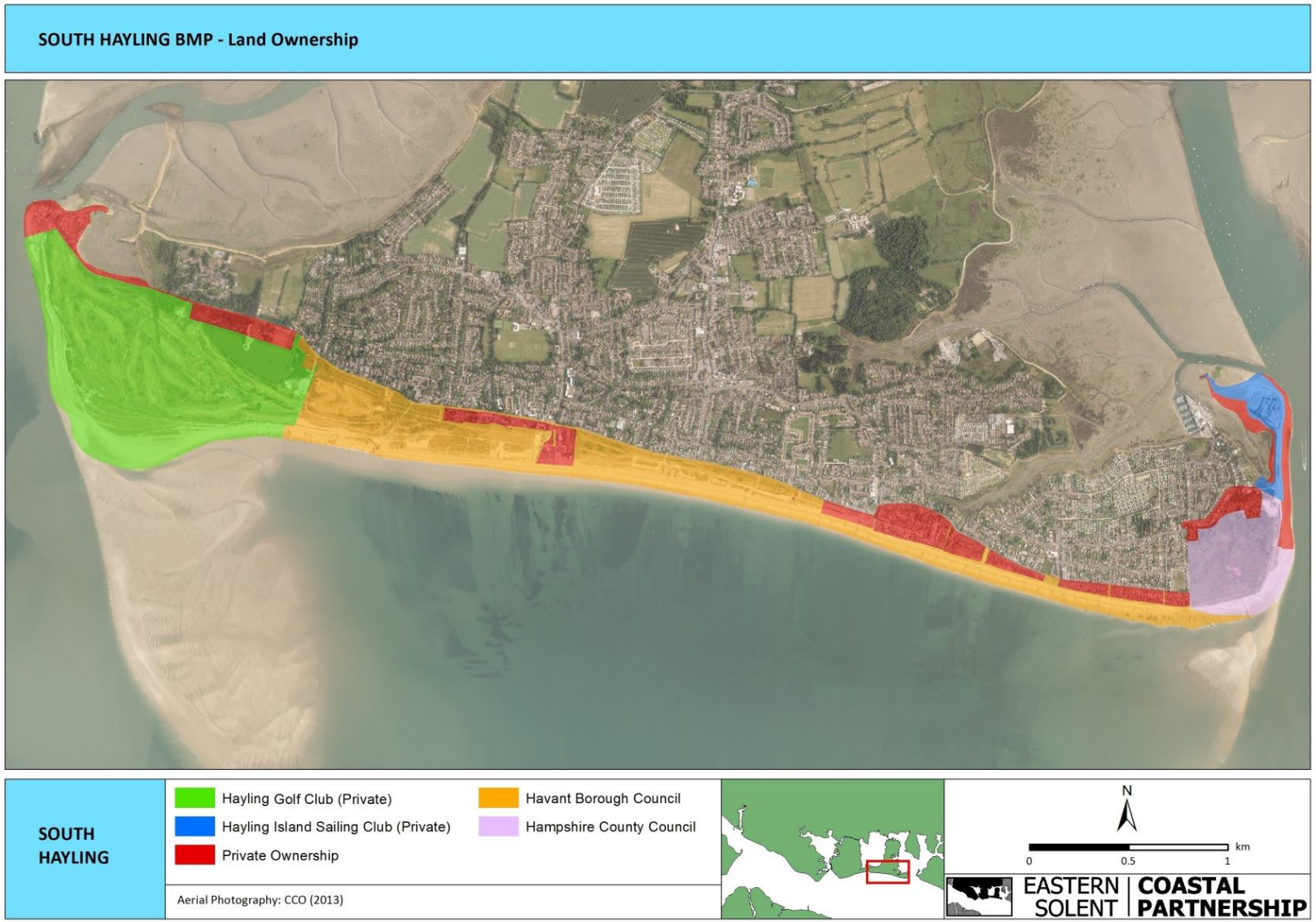

Figure 1.4 Land Ownership map

1.3.1 Amenity value

The Hayling Island coast became a popular destination for visitors from London in the post-war period, with caravans and chalets a feature within the landscape. The island continues to cater for summer trippers, resulting in an increase in the summer-time population on the island. The seafront's recreational activities include jet skiing, wind and kite-surfing, golf, skateboarding, volleyball, fishing, funfair and amusements, a light railway and sailing (Ref 1.6). The blue flag beaches are popular for general amenity, especially in the summer. More passive past times include walking, cycling, sea-bathing and eating and drinking at the pubs and café kiosks.

1.3.2 The Background Natural Environment

The BMP area is within or adjacent to the following environmentally designated areas:

- Solent Maritime Special Area of Conservation (SAC)
- Chichester and Langstone Special Protection Area (SPA)
- Chichester and Langstone Harbours Ramsar Site
- Chichester Harbour Site of Special Scientific Interest (SSSI)
- Sinah Common SSSI
- Langstone Harbour SSSI
- Sandy Point SINC, LNR (Local Nature Reserve) and Countryside Heritage Site
- Southern Eastoke Frontage Site of Importance for Nature Conservation (SINC)
- Beachlands East SINC
- Southern Eastoke Frontage SINC
- Hayling Island Beach SINC
- Lifeboats Station Heath SINC
- Lifeboats Station Saltmarsh SINC
- Land East of Sandy Point SINC

In addition, the following environmental designations are within 2km of the BMP area:

- The Kench LNR

If agreed, the proposed Solent and Dorset SPA (pSPA) will cover the whole of the South Hayling frontage up to MHW. It is currently under consideration, with a live consultation underway at the time of preparing this summary. As this is a proposed SPA, it will be assessed as though it has been adopted.

Figure 1.5 to Figure 1.7 show the extents of the various environmental designations (European, local and national) in relation to the BMP area. Appendix E contains further details about these designations for ease of future reference.

There are also a range of historic environment features and assets surrounding the study area, including Scheduled Monuments and Listed Buildings. None of these historic

environment features are within or immediately adjacent to the BMP frontage. The Old Lifeboat House, is a building of local interest located 50 metres behind the active beach.

Further detail and discussion of the environmental characteristics relating to the BMP area are provided in Section 2.7.

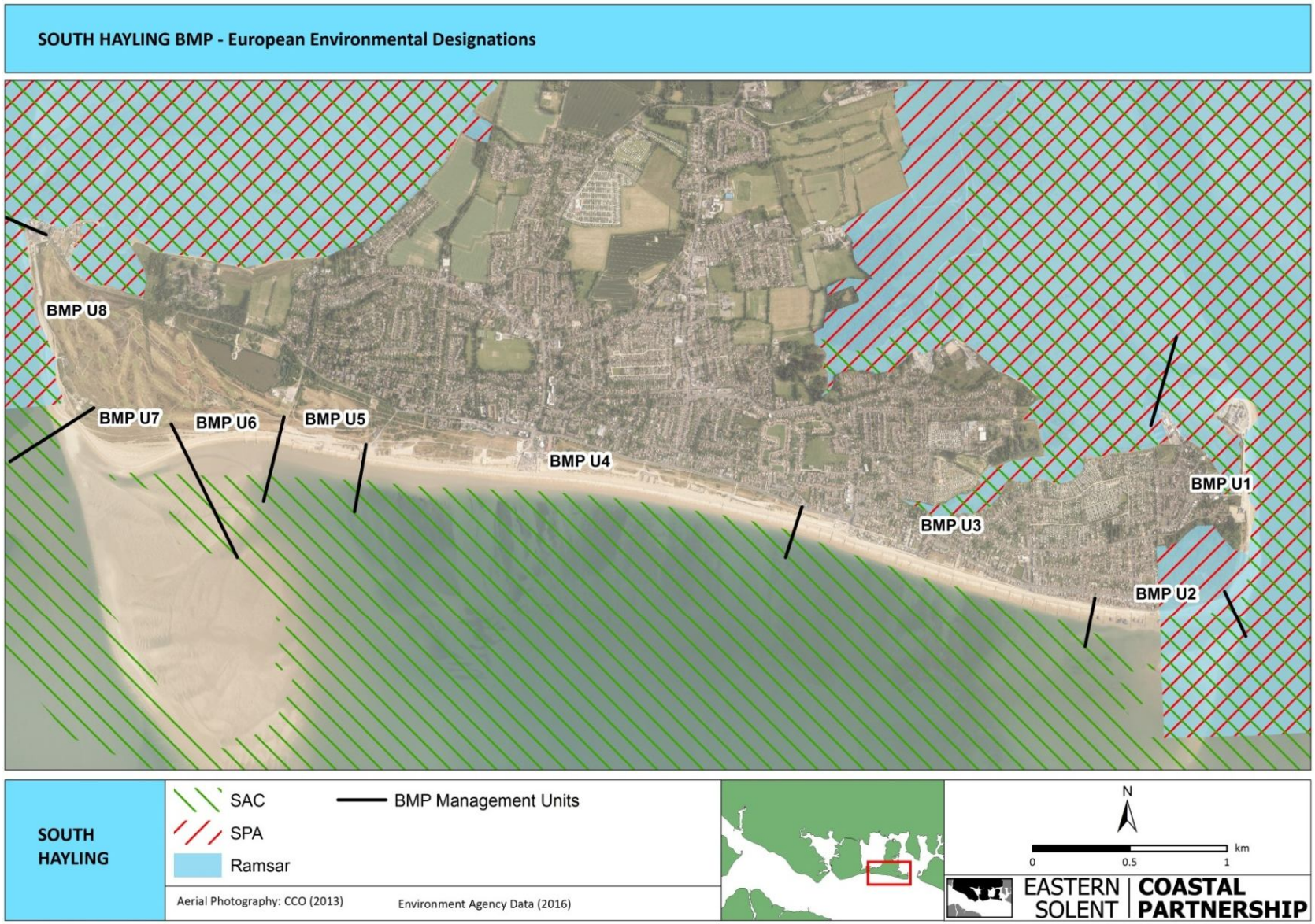

Figure 1.5 International and European environmental designations around the BMP frontage

Figure 1.6 Proposed SPA for Solent and Dorset SPA

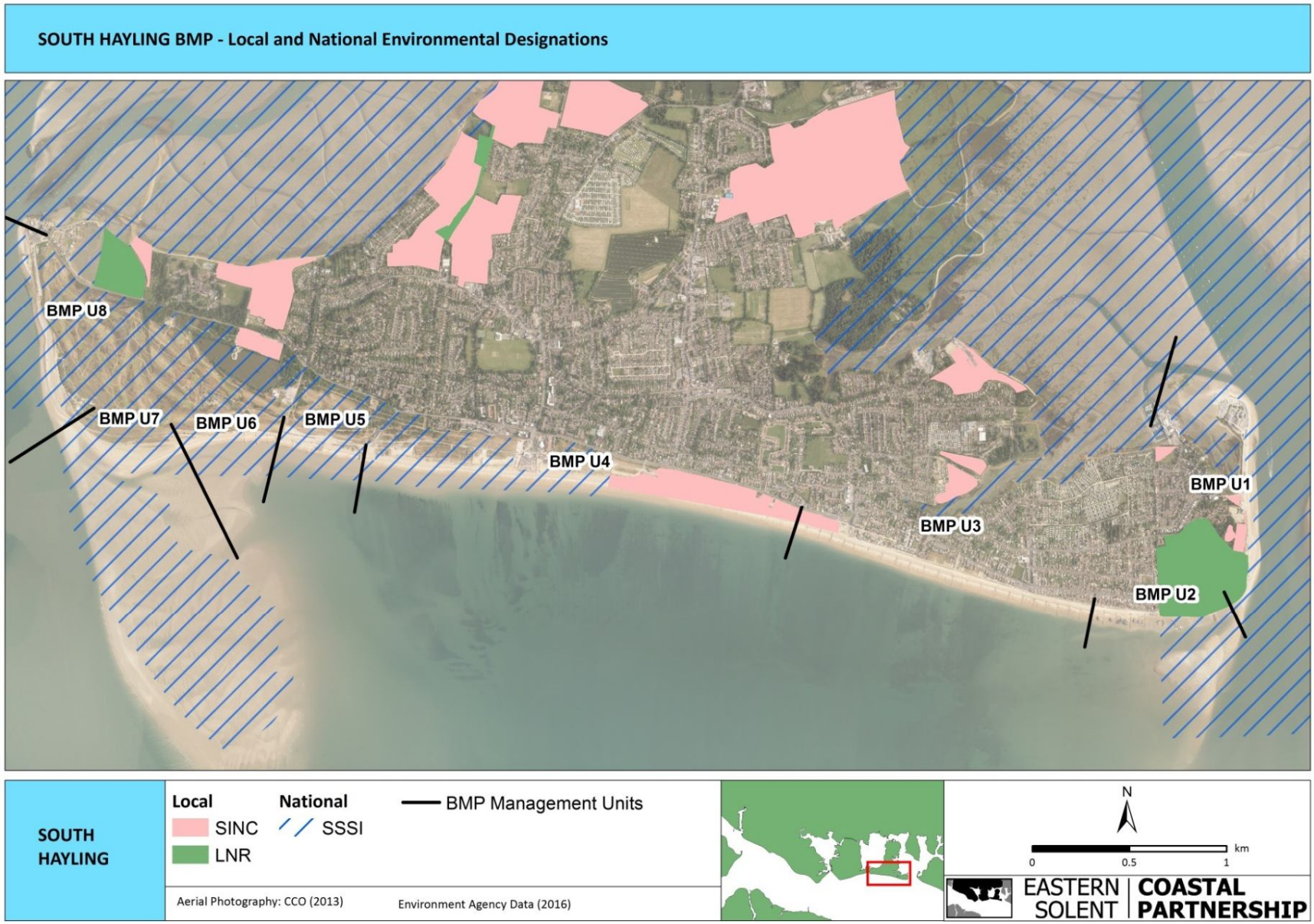

Figure 1.7 Local and National environmental designations around the BMP frontage

Figure 1.8 shows the location of the historic environment features in relation to the BMP study area

1.3.3 Background Water Quality: Water Framework Directive

The purpose of the Water Framework Directive (WFD) is to establish a framework for protecting inland surface waters, transitional waters, coastal waters and ground waters to ensure that any works or discharges do not cause deterioration in the WFD water bodies. The framework for delivering this Directive is through the River Basin Management Plans (RBMPs).

The proposed Beach Management Works falls entirely within the South East River Basin District (SE RBD) and the scheme itself falls within or is adjacent to four water bodies;

- Langstone Harbour Water Body,
- Solent Water Body
- Chichester Harbour Water Body
- Isle of Wight East.

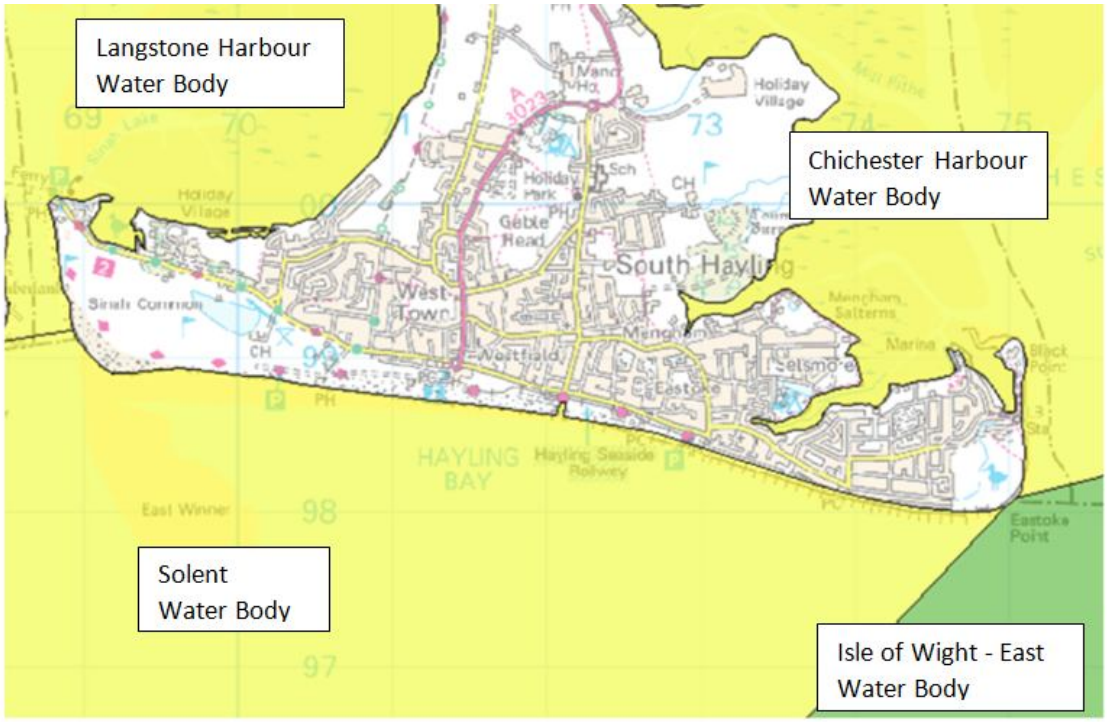

Figure 1.9 WFD water bodies adjacent to Hayling Island open coastline

1.3.4 History of flooding / erosion incidents

The history of flooding and erosion on the Eastoke Peninsula has arisen due to the development of an urbanised area on a low lying peninsula of land behind a retreating shingle barrier beach. As houses were constructed behind the retreating barrier beach, shore parallel defences were first constructed in the mid 1940s as a response to both erosion and wave overtopping (Figure 1.10). These were replaced with much higher seawalls in the 1970s but over time the beach levels in front of these defences continued to drop and the incidence and severity of flooding increased until the Hayling Island Beach Replenishment Scheme in 1985 (See Figure 1.11 and Table 1.2 for flood events). The areas

liable to flooding due to wave overtopping prior to the 1985 scheme are shown in Figure 1.12, and the impact of extreme events illustrated in Plate 1.1 to Plate 1..

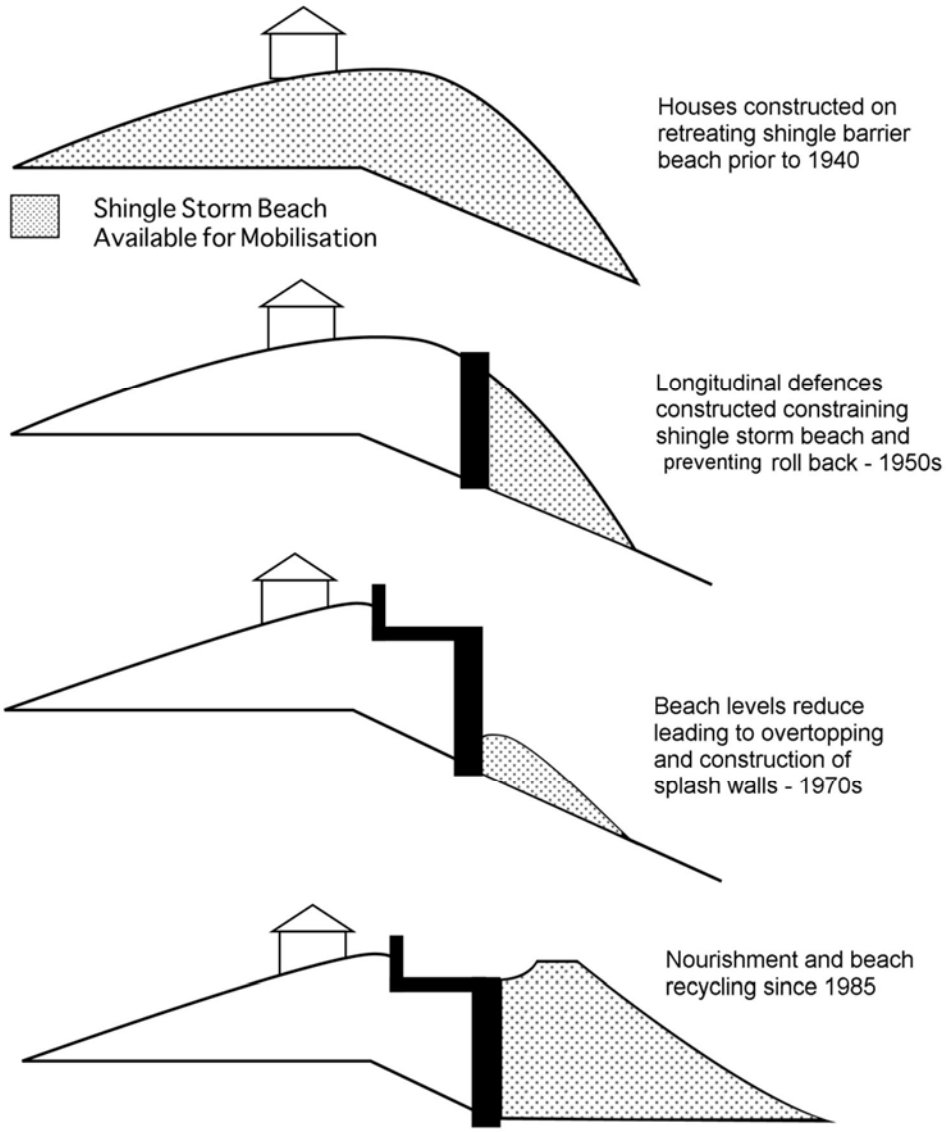

Figure 1.10 Process of beach constraint through construction of shore parallel defences at Eastoke, Hayling Island (Ref1.3)

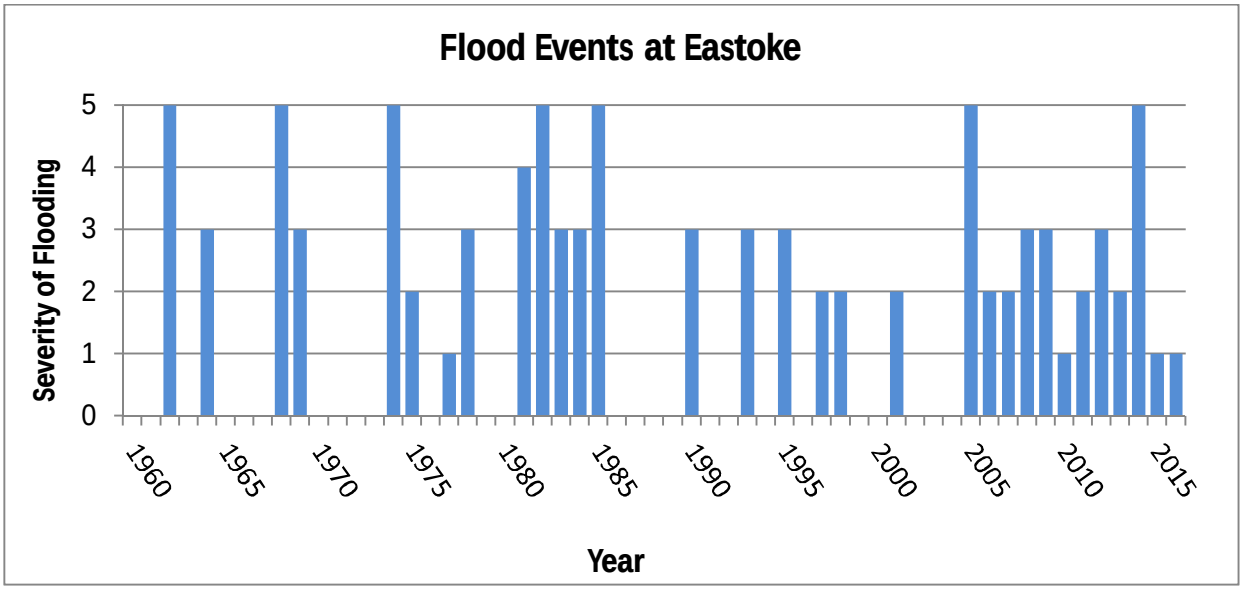

Figure 1.11 Incidence of flooding events at Eastoke, Hayling Island (adapted from Ref 1.4). Severity is measured according to Table 1.2.

Table 1.2 Severity of flooding presented in Figure 1.11.

Level of Severity	Description
5	Flooding over large areas. Significant pumping required by emergency services. Generally more than half a day disruption to homeowners and road users. More than 15 properties affected.
4	More than 5 properties affected by flooding.
3	More than 3 roads affected and/or at least one property affected.
2	Some road flooding - usually localised or shallow
1	Flooding in open areas/prom areas - no real structural damage or disruption.

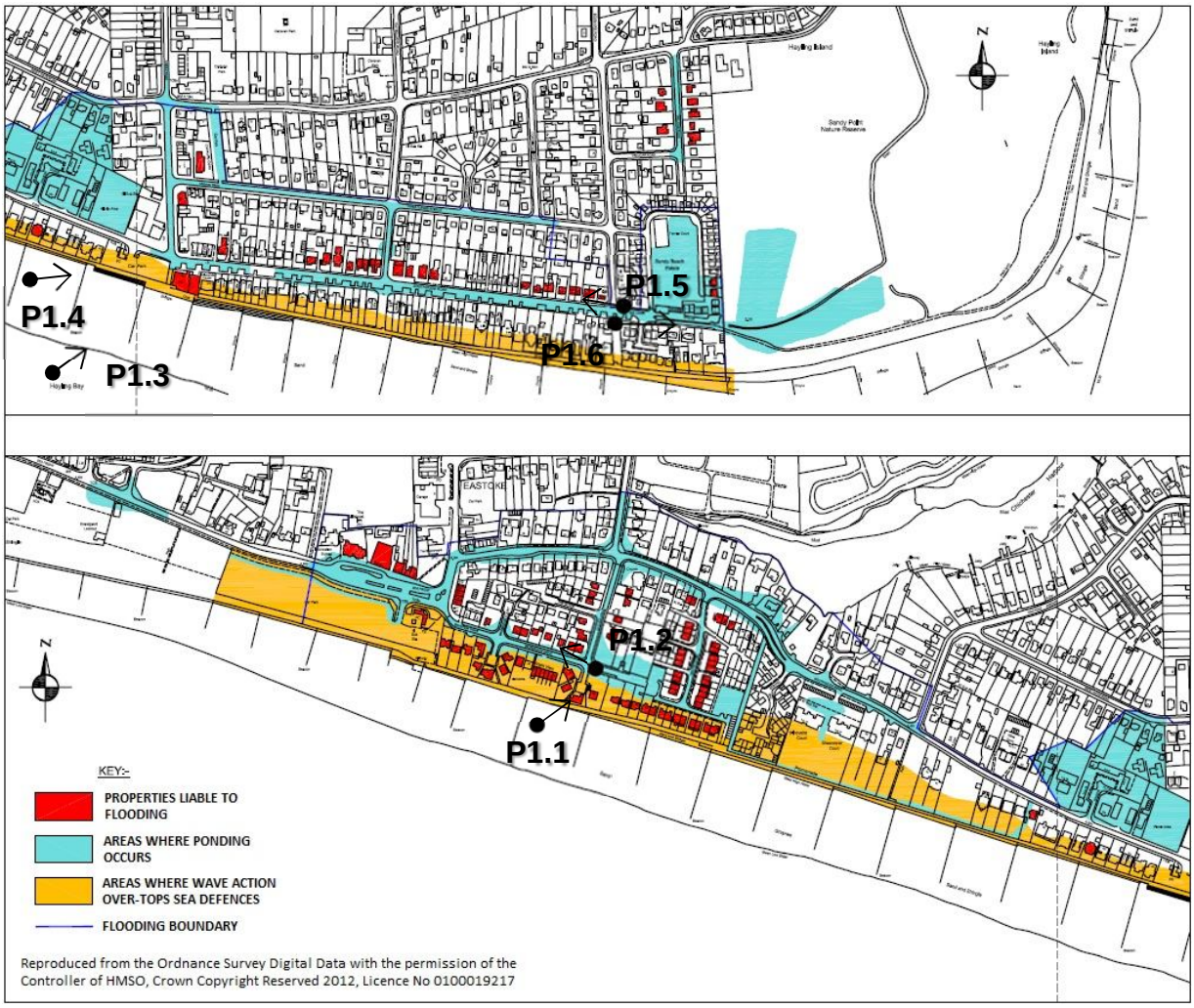

Figure 1.12 Areas liable to flooding due to wave overtopping prior to the 1985 Beach Replenishment Scheme, based on HBC Drawing No. 1007/358, March 1997. Approximate location of Plates 1.1 – 1.6 also indicated

Plate 1.1 Storm damage to property behind the promenade, December 1978

Plate 1.2 Storm damage to properties behind the seawall, December 1978

Plate 1.3 Wave overtopping adjacent to Creek Road car park, pre Beach Replenishment 1985

Plate 1.4 Eastoke Nourished frontage, groyne 19, 3rd November 2005

Plate 1.5 Southwood Road looking west from Bosmere Road, 3rd November 2005

Plate 1.6a November 2014, Southwood Road

Plate 1.6b January 2014, Southwood Road

1.3.5 Recent Flooding

As can be seen from Figure 1.11 there has been serious flooding during the 2013/14 winter, in 2005 and on several occasions before the 1985 replenishment scheme. After the 1985 scheme the incidence of significant flooding has greatly reduced, and the flooding that has been recorded is usually associated with key erosion hotspots (Section 2.6), giving rise to localised flooding. Since the construction of the nourished beach, significant flooding occurred in November 2005 and during the winter storms of 2013/14, when the beach was overtopped along much of South Hayling. The extreme event that occurred on 3rd November 2005, including very long period swell waves in combination with extreme water levels is discussed in detail in Sections 2 and 3. The flooding resulting from this event was not on the same scale as those prior to the 1985 replenishment scheme but did serve as a stark reminder of the very real and prominent threat to this area from overtopping, and the likely effects if beach management were to cease.

1.3.6 Defence History

Since the early 1920s, the Eastoke peninsula has been increasingly developed as a residential area (Plate 1.8).

Plate 1.7 View of Eastoke Peninsula looking north - east (© Cope, 2013)

The building of beach huts and bungalows commenced in the 1930s close behind the wide shingle barrier beach. However, natural retreat and loss of sediments from this beach made it necessary to build defences to protect these properties. By 1947, a concrete seawall had been constructed in front of the old Beach Club, with a timber revetment (sloping surface) and groynes adjacent to it (Figure 1.13). By 1974, the seawall had been extended to the east and west, for a total of 2.6 kilometres. This seawall, however, did nothing to solve the fundamental causes of beach erosion, and wave reflections from its front face lowered the levels of the shingle beach. By 1978 major repairs to the seawall were required.

By the early 1980s, the Eastoke frontage was regularly overtopped by wave action, causing flooding and damage of many properties. The ageing concrete seawall was also approaching the end of its serviceable life and a failure could have led to rapid shoreline retreat and subsequent loss of properties. The frequency and severity of overtopping events were increasing annually. In an effort to reduce the damage, a rear splash wall was

constructed along the entire length of the seawall. These measures did not adequately prevent regular overtopping or storm damage to properties.

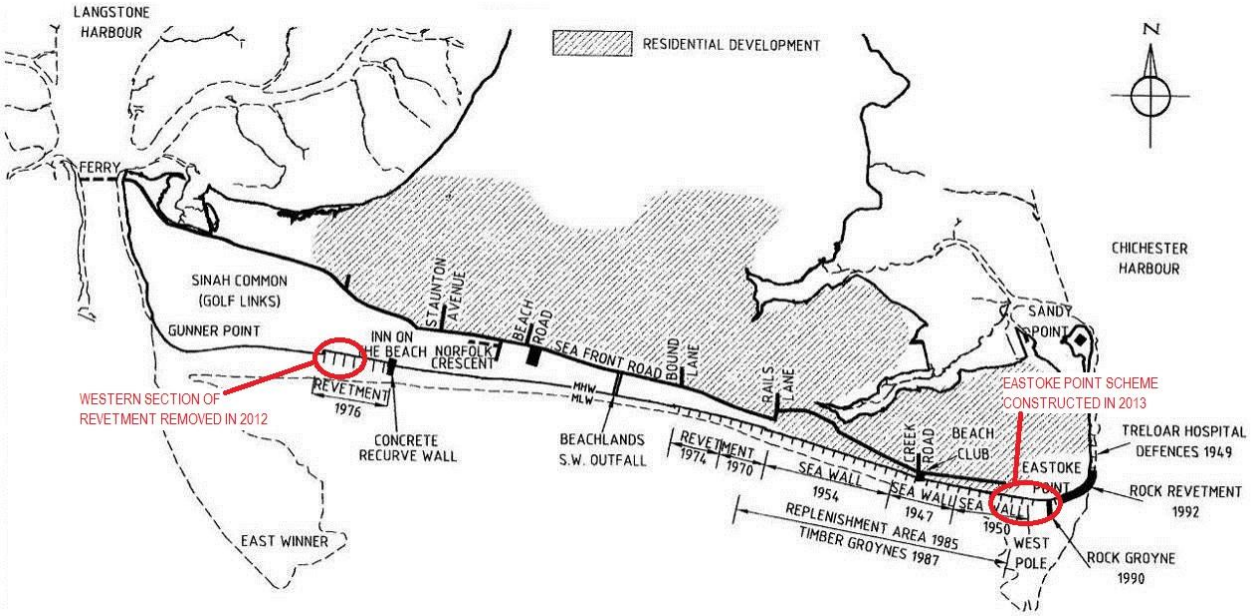

Figure 1.13 Historic construction of sea defences around South Hayling

A major Beach Replenishment Scheme, carried out in 1985 successfully alleviated further incidents of this nature by removing the energy of waves before being reflected by the concrete seawall. The scheme involved importing half a million cubic metres of shingle from the Owers Bank and placing it on the beach over a length of 2.2 kilometres. Subsequently, there has been a requirement for ongoing shingle recycling to maintain the level of protection provided by the scheme design.

Such a large amount of material being injected into the sediment transport system resulted in the rapid transport of material along the frontage. In 1987, new timber groynes were built in order to try and control the transport rate along the replenished area and in 1990 a rock groyne was constructed to further reduce loss of material around Eastoke Point.

In 1992, it became necessary for emergency repairs to be carried out at Eastoke Point. These works involved the construction of 150 metres of rock revetment and rock stub groynes. These works proved to be successful and helped to reduce the occurrence of volatile beach levels and subsequent flooding in this area.

The successful implementation of the 1992 BMP has influenced the ongoing management of the coastal defences at Eastoke. Since that time the beach has been the main defence on the open frontage, comprising recycling and periodic dredge and deposition of the material from Chichester Bar. The associated control structures have been maintained and replaced as required, but no changes in the form of hard defences have been carried out since the

early 1990s, until 2013 when the Eastoke Point scheme was constructed. This involved building a rock revetment and 4 rock groynes to replace 4 timber ones and recharging the beach to stabilise this highly dynamic area at the entrance to Chichester Harbour. More detail on this is available in Section 3.1.3.

Away from the nourished frontage the defences west of Inn-on-the-Beach (BMP U5), constructed in 1976, are reaching the end of serviceable life and a 75m section of sloping timber breastwork was removed in March 2012 (Figure 1.13). This returned the beach to a more natural beach profile. The remaining section of sloping timber breastwork will be removed when deemed a health and safety risk.

1.3.7 Current Defence Condition

The coastal assets along the entire South Hayling frontage are regularly inspected and maintained by the Eastern Solent Coastal Partnership (Section 5.1.2), and the results are stored in the Eastern Solent Coastal Partnership (ESCP) coastal asset database. An overview of the defence condition, including the nourished beach, is given here for each BMP unit, based on the latest survey results stored in the database. The condition of the defences is described according to the descriptions within the Environment Agency Condition Assessment Manual (Ref 1.5).

BMP U1

Generally beach levels are healthy and accreting, to the point that the pontoon at Hayling Island Sailing Club is no longer inter-tidal but a sand beach. This is causing difficulty at the sailing club as the pontoon is no longer in use until permission is granted from regulatory bodies to extract excess sand. If permission is granted, any sand removed from the pontoon must remain in the SAC system and continue to feed the spit.

Various timber control structures are owned and maintained by private organisations, which are mainly in fair condition or buried beneath the beach. A rock revetment constructed around the Hayling Island Sailing Club is in good condition.

BMP U2

The rock revetment and rock groynes around Eastoke Point are in very good condition, with most of the structure buried by beach material. The original capital beach nourishment in 1985 rapidly eroded in this area and beach recycling alone was not capable of maintaining the required standard of protection, so the Eastoke Point Scheme was built in 2013. A rock revetment was built and 4 timber groynes were removed and replaced with 4 rock ones and the beach was nourished. More information is available on this in Section 3.1.3.

BMP U3

The nourished beach is the primary defence along this section of the frontage. There are two key erosion hot spots where the beach crest is often drawn down below the design standard; these are Eastoke Corner and the area in front of the Creek Road car park where there is

currently a sediment drift divide. These are discussed in more detail in Section 2.6. The old concrete sea wall is buried under the nourished beach and its condition is considered to be largely unchanged. The timber groynes constructed in 1987 are generally in fair condition, with ongoing maintenance and repairs carried out by HBC.

BMP U4

The timber groynes along this section of beach are generally in fair condition. The timber sloping revetment is in fair/poor condition where visible, although it is prone to damage when beach levels fall in front of the structure.

The central beachlands open coast has no hard defences other than a single timber groyne to the east of the unit which is in fair condition. The beach here is generally healthy but the condition will vary slightly depending on how much material is extracted along the Open Beach section.

BMP U5

To the west of Inn-on-the-Beach at West Beach, the sloping timber breastwork is in a generally poor structural condition, and heavily dependent on beach levels in front of the structure. The visible structure has been assessed as being in poor condition overall but buried sections are known to be in a very poor condition and heavily dependent on beach levels protecting the structure toe. The adopted policy is to maintain the structure where reasonably practicable, and remove sections of the structure should they pose a threat to public safety. A 75m section at the western end was removed in March 2012 due to a significant structural failure, triggered by falling beach levels exposing the degraded lower structure. The remaining structure and the existing timber groynes will be monitored and removed as their condition deteriorates.

BMP U6

There are three privately owned timber groynes in poor condition in front of the Hayling Golf Club driving range at the eastern end of this management unit. There is localised erosion associated with a dynamically changing beach plan-form in this location (Section 2.6). Other than these three control structures the frontage is open beach in the lee of a significant ebb-tidal shoal, the West Winner.

BMP U7

This zone is unmanaged and accreting at a rate of up to 25,000m^3 each year (2003 – 2015). Given the longshore drift direction from east to west, the main source of material accreting at Gunner Point has been from import of shingle at Eastoke since 1985. Historically, material has only been extracted from Gunner Point by HBC for emergency works in 2014. Following approval in principle by the landowners and Natural England, this iteration of the BMP will look to Gunner Point as a new source of material for sediment recycling.

BMP U8

This management unit contains a variety of redundant sea defences and man-made

structures that are buried within the beach. Many of the structures, which are all privately owned and maintained, were buried as pulses of material moved up the eastern flank of the Langstone Entrance channel. There is currently some localised erosion to the north of the unit, associated with the advance of a spit like feature that is gradually moving northwards.

1.4 Issues

1.4.1 Flooding / Erosion Issues

There is a combined risk to properties on the Eastoke Peninsula from flooding and coastal erosion. The main issue on this frontage is flooding caused by wave overtopping of the defences. Wave overtopping and coastal erosion are currently being managed through ongoing beach recycling and recharge, although there are ongoing erosion issues in specific areas (Section 2.6).

Currently the main flood defence consists of a mixed sand and gravel beach which is maintained to a design crest height and width (Section 3.2). Problems occur when the beach is not at this standard or the waves have such an intensity and/or duration that the crest height and width reduces, resulting in overtopping. This BMP will investigate the most cost effective way of maintaining the nourished beach.

1.4.2 Natural Environment Constraints and Opportunities

When undertaking beach maintenance works, there are a number of environmental aspects to be managed (refer also to Section 2.7 and Appendix E). Some key environmental elements to be appreciated and managed are:

- Vegetated shingle;
- Annual Vegetation of Drift Lines;
- Breeding and ground nesting birds on the open beach;
- Migrating and overwintering birds (in particular roosting habitat);
- Roosting birds;
- Feeding Terns;
- Natural coastal processes and the need to maintain the feed of material moving towards the two peninsulas at Gunner Point and Black Point Spit, which are high tide roost sites;
- Intertidal mudflats and sandflats;
- Water Quality;
- Public Health and Safety.

Beach management works have been on-going at Hayling Island since 1985. These works have been undertaken sensitively with respect to the natural and built environment, and through experience have continued to improve. The BMP is a ‘soft’ form of Flood and Coastal Erosion Risk Management, working with natural coastal processes. The Hayling Island open coastline has benefited from on-going beach maintenance operations. With the

import of shingle, the shingle beaches have offered continued flood and erosion protection to the community and provided enhanced opportunities for the establishment of vegetated shingle and annual drift line vegetation.

This revised BMP has been developed in-line with the existing management of this coastline, however the area of works has increased over the previous BMP, extending east and west to include the full Hayling Island open coastline. This will enable full management of the Hayling Island open coastal sediment cell, providing a complete plan for the benefit of the whole frontage.

The ESCP are currently developing Planning and Marine Licence applications for the extended BMP area for submission early 2017. An Environmental Statement, Water Framework Directive Assessment, Habitat Regulations Assessment and Construction and Environmental Management Plan are being produced in close liaison with Natural England, to highlight how the extended BMP will be delivered without any Likely Significant Effect on the natural environment and designated sites. These have been advised by the Environmental Scoping Report, and subsequent scoping opinion. In addition, Natural England has confirmed that the BMP is likely to lead to an environmentally acceptable solution (see Appendix E). In the meantime, the existing planning permission is until the end of September 2019.

A WFD assessment is being undertaken to identify whether the BMP has the potential to prevent these (and wider) Water Bodies meeting their objectives, to ensure there is no deterioration to these water bodies. It will identify and promote the delivery of any objectives and mitigation measures that may be required. It will also consider scheme impacts on other European protected sites, including Shellfish Waters, Bathing Waters and Natura 2000 sites. This WFD assessment will be guided by the preliminary WFD assessment upon which we received a scoping opinion. It will support the consent applications for this extended BMP. The proposed BMP will be fully compliant with the WFD upon adoption of appropriate mitigation.

The assessment will take the following steps;

- An overview of the WFD process and methodology for assessment;
- Information on the Beach Management works / activities;
- Background information regarding relevant water bodies and protected sites;
- Assessment of potential impacts and mitigation;
- Contributions towards achieving water body objectives;
- Conclusions, based on the evidence presented previously.

1.4.3 Beach Safety and Amenity Constraints

As noted in Section 1.3.1, the whole of the frontage covered by the BMP is a popular destination for a range of amenity uses. The use of the beach varies depending on the season and facilities such as car parks, beach huts and water use. Zoning provide a focus

for amenity use and access onto the beach. The peak tourism season is between April and September, although the seafront is used all year round.

In addition to maintaining public safety when works occur, other amenity and public safety issues exist at the site that relate to the beach and structures. These include:

- Varying beach levels could pose access and fall issues as well as create risk of undermining to the defences.
- Health and safety issues associated with the timber groynes including damaged or missing planking and jagged edges.

These issues are in part automatically resolved through the ongoing Beach Management Activities as the design profile and associated control structures remove the risk of falls from the promenade. In addition where significant cliffing of the nourished material occurs reprofiling may be undertaken to remove steep drops on the beach crest (Section 5.3.2).

1.4.4 Uncertainties about Beach Processes

Despite a good level of process understanding developed for this BMP (see Section 2), there remain some uncertainties of relevance to the future management of this frontage:

- The joint probability of extreme wave and water levels in the BMP area relating to long-period swell events and bi-modal events.
- The impact of long-period swell waves and bi-modal events on wave run-up and overtopping.
- The impact of long-period swell waves and bi-modal wave conditions on beach profile evolution.

The monitoring programme set out in Section 4 includes measures that aim to improve understanding of these uncertainties. Since the last BMP, the Channel Coastal Observatory (CCO) and HR Wallingford have developed a new model called SHINGLE-B which provides the capability to assess bi-modal wave conditions on a given shingle beach profile. Given the model was still under development at the time of writing, only a sensitivity test on the Eastoke beach design profile was undertaken. Extreme bi-modal wave conditions do not exist for Hayling to input into the model, therefore, **this BMP recommends development of bi-modal extremes to be tested on the existing design profile over the next 5 years.**

1.4.5 Licences, Approvals and Consents

Planning permission in accordance with the Town and Country Planning Act 1990 for the ongoing beach recycling works around Hayling has been granted for a ten year period, running until 30th September 2019 (Appendix C), covering the area from The Ness to Inn-on-the-Beach. Beach maintenance works in the form of recycling and reprofiling are exempt from a Marine Licence under the Marine & Coastal Access Act 2009, so long as the activity is carried out within the existing boundaries of the works being maintained (Ref 1.8). The

beach recycling works to remove the hazard to navigation (Chichester Bar) seaward of MHWS at Eastoke Point are exempt from requiring a Marine Licence as they are carried out on behalf of Chichester Harbour Conservancy (Appendix C).

A Chichester Harbour Conservancy 1971 Section 45 Works Licence has been approved for recycling material from Chichester Bar to Eastoke beach (Appendix C). **The consent is valid until 26th January 2019 and a renewal will be sought prior to the licence lapsing.** The beach recycling operations fall outside of the area requiring a Harbour Works Licence.

The current iteration of the BMP is applying for an extension of the planning permission to cover the whole south Hayling frontage from the Ferry Boat Inn to Hayling Island Sailing Club. This is to enable recycling from Gunner Point back to Eastoke and to address minor erosion and accretion issues throughout the frontage. We are seeking a planning permission that is not time limited, so future iterations of the BMP would not require additional planning approvals (unless there are significant changes that couldn't be dealt with through a variation). We have stated that we will monitor BMP works into the future to satisfy our regulators that the environment is not adversely affected by the BMP works, and this may allow refinement of activities going forward (i.e. amendment of Conditions).

A Marine Licence application is also being submitted to the Marine Management Organisation to allow marine based recharge of material, thereby providing consistent licences. Again, we are seeking the longest possible licence permission for this (preferably not time limited, to match the planning application). The need for a Marine Licence arises from the anticipated future need for additional shingle to be imported into the system from outside the existing sediment cell. This could include import by sea or road. The only activities that require a Marine Licence, are import of material from outside the sediment cell, so the open beach recycling / dredging from Chichester Harbour entrance are exempt as they involve the recycling of materials within the same sediment cell.

Beach management works will continue under the existing planning application, until the revised planning and Marine Licence applications are made during early 2017. We have liaised heavily with regulators due to the extension of the BMP, and invoked Natural England's Discretionary Advice Service in order to agree key principles for the extended BMP. Natural England are confident that the BMP can be extended without having a Likely Significant Effect (LSE) on the environment, and this is confirmed in their letter that supports the BMP in principle (attached within Appendix E).

1.5 Responsibilities for Management

Responsibility for the management and operation of activities along the BMP frontage rests mainly with HBC. The Eastern Solent Coastal Partnership (ESCP) provide a shared service for Havant Borough Council, Portsmouth City Council, Gosport Borough Council and Fareham Borough Council. The ESCP have written this iteration of the technical BMP, are applying for the appropriate licences and consents and will submit the Outline Business

Case to the Environment Agency for Flood Defence Grant in Aid to fund the future 5 year phase of the BMP. Table 1.3 summarise the roles and responsibilities and identifies non-HBC responsibilities.

Table 1.3 Roles and responsibilities for management and operational activities

Management Operation		Assigned Responsibility
1	Operations to maintain beach profile	HBC
2	Cleaning/clearance of promenade, steps, revetment, for amenity	HBC
3	Cleaning/clearance of beach	HBC
4	All structural maintenance of promenade, seawall, revetment, timber groynes, slipways and flood gates	HBC / Private Ownership
5	All structural maintenance of surface water outfalls	Southern Water
6	All maintenance of access steps, ramps and slipways to beach from seawalls/revetments	HBC / Private Ownership
7	All maintenance of footpath and cycleways including signs for designated public footpaths and rights of way	HBC / HCC PRoW (Public Right of Way)
8	Litter clearance	HBC
9	Monitoring of shingle movement (and other coastal processes)	HBC / Southeast Strategic Regional Coastal Monitoring Programme
10	Maintenance of seats, litter bins etc	HBC
11	Flood warning and response actions	HBC / Environment Agency
12	Emergency planning	HBC / HCC / EA

Actual ownership of the assigned responsibility for each management operation identified in Table 1.3 is in some cases held by different departments within the identified organisation. Therefore, in order to support Table 1.3 and to provide clarity on who should be contacted for each item, Appendix G provides contact details for each management operation as well as other organisations with interests in this area.

1.5.1 Monitoring

HBC has responsibility for monitoring of the South Hayling Beach covered by this plan. Further detail on the monitoring programme and objectives is contained in Section 4.

1.5.2 Maintenance Activities

HBC are also responsible for inspecting and carrying out maintenance of sea defences on the majority of the frontage from BMP U2 to BMP U5. Structures in BMP Unit 1 and BMP Units 6-8 are inspected by HBC but are privately owned and maintained. **Where issues are identified in these areas the appropriate owner / maintainer is notified of the defect and any obligation to make good.**

1.5.3 Other Actions

The majority of the beach is maintained and supervised on a day to day basis by Norse South-east (a HBC joint venture) from their Beachlands Office. These activities include:

- Undertaking regular daily inspections and reporting of the beach condition from the Ferry Boat Inn (BMP U8) in the west to the Nature Reserve boundary (BMP U1) in the east to check for any hazards to the public from such items as beach cliffing, groyne deterioration and voids.
- Undertaking regular daily inspections of the Beachlands Coastal area including buildings, beach huts, lifesaving equipment, signs, litter bins, dog bins and notice boards and ensuring any defects are rectified
- Dealing with any emergency situations such as oil pollution, dangerous chemicals or canisters on the beach which may occur.

1.5.4 Responsibility for flood warning

The EA is responsible for providing flood defence warning for the South Hayling frontage through their Area Flood Warning Duty Officer (FWDO). The public are warned through the EA floodline, the EA website and by the public registering with the EA for Flood Warnings Direct.

The flood warning is passed to HBC's Emergency Response Officer and the HBC Duty Officer. The ESCP Coastal Incident Officer is also notified, and a coordinated response is developed following the procedures identified in the coastal flood risk response plan (See Section 4.6 and Appendix G).

1.5.5 Responsibility for outfalls

There is only one surface water outfall along the length of beach covered by this BMP. This is opposite Sea Grove Avenue and is a ∅1050mm pipe that outfalls surface water and storm overflow in to the sea. It is owned and maintained by Southern Water. There may be other minor outfalls that discharge surface water through the beach but these are largely buried and have not been identified individually.

1.5.6 Key Stakeholders

The following organisations are key stakeholders in the development of this BMP, and contact details are listed in Appendix F.

- **Eastern Solent Coastal Partnership**. Who are the team within HBC responsible for the development and implementation of this BMP to manage erosion and flood risk for the frontage.
- **Havant Borough Council**. Who are a major landowner of the frontage and undertake day to day management of the defences. Norse SE are responsible for the Open Beach, car parks and open areas.
- **Hampshire County Council**. Who are landowners at the eastern end of the frontage

where they own the Eastoke Point nature reserve and beach frontage.

- **Hayling Golf Club**. Who are landowners at the western end of the frontage where they own the golf course and beach frontage
- **Hayling Island Sailing Club**. Who are landowners at the eastern end of the frontage where they own the spit and beach frontage extending up to Black Point.
- **Natural England**. Who have an overview on proposals to carry out works such as this BMP in an environmentally sensitive area.
- **Environment Agency**. Who have a strategic overview for all forms of flooding and coastal erosion, and therefore has a significant interest in the management of flood and erosion risk along the coastline covered by this BMP. They also administer the funding stream for any works to be carried out under this BMP.

1.6 Linkages for other documents

1.6.1 Shoreline Management Plans

A Shoreline Management Plan (SMP) is a large-scale assessment of the risks associated with coastal processes and helps reduce these risks to people and the developed, historic and natural environments. Coastal processes include tidal patterns, wave height, wave direction and the movement of beach and seabed materials.

The first round of SMP's were carried out in the mid 1990's and the plan covering this frontage was called the East Solent SMP and was completed in 1997. This found that the preferred option for the eastern end of the frontage was "Hold the Line" while on the frontage around Gunner Point the preferred option was "Do Nothing".

The current Shoreline Management Plan (SMP) covering the BMP area was completed in 2010 (Ref 1.1). This document adopted a single policy unit (5aHI05) covering the entire open coast for South Hayling, corresponding with the extent of this BMP. The SMP policy recommended for this section of coast is to continue to 'Hold the Line' over the next 100 years. There are additional qualifying statements about allowing the coastline in key areas to evolve with minimal interference. The ESCP intend to implement this policy through use of beach management and removal of the existing hard defences as they reach end of life, particularly at the western end of West Beach (BMP U6).

1.6.2 Hayling Island: Eastoke Sectoral Strategy Study

This joint HBC and EA report (Ref 1.2) was completed in October 2006. It split the Eastoke frontage in to four sections, namely;

- Southern Frontage – Main section
- Southern Frontage – Eastoke Point
- Northern Frontage – Main section
- Northern Frontage – Bracklesham Road

For this BMP the options for the Southern frontage are relevant. The preferred option for the *Southern Frontage – Main section* was "Hold the Line" to a 1 in 200 year Return Period standard of defence through beach recharge and annual recycling. For the *Southern Frontage – Eastoke Point* the preferred option was "Hold the Line". Construction of the capital scheme at Eastoke Point by the ESCP in 2013 has helped to deliver this "Hold the Line" policy and reinforces the need for beach management on this frontage.

1.6.3 Eastoke Point Coastal Defence Study

This report (Ref 1.9) was completed in May 2009 and specifically addressed the issues in connection with maintaining the beach profile at Eastoke Point. It did however reinforce the need for continuing management of the beach in front of the wider Eastoke frontage as the beach will still provide a sea defence at this location even after construction of the capital scheme.

1.6.4 Beach Management Plans

The following lists the Beach Management Plans undertaken at Eastoke.

- A BMP at Hayling Island was first adopted in 1992 (Ref 1.100) and ran from 1992-1996: The objectives of this original plan included:

  - Continuous monitoring of the beach;
  - Immediate reaction to any rapid drawdown, as waves remove material in a groyne bay (beach compartment between two groynes);
  - Annual beach recycling; and
  - Use of material accreting (accumulating) at Central Beachlands as a source of material

  The study sought funding for Coastal Management Studies (to better understand the coastal processes on South Hayling) and to undertake Beach Recycling activities.

- Beach Management Strategy Plan for the southern frontage of the Eastoke Peninsula 1999 (Ref 1.11):

  This study was undertaken to determine appropriate and sustainable policies for the management of the coastal defences along the southern frontage of the Eastoke Peninsula. The plan recommends maintaining a shingle beach to a 1 in 200 year standard of protection through annual Shingle Recycling operations and periodic recharge from Chichester Harbour entrance.

- Beach Nourishment 2006 Project Appraisal Report: This report sought and successfully achieved FDGiA to undertake a Beach Nourishment operation along the shore of Eastoke Beach in order to raise the defence to provide a 1 in 200 year standard of

protection against coastal erosion and flooding.

- Beach Recycling 2008-2012 Project Appraisal Report: This report sought and successfully achieved FDGiA to undertake annual beach recycling operations on the southern Eastoke frontage at Hayling Island for 5 years.

- South Hayling BMP 2012 – 2017 Project Appraisal Report (this was a joint submission with the Eastoke Point Scheme Project Appraisal Report):

  The most recent BMP (Ref 1.12) was adopted in 2012 with the following objectives:
  - To reduce the risk of coastal erosion by providing protection against breaching of the defences and a reduction in coastal flooding.
  - To reduce the risk of flooding from extreme surges.
  - To provide clearly defined defences with good access for maintenance.
  - To limit the impact of the scheme on people and property.
  - To provide a scheme which is adaptable to sea level rise and climate change.
  - To maintain the amenity benefit of the beach over the whole frontage for both the local population and the holidaymakers who visit the area.

1.7 Relevant Information

The following provides a list of all sources of information that has been referenced in this section of the BMP.

Ref 1.1 **North Solent Shoreline Management Plan**, New Forest DC (2010)

Ref 1.2 **Hayling Island : Eastoke Sectoral Strategy Study**; Joint report to Havant Borough Council and Environment Agency, W.S. Atkins Ltd (2006)

Ref 1.3 **Improving Beach Management on a Nourished Beach; Morphodynamics at Hayling Island, UK**, Unpublished MPhil Transfer Report, School of Environment and Civil Engineering, University of Southampton. Moon, C.R. (2010).

Ref 1.4 **Reconstructing coastal flood occurrence combining sea level and media sources: a case study of the Solent, UK since 1935**, Natural Hazards, 59 (3), 1773-1796, Ruocco A. C., Nicholls, R.J., Haigh, I.D. and Wadey, M.P. (2011).

Ref 1.5 **Condition Assessment Manual**, Document Reference 166_03_SD01, Environment Agency (2006).

Ref 1.6 **Hayling Island Seafront Masterplan**, Havant BC (2012).

Ref 1.7 **South East Coast BMP Programme**, Project Code IMSE100035, Environment Agency (2011).

Ref 1.8 **Marine Licensing guidance 2: Construction (including renewables) and removals,** Marine Management Organisation (2011). Internet site: http://www.marinemanagement.org.uk/licensing/documents/guidance/02.pdf. Date accessed: 1st Aug 2012.

Ref 1.9 **Eastoke Point Coastal Defence Study**, HR Wallingford (2008).

Ref 1.10 **BMP 1992 – 1996**, Technical Report, Havant BC (1992)

Ref 1.111 **Beach Management Strategy Plan**, Technical Report, Havant BC (1999)

Ref 1.12 **BMP 2012 – 2017, Technical Report, Havant BC (2012)**

2. SUPPORTING INFORMATION

This section of the Beach Management Plan (BMP) provides a summary of the coastal processes affecting the BMP frontage, extending along the 8 kilometre South Hayling coastline, between the Ferryboat Inn and Hayling Island Sailing Club (HISC). This includes an assessment of the following information:

- Sea levels (tidal information, extreme water levels);
- Wave climate (typical waves, extreme waves);
- Joint probability of extreme wave and water levels;
- Climate change;
- Sediment characteristics and transport (sediments, shoreline movement, beach stability);
- Environmental characteristics;

The 'Sea levels, Wave climate' and 'Sediment characteristics and transport' sections have been updated since the South Hayling BMP (2012), using South-east Regional Coastal Monitoring Programme data. The remaining sections use the same information as the last iteration given there is no new data available.

2.1 Sea Levels

2.1.1 Typical Tidal Levels

Tide levels for Chichester Harbour Entrance (Ref 2.1) are provided in Table 2.1. Admiralty Tide Tables are published annually which provide predictions of astronomic tides for the following year. Astronomic tide predictions are also available from the UK Hydrographic Office (UKHO) website up to 7 days in advance (Ref 2.2). Up to date and historical tide data, which includes both astronomic and meteorological effects, can be obtained from the National Tide and Sea Level Facility (NTSLF) network based at the British Oceanographic Data Centre (BODC) (Ref 2.3) and CHIMET (nearshore metocean, wave and water level station from Chichester Bar Beacon approximately 0.5 miles out to see from Chichester Harbour entrance) (Ref 2.4). The nearest NTSLF tide gauge is located just inside Portsmouth Harbour. The CHIMET gauge is located in the outer entrance channel to Chichester Harbour.

Table 2.1 Typical Tide Levels at Chichester Harbour (Ref 2.1)

	Tide Level	
	Chart Datum (mCD)	**Ordnance Datum Newlyn (mOD)**
Highest Astronomical Tide Level (HAT)	5.3	2.56
Mean High Water Springs (MHWS)	4.9	2.16
Mean High Water Neaps (MHWN)	4.0	1.26
Mean Sea Level (MSL)	2.9	0.12
Mean Low Water Neaps (MLWN)	1.9	-0.84
Mean Low Water Springs (MLWS)	0.9	-1.84
Lowest Astronomical Tide Level (LAT)	0.2	-2.54

The typical spring tidal range at Eastoke is 4m. There is a height difference of ±0.2m on spring tides when comparing Portsmouth tides to Chichester Harbour.

2.1.2 Extreme Still Water Levels

Extreme still water levels can cause coastal flooding, or allow waves to cause flooding by reducing the freeboard (difference between top of defences and the still water level). The latter is the situation for Hayling open coast where the wave period and hence run-up can be relatively high. Extreme sea levels can occur due to a large astronomical tide, surge or both. The nearest high quality record of sea levels relevant to Hayling is the tide gauge at Portsmouth, which provides a record of observed sea levels from 1991-present. Data can be downloaded from the British Oceanographic Data Centre (BODC). To determine the probability of the sea levels in this time series, extreme still water levels statistics (return periods) are available from the Environment Agency's Coastal Boundary Data project (Ref 2.5). A standard surge curve is also available for use if required for further analysis (e.g. flood modelling). The extreme water levels for the nearest Coastal Boundary Data grid points (No. 4604, No. 4610 and No. 4616) (Figure 2.2) are shown in Table 2.2. When considering surges in the context of extreme sea levels the most relevant measurement of surge is the 'skew surge' (Figure 2.1), which is the observed sea level minus the predicted tide – this eliminates misleading values of mid-tide surges (Ref 2.31). Mean sea level rise means that more recent (and future) sea level extremes are likely to occur more often. Therefore when considering return periods for sea level events, allowance can be made for mean sea level rise since these probabilities were generated (the 'base year' for the analysis was 2008). Typically this would use a rate from the observed sea level records (approx. 1.8 mm per year) to 'offset' the levels.

The highest sea level recorded at Portsmouth (within the 25 years of data in the BODC

database) was on 6th December 2013 of 5.56 mCD (approximately a 1 in 10 year return period). This was generated by a North Sea surge (which registered as a skew surge of approx. 0.7m at Portsmouth). This surge propagated east to west along the English Channel. Due to the lack of accompanying wind and waves that event did not generate open coast flooding in the Solent. It is surges associated with south-westerly storms that pose the greatest threat to the open coast at Hayling, since the extreme sea level will be accompanied by large waves. This was the case for the 2nd highest sea level event of 14th February 2014 of 5.54 mCD, when an almost 0.9m skew surge accompanied by large waves caused flooding and erosion along English Channel coasts, including at Hayling Island. It is notable that on 3rd November 2005 houses flooded severely at Eastoke due to energetic swell waves overtopping the beach when the sea level was 5.17 mCD (approx. 1 in 1 year return period, with a 0.3m skew surge). This event highlighted the important contribution of wave run-up and possibly other factors (drainage, beach levels etc.). However, larger sea levels allow waves to attack further up the beach and also represent stormy conditions that would damage the beach and defences. The 2013/14 season is remarkable for the frequency of storms over a 143 year record (over the UK and Ireland) (Ref 2.32), and along with high tides these storms generated 11 high waters in exceedance of the 1 in 1 year return period at Portsmouth (Ref 2.33). It has been noted that this exceptional period of 'temporal clustering' of storms caused high levels of damage and erosion to many beaches along the UK south coast (Ref 2.34).

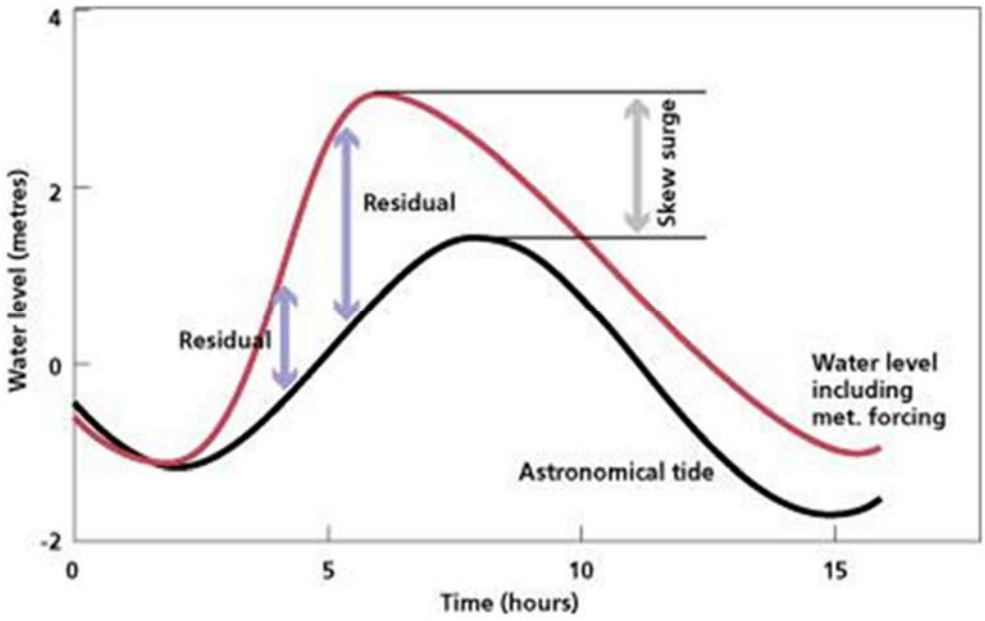

Figure 2.1 Illustration of the 'skew surge' concept used to develop return period statistics for UK Coastal Flood Boundary Conditions for UK Mainland and Islands (Ref 2.5). Source: National Tide and Sea Level Facility

Figure 2.2 Extreme water level grid points 4616, 4610 and 4604 from the Extreme Sea Level study within the EA's Coastal Flood Boundary Conditions for UK Mainland and Islands guidance (Ref 2.5)

Table 2.2 Extreme water levels (Ref 2.5)

Return Period (1 in X years) [APO]	Chainage 4616 (Portsmouth harbour entrance tide gauge)		Chainage 4610		Chainage 4604	
	Water Level (mOD)	Water Level (mCD)	Water Level (mOD)	Water Level (mCD)	Water Level (mOD)	Water Level (mCD)
1 [100%]	2.56	5.29	2.65	5.39	2.75	5.49
2 [50%]	2.64	5.37	2.73	5.47	2.82	5.56
5 [20%]	2.73	5.46	2.83	5.57	2.92	5.66
10 [10%]	2.81	5.54	2.90	5.64	2.99	5.73
20 [5%]	2.88	5.61	2.97	5.71	3.07	5.81
25 [4%]	2.9	5.63	3.00	5.74	3.09	5.83
50 [2%]	2.98	5.71	3.07	5.81	3.16	5.90
75 [1.3%]	3.02	5.75	3.11	5.85	3.21	5.95
100 [1%]	3.05	5.78	3.14	5.88	3.24	5.98
150 [0.7%]	3.09	5.82	3.18	5.92	3.28	6.02
200 [0.5%]	3.12	5.85	3.21	5.95	3.31	6.05
500 [0.2%]	3.14	5.87	3.31	6.05	3.41	6.15
1000 [0.1%]	3.16	5.89	3.38	6.12	3.48	6.22
10000 [0.01%]	3.21	5.94	3.62	6.36	3.73	6.47

2.2 Wave Climate

2.2.1 Offshore Extreme Wave Climate

The published Best Practice Guidance from 'Coastal Flood Boundary Conditions for UK Mainland and Islands' (Ref 2.6) has been used to identify the relevant extreme (marginal) swell wave heights. The location of the grid point used is illustrated in Figure 2.3, and the outputs presented in Table 2.3 and Table 2.4.

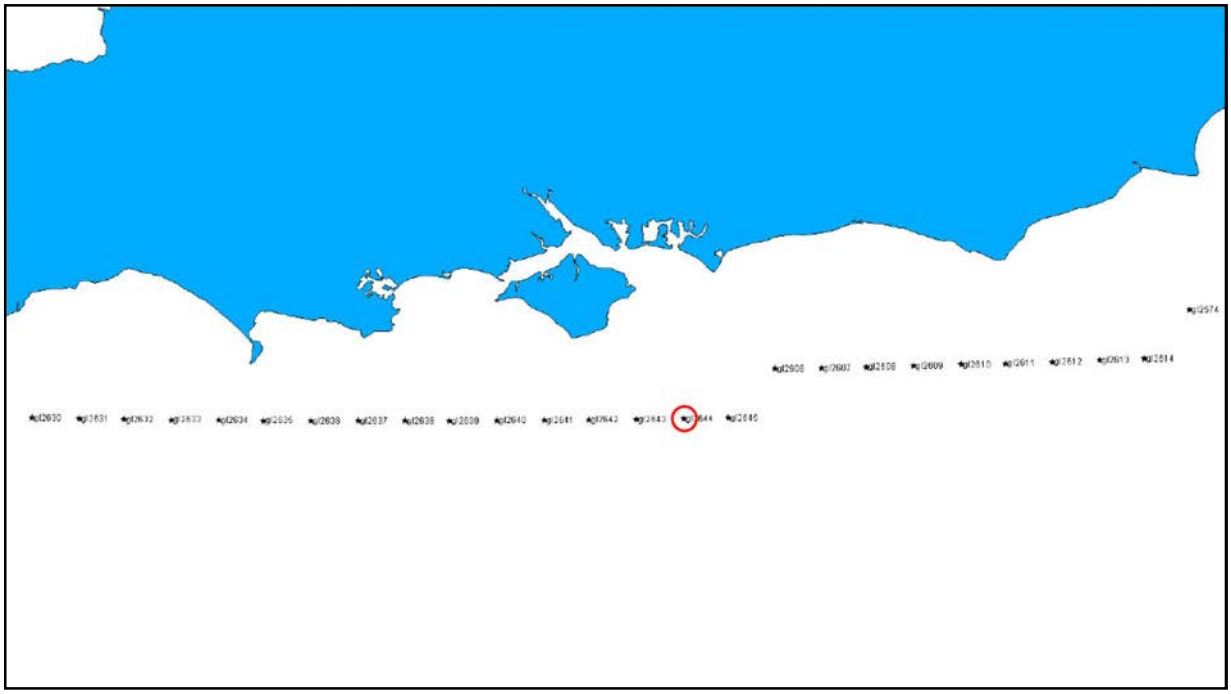

Figure 2.3 Coastal Flood Boundary Extreme Swell Grid Point Locations

Table 2.3 Extreme offshore swell heights, GL2644 (Ref 2.6)

Return Period	Swell from south (m)	Swell from south-west (m)
T1	2.09	2.52
T2	2.32	2.66
T5	2.57	2.82
T10	2.72	2.92
T20	2.84	3.02
T25	2.88	3.04
T50	2.98	3.13
T75	3.03	3.17
T100	3.06	3.2

T150	3.1	3.24
T200	3.13	3.27
T250	3.15	3.29
T300	3.16	3.31
T500	3.2	3.35
T1000	3.25	3.4

Table 2.4 Extreme offshore swell period, GL2644 (Ref 2.6)

Wave Height (m)	T_z (seconds)					
	<8	8 - 10	10 - 12	12 - 14	14 - 16	>16
H_s <1	0.59	0.2	0.11	0.07	0.02	N/A
H_s 1-2	0.63	0.28	0.07	0.01	N/A	N/A
H_s 2-3	0.49	0.44	0.06	0.01	N/A	N/A
H_s 3-4	N/A	N/A	N/A	N/A	N/A	N/A

Due to the importance of wave transformation at this site, the current assessment (following section) focuses upon nearshore wave conditions using observations from a wave buoy.

2.2.2 Nearshore Wave Climate

The processes of wave generation and transformation from offshore to inshore are particularly complex in the East Solent. Storm waves reaching the coast can be generated locally under winds from the south-west through to the east, or in the English Channel. Swell waves generated further afield will also penetrate the area, though heights will be modest (Ref 2.7).

The overall pattern for wave heights is a decrease in energy from east to west into the sheltered East Solent (Ref 2.8). Whitcombe (Ref 2.9) utilised a 100 to 200m resolution wave refraction model that indicated offshore waves are refracted as they enter Hayling Bay and converge on the East Winner and the banks/bars at the mouth of Chichester Harbour. Most waves along the central sector of Hayling Island approach normal to the shoreline, except when propagated across south-east and east-south-east fetch directions. Wave focusing is highest at the Eastoke frontage under swell waves approaching from the south-south-west.

Wave modelling carried out using hindcast data (based on 20 years data between 1971 and 1991) by HR Wallingford (Ref 2.10) and updated in 2006 to reflect the longer data set (Ref 2.29), predicts the following return periods for waves at Hayling Island.

Table 2.5 Predicted extreme wave conditions adjacent to Hayling Island

Point (Ref 2.10)	Location	Depth (mCD)	Significant wave heights (m) for given return periods		
			1 year	10 year	50 year
11	Entrance to Chichester Harbour	-9.4	2.82	3.42	3.84
12	SW of West Pole, eastern end of Hayling Island	-2.0	3.61	4.34	4.83
13	Eastoke, Hayling Island	-2.0	5.19	6.45	7.31
14	West Town, Hayling Island	-2.0	3.30	4.00	4.48
15	East Winner, western end of Hayling Island	-2.0	3.83	4.71	5.32
16	Entrance to Langstone Harbour	-10	2.10	2.42	2.62

A directional Waverider buoy has been deployed off Hayling Island since July 2003 in ~10m water depth as part of the Southeast Strategic Regional Coastal Monitoring Programme. Summary statistics for wave height and direction (

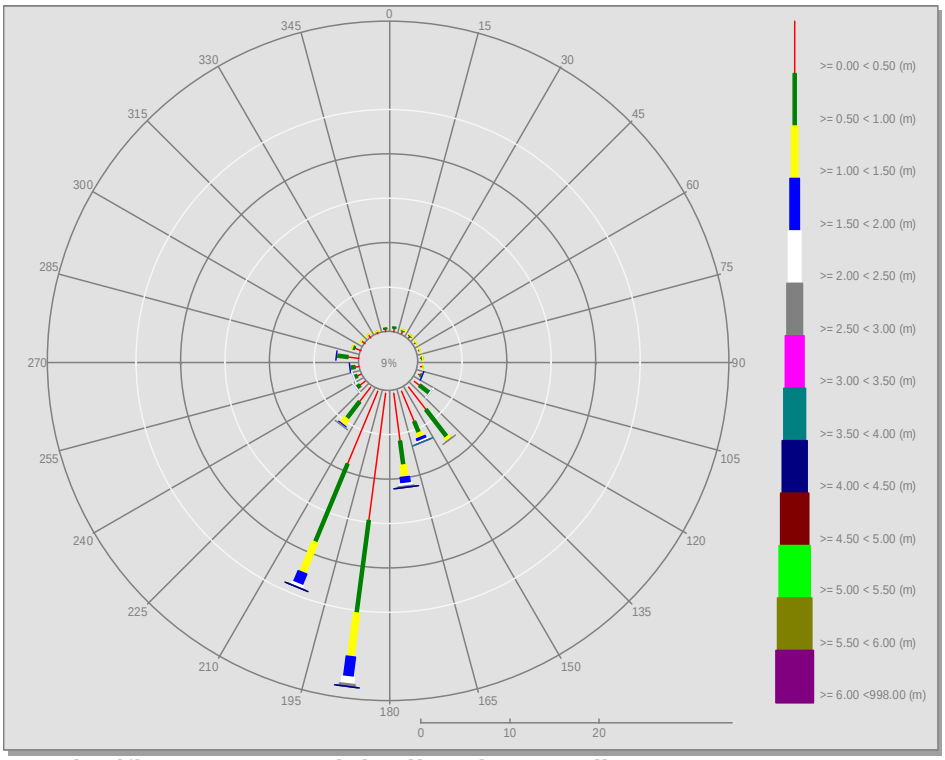

Figure **2.4 Significant Wave Height direction, Hayling Wave Buoy 2003 – 15 (Ref 2.30 – CCO, 2016)**

, annual maximum wave height (Table 2.6) and incidence of storms (**Error! Reference**

source not found.) are presented below.

Figure 2.4 Significant Wave Height direction, Hayling Wave Buoy 2003 – 15 (Ref 2.30 – CCO, 2016)

The wave rose of H_s (significant wave height) and direction shows a S - SSW dominated wave climate (

Figure **2.4**). This matches the predominant SW winds and direction of swell waves refracting around the Isle of Wight.

Table 2.6 presents the maximum wave height per year since 2003 for the Hayling Island wave buoy. The 4.4m significant wave height recorded during the Easter 2016 storm is the highest recorded since 2003. It is equivalent to approximately a 1 in 30 year wave height. The next largest wave height recorded on the 5th February 2014 at 4.13m was downgraded from a 1 in 50 year to a 1 in 10 year event following the Easter 2016 storm (*Channel Coastal Observatory, personal comment, 2016*).

Table 2.6 Annual wave statistics – Hayling Island wave buoy (CCO, 2016)

Year	Annual Maximum H_s	
	Date	A_{max} (m)
2003	29-Nov-2003 10:00	2.68
2004	08-Jan-2004 10:30	3.64
2005	02-Dec-2005 17:00	3.53
2006	03-Dec-2006 08:00	3.42
2007	18-Jan-2007 13:00	3.58
2008	10-Mar-2008 08:00	3.79
2009	14-Nov-2009 13:30	3.36
2010	11-Nov-2010 08:30	3.25
2011	13-Dec-2011 01:00	3.77
2012	03-Jan-2012 08:30	3.32
2013	28-Oct-2013 06:00	3.73
2014	05-Feb-2014 14:30	4.13
2015	15-Jan-2015 03:00	3.37
2016	28-Mar-2016 03:00	4.40

FigureFigure 2.5 shows the incidence of storms since 2003, demonstrating that the winter of 2013/2014 was the stormiest on record since the buoy was deployed. Emergency works were undertaken at Eastoke following the 14th February 2014 storm, whereby 25,400m^3 of material was recycled from Gunner Point back to Eastoke to reinstate the beach profile.

During the winter of 2015/16, the Channel Coastal Observatory (CCO) note, '*eight storms exceeded the 2.9m threshold from midwinter to early spring. The storm on 28 March 2016 was the largest recorded at the site and was distinctly bi-modal with waves of around 17 seconds, while the rest were relatively unexceptional*' (see Figure 2.5). The clustering effect of the low magnitude, high frequency storms during the winter of 2015/16 coupled with the highest percentage of bi-modal seas recorded in December 2015 (see Section 2.2.3) and the highest recorded wave height on the 28th March 2016, resulted in substantial draw down of the beach at Hayling Island.

Fortunately the Eastoke Point scheme was completed by November 2013. Therefore the severity of flooding via Bosmere Road to Eastoke was less for the winter of 2013/14 and minimal for 2015/16 compared with earlier storms.

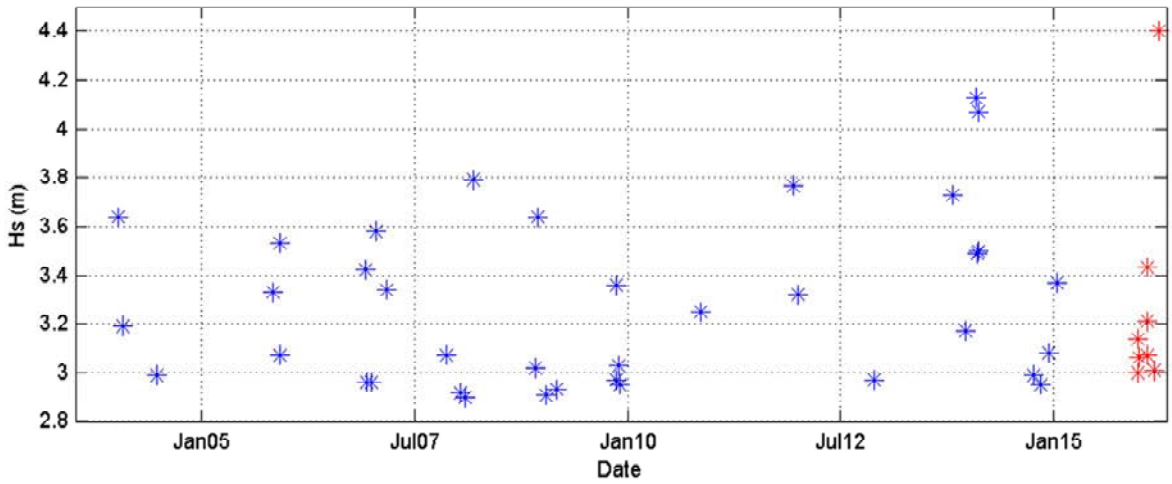

Figure 2.5 Incidence of storms since deployment where Hs > 2.8m (Ref 2.30 – CCO, 2016)

2.2.3 Bi-Modal Wave Climate

Hayling Island has been identified as a site influenced by a bi-modal wave climate, where there is a combination of not only wind waves but swell waves also. SCOPAC research (Ref 2.12) identifies that the current methods for scheme design do not tend to account for bi-modal wave conditions. Coastal flood forecasts often fail to predict these significant events

which result in unexpected wave overtopping, leading to flood damage and a need for substantial maintenance. During the November 2005 event, long period swell waves, within a bi-modal wave climate, played a key role in overtopping the nourished beach, with a dominant wave period of over 18 seconds, in combination with a high spring tide and tidal surge.

The CCO report the average occurrence of bi-modal wave conditions for the month of December for the Hayling Island wave buoy is 11%. During December 2015 this rose to 38%, which is the highest ever recorded by the South-east Regional Monitoring Programme (*Channel Coastal Observatory personal communication, January 2016*) and coincides with beach draw down.

SHINGLE-B is an output from physical model tests to establish the response of barrier beaches to bi-modal waves. The model was developed by HR Wallingford as part of a CCO led FDGiA (Flood Defence Grant in Aid) project. Sensitivity testing of the existing design profile were undertaken however, results were inconclusive given the user manual was being developed at the time of testing and bi-modal extremes do not exist for Hayling Island (see Section 3.2.4).

2.3 Joint Probability Extreme Wave and Water Levels

The joint probability of wave and water levels based on the Coastal Flood Boundary Conditions (Ref 2.6) are presented below (Ref 2.13). The analysis is based on swell waves as experience has shown that most overtopping is associated with longer period wave conditions. These figures are regarded as the most applicable offshore joint probability figures available for the BMP frontage.

Table 2.7 Joint Probability of offshore water levels and wave heights (Ref 2.13)

Water Level (m AOD)	Wave Direction (°N)	
	Swell from South	Swell from Southwest
2.44	3.27	3.13
2.52	3.23	3.09
2.59	3.16	3.01
2.68	3.06	2.89
2.75	2.96	2.77
2.82	2.86	2.63
2.92	2.71	2.4
2.99	2.58	2.19
3.07	2.44	1.96
3.16	2.25	1.66

3.24	2.11	1.43
3.31	1.97	1.2

The offshore joint probability values were also transformed inshore to profile 5a00276 on the Eastoke nourished frontage as part of the design for the Eastoke Point Scheme (Ref 2.13) using a spectral wave model.

Table 2.8 Joint probability of nearshore water levels and wave heights (Ref 2.13)

Events	Water Level (m OD)	Offshore Waves		Results (Hs / Tp) (distance to shore)		
		Hs (m)	Tp (s)	80m	120m	160m
1:200yr swell from southwest	2.94	3.27	20	2.47 / 19.28	2.44 / 19.28	2.45 / 19.28
	3.42	2.71	20	2.45 / 19.28	2.42 / 19.28	2.42 / 19.28
	3.81	1.97	20	1.86 / 19.28	1.83 / 19.28	1.84 / 19.28
1:200yr swell from south	2.94	3.13	20	2.50 / 19.28	2.46 / 19.28	2.47 / 19.28
	3.42	2.40	20	1.33 / 19.28	2.28 / 19.28	2.29 / 19.28
	3.81	1.20	20	1.18 / 19.28	1.16 / 19.28	1.16 / 19.28

2.4 Climate Change and Risk

The latest advice for adapting to climate change was issued on 1st September 2011 by the Environment Agency (EA), Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities (Ref 2.14) – from here on referred to as "EA 2011". This guidance replaces the previous advice (Ref 2.15) and includes updated sea level rise allowances for Flood and Coastal Risk Management (FCERM) based on the UK Climate Projections 2009 (UKCP09) climate change projections.

A range of scenarios are provided in the EA 2011 guidance, including low and high emissions scenarios demonstrating the range of future uncertainty. Upper end estimates have been developed based on a low probability high end scenario (UKCP09 H++ scenario) which is beyond the likely range but considered to be within physical plausibility. Based on the EA 2011 guidance the upper confidence bound (95 percentile) medium emissions scenario has been adopted as the appropriate 'change factor'.

2.4.1 Sea Level Rise

For the purpose of the BMP, long term sea level rise is secondary as the BMP only covers 5 years ahead where, based on the EA 2011 guidance, a 0.028m increase can be expected. This is within the general error margins of any of the methods employed for the joint return period analysis or beach surveys. However, for completeness the latest figures and previous

predictions are compared below (Table 2.9 and Figure 2.6). For the period of the BMP (2017 – 2022) the rate of SLR predicted over 5 years is within 7mm of the previous DEFRA (Department of Environment, Food and Rural Affairs) 2006 allowances.

Table 2.9 Comparison of SRL predictions (mm), 1990 - 2100

	1990	2000	2010	2020	2030	2040	2050	2100
Defra Supplementary note March 2003	0	60	120	180	240	300	360	660
Climate Change Impacts October 2006	0	40	80	120	182.5	267.5	352.5	980
EA2011 Upper End Estimate	0	40	80	120	175	245	315	945
EA 2011 H++	0	60	120	180	272.5	397.5	522.5	1902.5
EA 2011 Low emission 50%	0	30	62	97	135	176	219	474
EA 2011 Medium emission 95%	0	44	93	146	204	266	332	728

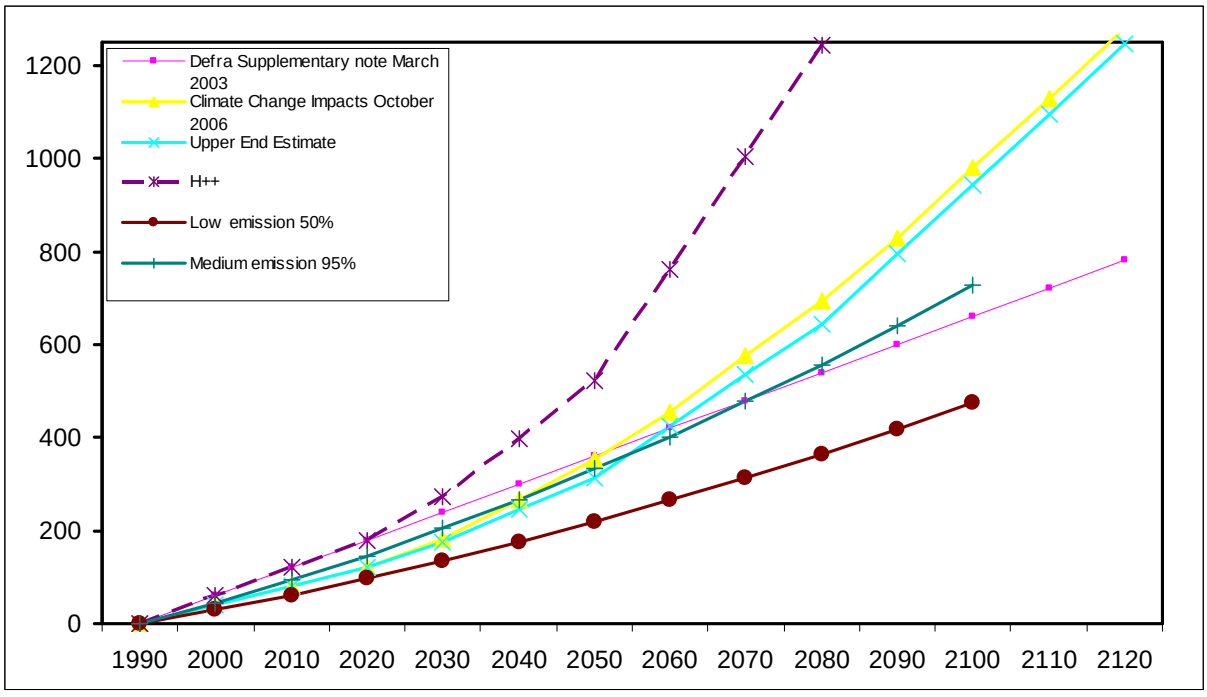

Figure 2.6 DEFRA 2003, 2006 and EA 2011 sea level rise predictions

2.1.1 Future Extreme Waves

The EA 2011 guidance does not currently provide advice on a change or increase in wave climate due to climate changes, but does note,

'It is anticipated that over the next 12 months, wave climate projections will become available covering significant wave height, period and direction. When these are published this advice note will be updated to include that evidence.'

This data will be crucial to the BMP and proposed testing of the design profile when available.

2.4.2 Change in Surge

The EA 2011 guidance suggests the addition of the following regarding surge:

	Total potential change anticipated up to the 2020s	**Total potential change anticipated up to the 2050s**	**Total potential change anticipated up to the 2080s**
Upper end estimate	20cm	35cm	70cm
Change Factor	Ensure a rigorous assessment of the current coastal extreme water level has been undertaken	Ensure a rigorous assessment of the current coastal extreme water level has been undertaken	Ensure a rigorous assessment of the current coastal extreme water level has been undertaken

The EA 2011 guidance does recognise there is considerable uncertainty in these projections.

2.5 Sediment Transport

2.5.1 Sediments

The coastline is characterised by mixed sand and gravel (shingle) beaches and a low lying hinterland. The geology of the study area comprises a mixed sand and shingle storm beach overlying Upper Eocene deposits of the Barton, Bracklesham and Bagshot beds.

Some sections of beach have been subject to human intervention measures, including hard sea defences and beach nourishment. The entire south Hayling Island frontage has now benefitted from the material nourished at Eastoke as it has been transported across the wider BMP study area since the original Hayling Island Beach Replenishment Scheme in 1985. The beach contains wide ranging grades from sand to shingle sized material, with any finer material rapidly being winnowed out of the beach if placed as part of the ongoing nourishment operations.

The last set of sediment samples were collected in 2009, on 23 different profiles around the frontage (Figure 2.7 and Appendix A). Surface samples were collected at the beach crest, MHW, MSL and MLW along each profile.

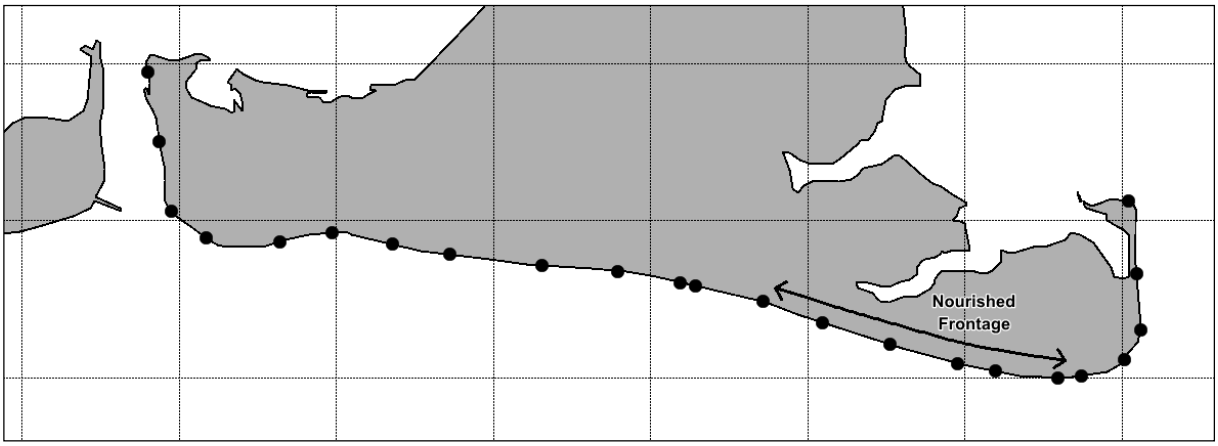

Figure 2.7 Location of sediment samples, Hayling Island

A summary of the key statistics is tabled below (Table 2.10).

Table 2.10 Summary of particle size distribution statistics for Hayling Island

		ALL SAMPLES	NOURISHED BEACH				
			ALL	CREST	MHW	MSL	MLW
Full Sample	D_{50} (mm)	1.1	1.1	1.6	0.6	1.1	1.0
	% sand	63.9	61.5	54.6	68.5	59.5	63.4
Coarse Fraction (>2mm)	D_{50} (mm)	5.7	5.6	6.3	5.3	5.6	5.2
	D_{90} (mm)	15.8	14.9	18.1	13.4	15.6	12.6

2.5.2 Shoreline movement

(a) Overview of shoreline evolution

Several authors have published work relating to the evolution of the shoreline covering the BMP frontage, notable examples include Harlow (Ref 2.16), Whitcombe (Ref 2.9), Webber (Ref 2.17), Wallace (Ref 2.18) and DEFRA (Ref 2.19) with annual reports on more recent beach changes from CCO (Ref 2.20). In summary, the present shoreline of the East Solent is a result of very active post-glacial processes of erosion and accretion, increasingly controlled by coastal defences and Beach Management Activities over the last century. Substantial erosion and roll back of the shingle banks has occurred along the eastern frontage of Hayling Island. Concurrent accretion has occurred in the central and western parts of the frontage. This is particularly so at Gunner Point where the shoreline has moved seaward by up to 350m since 1832 (Figure 2.8), resulting in the development of multiple shingle ridges.

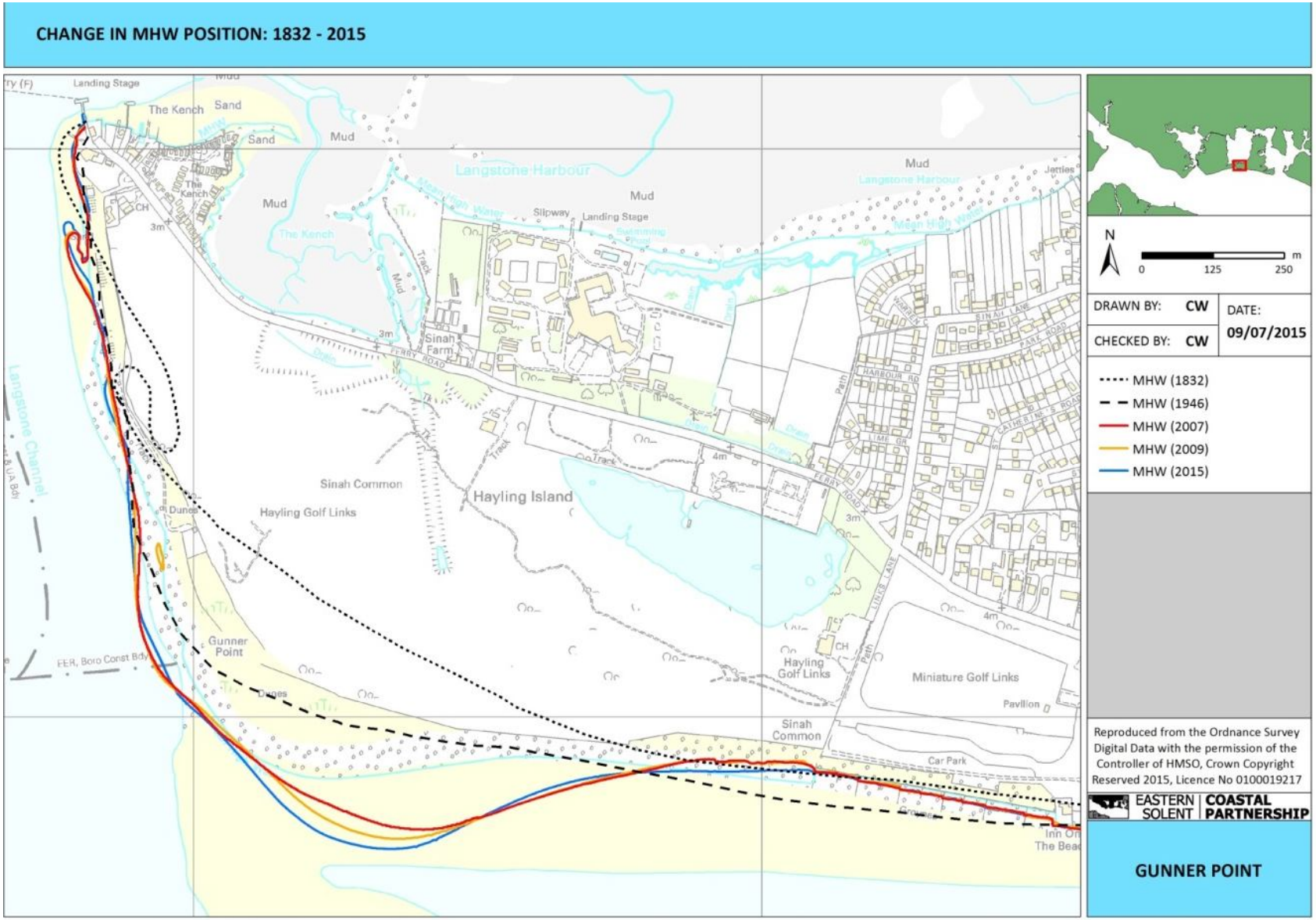

Figure 2.8 South West Hayling Island MHW 1832 - 2015

Black Point spit (BMP U1) has grown north and changed morphology markedly in the past and is currently undergoing significant accretion of sand at the tip. The proximity of the deep water channel at the entrance to Chichester Harbour, with its rapid ebb and flood flows and the intermittent onshore transport of material from the ebb delta complicate matters to such a degree that beach changes at Eastoke Point cannot be predicted with any degree of certainty (Ref 2.10), although the coastline is now stabilised by the 2013 rock revetment scheme. The Eastoke frontage (BMP U3) has been subject, by contrast, to a steady rate of recession given the wave focusing and location of the drift divide.

The wide shingle beach in the central part of Hayling (BMP U4 and U5) has experienced steady accretion during most of the last century, with the western end of the Hayling frontage historically being an area of accretion and continues to be so (BMP U6, U7 and U8).

(b) Sediment transport pathways

A number of studies have investigated the geomorphology and sediment transport around the Hayling coastline, and the adjacent Chichester Harbour tidal inlet, covering both pre- and post-nourishment periods. The SCOPAC Sediment Transport Study (Ref 2.21) provides a review of the available research up to 2004. Further detailed studies have been carried out by the Eastern Solent Coastal Partnership to improve the understanding of sediment transport from the nourished Eastoke frontage and around the wider frontage. The main sediment transport pathways around the BMP frontage are shown below (Figure 2.9).

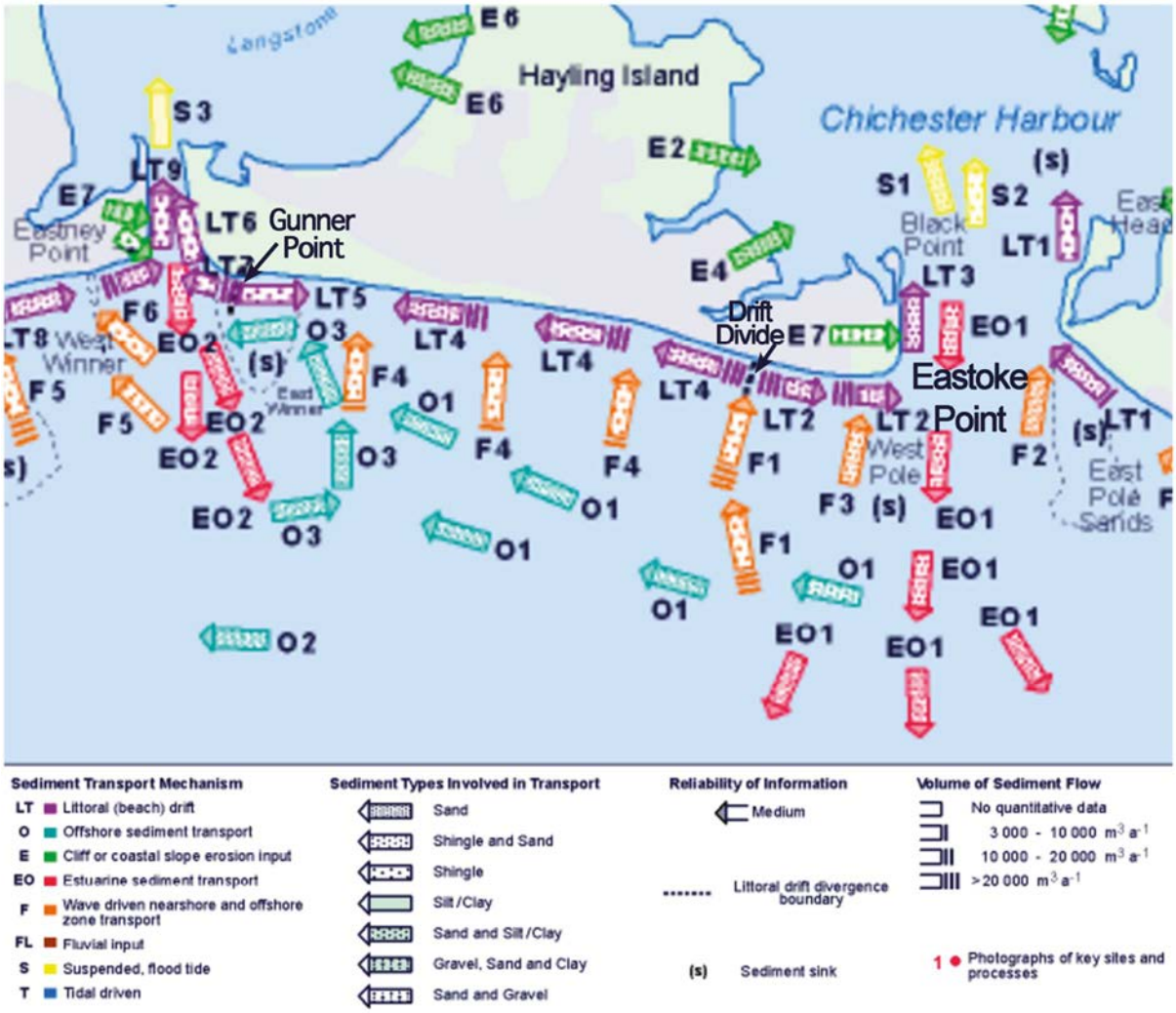

Figure 2.9 Sediment Transport Pathways (adapted from Ref 2.21)

The Hayling open coast has a drift divide located at the centre of the nourished frontage, close to Creek Road car park, where the natural supply of material onshore (F1, Figure 2.9) is not sufficient to maintain the beach to the required levels. Beach sediment is transported both east and west off the nourished frontage at the drift divide by wave action.

Beach recycling is now the main source of beach material to the wider south Hayling frontage, and the Futurecoast Study (Ref 2.19) identified Gunner Point as a potential beneficiary of the ongoing artificial recharge and recycling operations. Indeed, Harlow (Ref 2.16) assessed this area as a potential source of material for the 1985 Hayling Island Beach Replenishment Scheme. Since the last iteration of the Hayling BMP (2012), discussions with the landowner at Gunner Point and Natural England have given agreement in principle for Havant Borough Council to recycle material from Gunner Point back to Eastoke on an annual basis. This agreement in principle is dependent on the beach condition and landowner agreeing to the quantities of material being extracted prior to any extraction, as

well as environmental restrictions being adhered to, all of which are detailed in the Environmental Impact Assessment that will support the extended Planning and Marine Licence applications.

To the west of the nourished frontage net westward sediment transport is dominant. At Gunner Point there have been temporary drift reversals but a deployment of tracer pebbles in 2011 confirmed the movement of material around the point and up into the harbour entrance (Figure 2.10 and Figure 2.11). Once inside the harbour entrance rates of transport fall, and beach material is either lost into the deep water channel or slowly moves north towards the Ferryboat Inn.

The Ness at Sandy Point appears to represent a point where the influence of wave action and strong tidal flows counteract each other. Sediment transport north past this point still occurs but a large proportion of beach material moving onto the Ness is either stored as an accumulation of material or lost into the adjacent deep water channel (Figure 2.12). There is currently ongoing accretion of sand occurring on Black Point Spit, suggesting that the transport of shingle up toward the distal end of the spit slows due to the drop in wave energy in the harbour entrance. Limited quantities of gravel sized material are evident beyond the HISC pontoon as the sand fraction of the beach material is more mobile and continues to move past HISC onto Black Point.

(c) Difference plot changes

An analysis of topographic data has produced difference plots between 2006 and 2016 using summer baseline surveys, showing annual change in beach levels (see Appendix A). A decrease in beach elevation is shown in red and an increase in beach elevation is shown in blue. The extent of the difference plots is depicted with a yellow boundary. Figure 2.13 is a difference plot using 2005 and 2015 Lidar from the South-East Regional Coastal Monitoring Programme, incorporating the East Winner at Langstone Harbour and West Pole Sands at Chichester Harbour. The vertical accuracy is ±15cm.

Despite the Beach Management Activities on the frontage, the key areas of accretion and erosion can be identified from Figure 2.13. The accretion of sand at the tip of Black Point spit is evident (BMP U1), as is the import of material to the Eastoke Point scheme (BMP U2). The Eastoke frontage (BMP U3) itself appears to be lower than 2005, with the open beach showing both accretion and erosion (BMP U4). West Beach (BMP U5) shows the roll back of beach following removal of the western part of the revetment. The substantial accretion of shingle at Gunner Point (BMP U7) is evident with pulses of accretion and erosion moving north into Langstone Harbour (BMP U8). The Langstone Harbour channel appears to have moved further east in this difference plot.

A sediment budget analysis incorporating the nearshore zone and Chichester Harbour and Langstone ebb delta systems is necessary to understand the onshore/offshore relationship between the two.

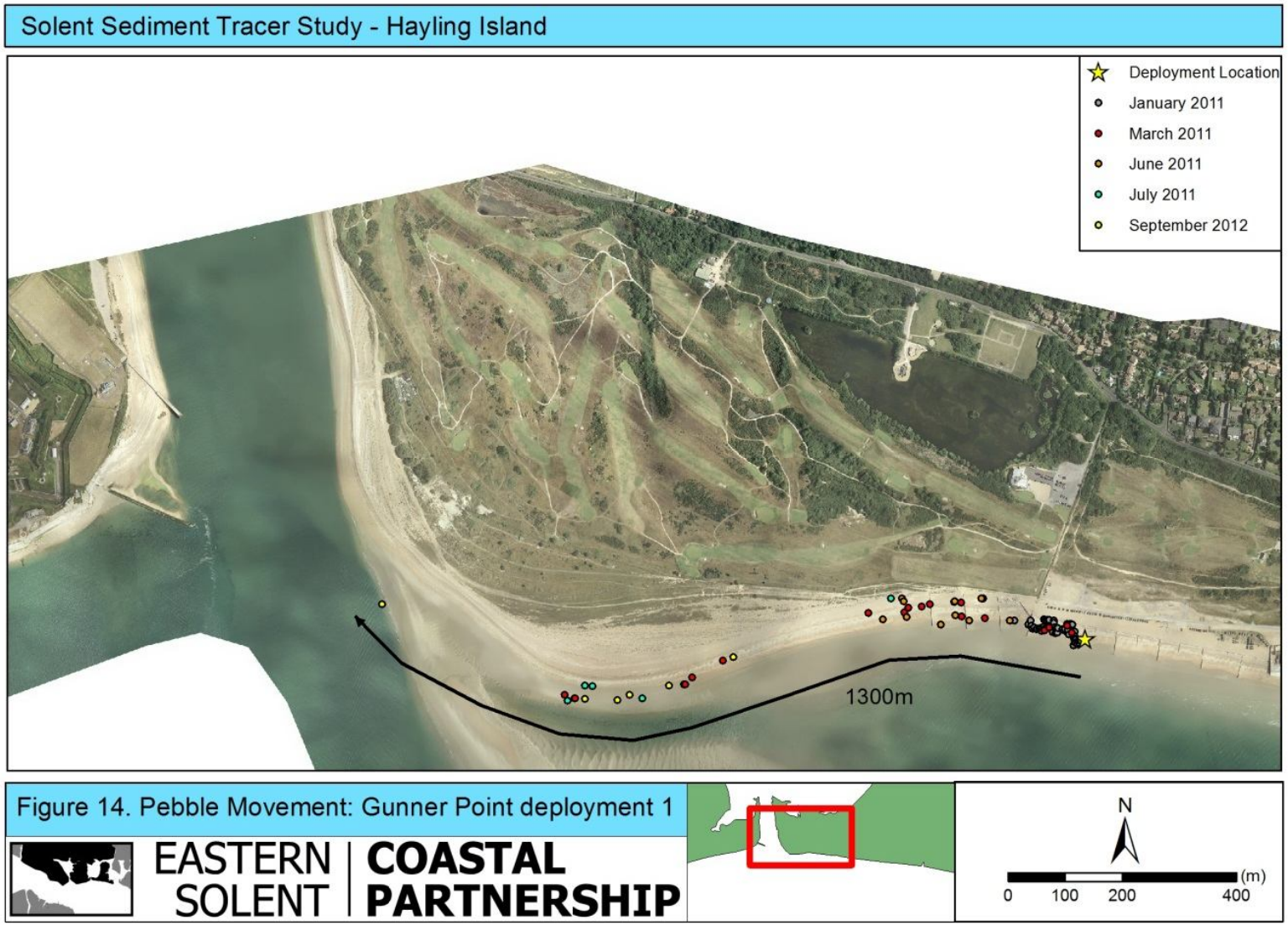

Figure 2.10 Results of the Tracer Study (Ref 2.35) for Gunner Point deployment (pebbles deployed in January 2011)

Figure 2.11 Results of the Tracer Study (Ref 2.35) for Gunner Point deployment (pebbles deployed in January 2011)

Figure 2.12 The sediment drift around Sandy Point and Black Point Spit

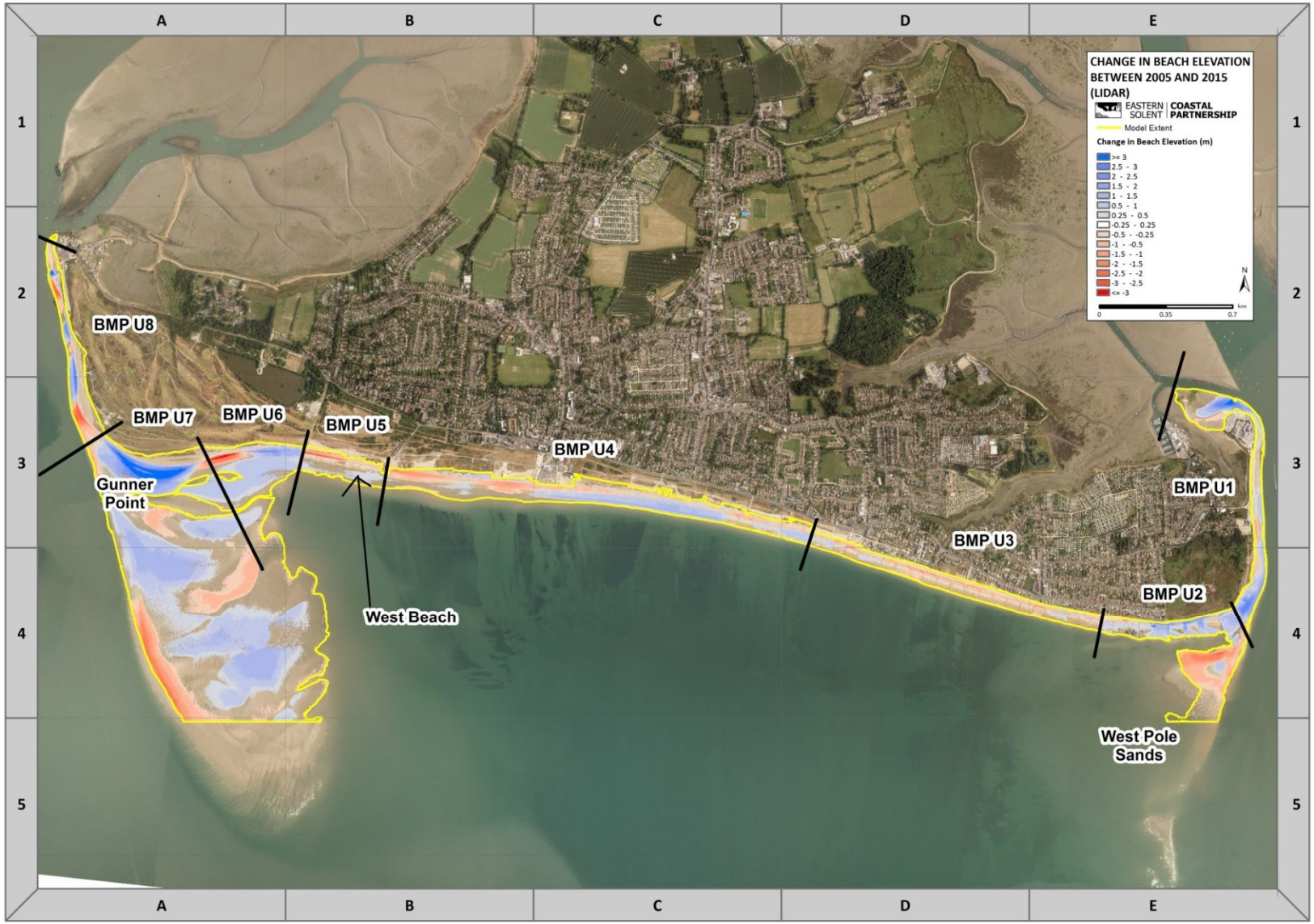

Figure 2.13 Difference plot showing beach change between 2005 and 2015

(d) Volume analysis

The summer baseline surveys have been analysed between 2006 – 2016 to assess changes in beach volume for the common area of all surveys above MLWS. Between summer 2006 and summer 2016 there has been an overall increase in sand and gravel beach volume of 252,934 m^3 around the South Hayling frontage beaches (this does not include the East Winner or West Pole Sands – Figure 2.13). Taking into account the 209,505 m^3 of land based and marine import, as well as Chichester Harbour dredged material supplied to the system over the same period this indicates an overall net increase of 43,429 m^3 over the 10 year period. This equates to an average annual increase of 4,343 m^3 around the South Hayling frontage beaches. Some of this additional material could be onshore feed of material, particularly onshore feed of sand from the Chichester Harbour ebb delta to BMP U1. The key point is that in terms of protecting the residential areas, the material is not accumulating at Eastoke where it is needed.

In the last South Hayling BMP (2012) there was an annual loss of 4,920 m^3 when analysing data between summer 2004 – summer 2011. When plotting the overall beach volume trends (Figure 2.14), it does appear there was a drop in overall beach levels for the south Hayling frontage between 2011 – 2013, explaining the annual loss between 2004 - 2011. In the past three years, the whole frontage (apart from the hotspots of erosion discussed in Section 2.6) appears to have recovered an accreting trend, with the majority of material gaining in volume at Gunner Point (predominantly shingle) and Black Point Spit (predominantly sand) (Figure 2.15). It's important to note that the changes in beach volume across the whole of South Hayling Island are very much inter-linked with nearshore changes to the Langstone Harbour and Chichester Harbour ebb delta systems, as well as the nearshore zone.

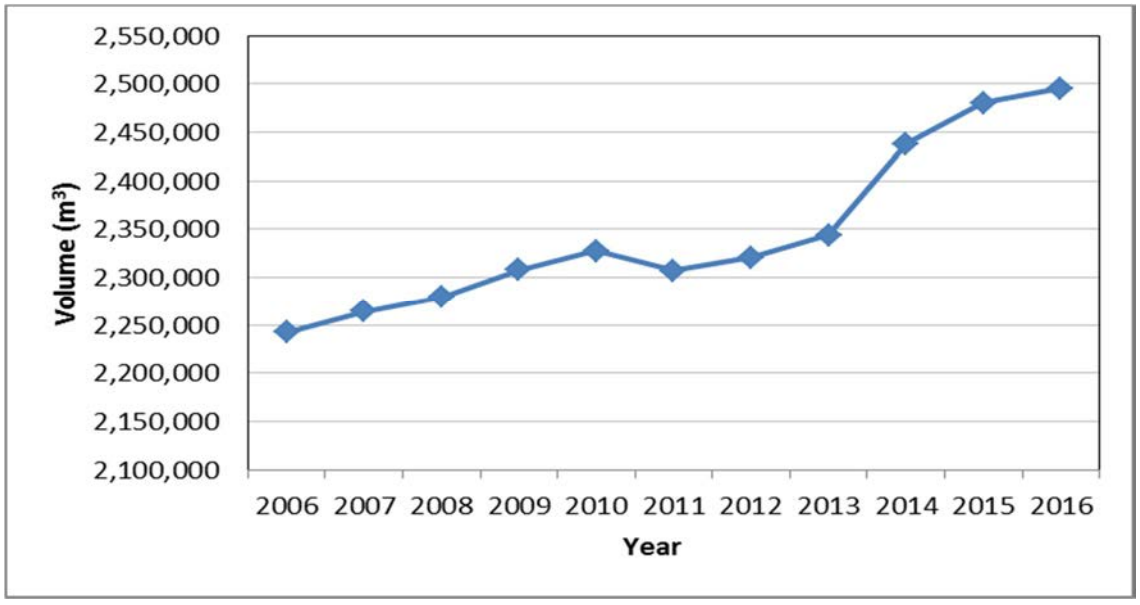

Figure 2.14 Total beach volume change along the South Hayling frontage (for a break down of the separate BMP Units refer to Figure 2.15).

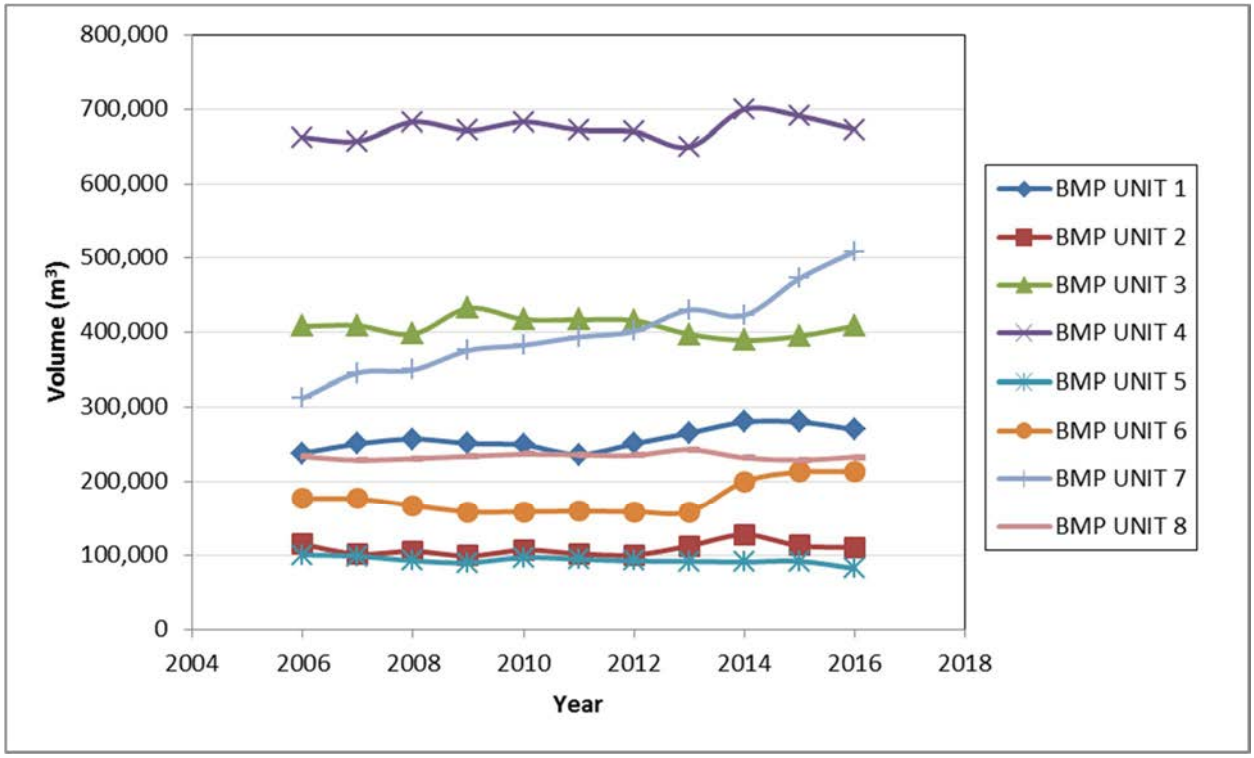

Figure 2.15 Beach volume change per BMP unit along the South Hayling frontage. Refer to Table 2.11 for locations.

Table 2.11 Names of the BMP Units and corresponding locations

Reference name	Location description
BMP UNIT 1	Hayling Island Sailing Club to Eastoke Point
BMP UNIT 2	Eastoke Point Scheme
BMP UNIT 3	Nourished Frontage (groynes 7-35)
BMP UNIT 4	Open Beach
BMP UNIT 5	Inn-on-the-Beach to driving range
BMP UNIT 6	Driving range to Gunner Point
BMP UNIT 7	Gunner Point
BMP UNIT 8	Gunner Point to Ferry Boat

Further analysis of volume changes between 2006 and 2016 for each BMP Unit has been carried out. Between Hayling Island Sailing Club and the Eastoke Point scheme (BMP U1), there has been a net increase of 31,797 m^3 since 2006, a large proportion of which is sand. Prior to the Eastoke Point scheme in November 2013, an average of 12,983 m^3 of shingle per annum was recycled from The Ness back to Eastoke between 2006 - 2012. Since the scheme, there was no extraction of material in 2013, with 4,180 m^3 extracted in 2014 and 16,192 m^3 extracted in 2015.

The Eastoke Point scheme (BMP U2) had an injection of 25,000 m^3 of material in 2013. Although this has been decreasing in volume since, the beach is at an adequate level.

For the nourished frontage at Eastoke (BMP U3), the volume of material has decreased during the last 5 year BMP as result of the 2013/14 storms and the 2015/16 storms (Figure 2.15). This is despite emergency works in 2014 whereby 25,000 m^3 of material was recycled from Gunner Point back to Eastoke. Still, there hasn't been a major import of material to Eastoke since 2009 when 90,392 m^3 of material was brought in via an offshore dredge (Appendix B). Since the 2009 dredge, there has only been 12,049 m^3 imported into the system up until summer 2016. At the time of writing (November 2016), a further 3,424m^3 is being imported by road. The remaining sources of material to Eastoke since 2009 have been 293,043m^3 of recycling; of which 25,000 m^3 was emergency works from Gunner Point and 29,260m^3 was from two Chichester Harbour dredge campaigns (Appendix B).The design profile graph (Figure 2.16) indicates additional material is required at the time of writing, to bring the beach back up to design volume and ensure there is enough material to recycle over the next 5 year phase of the BMP. Sources of this material are discussed in Section 5.1.1.

Between Eastoke Corner and Inn-on-the-Beach (BMP U4) and at West Beach (BMP U5), the beach volume has fluctuated depending on the amount of recycling that has taken place. Regardless of recycling, BMP U4 has an increase in beach volume of 10,321 m^3 since 2006 and BMP U5 has a decrease of 18,353 m^3 (Figure 2.15). In 2006 and 2007 no recycling material was extracted from the Open Beach due to ongoing monitoring showing a sharp drop in the volume of the Open Beach (BMP U4). After the 2007 recycling operation the beach increased in volume again and into summer 2008. Extraction from the Open Beach resumed in 2008, and in 2016 the largest recorded extraction took place (38,435 m^3) due to the low beach levels in BMP U3. The average annual extraction from the open beach between 2006 – 2016 is 13,323 m^3.

The area of erosion in front of the Golf Course Driving Range (BMP U6) appears to have stabilised for now following creation of a haul route in 2014 to transport material from Gunner Point to Eastoke. During the 10 year period of analysis there has been a net growth of material at Gunner Point of 196,459 m^3 (BMP U7), confirming the cuspate foreland is continuing to act as a long term sink but also a source of beach material on the frontage. From Gunner Point north to the Ferry Boat Inn (BMP U8) beach volumes have been stable, however, erosion and accretion pockets have formed.

In terms of recycling material, future extraction should target the areas of growth on the open frontage. An initial campaign to extract material from Gunner Point (BMP U7) is recommended, with extraction thereafter once material has accreted (see Section 4).

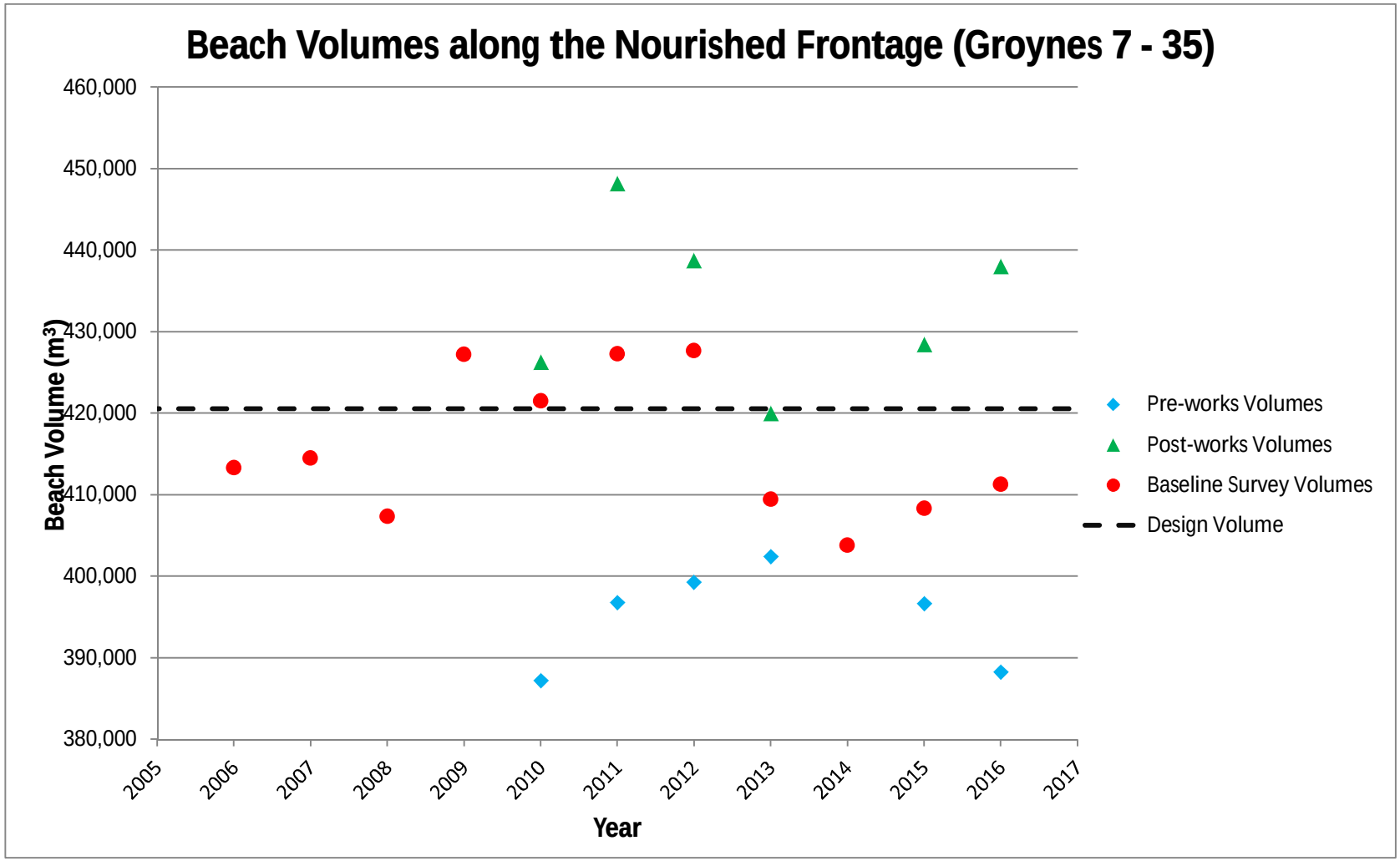

Figure 2.16 Eastoke beach design volume graph. Pre-works volume and post-works volume are beach volumes extracted from topographic surveys before and after Beach Management Activities. Baseline survey volumes are beach volumes extracted from summer topographic surveys. All surveys are clipped to a common area between 2006 and 2016; volumes are above MLWS and the design volume is based on a 1 in 200 year SoP.

The annual losses from the nourished frontage, based on CSA and volumetric analysis, are contained in Appendix B. Analysis of beach volumes above -4m OD from 1985 to 2003 in the previous BMP (2012) revealed net average annual losses off the frontage of 37,984 m^3. This iteration of the BMP analysed losses between 2006 and 2016 for which topographic survey data had a more continuous coverage and reached MLWS (-1.84m OD). Net average annual losses were 50,452 m^3 which corresponds well with the average annual volume of material brought into the nourished frontage at 51,064 m^3. The net average annual losses range from 31,285 m^3 to 79,824 m^3, with the higher losses generally associated with the larger recycling and marine-based recharge operations. Over the past 5 year BMP, net average annual losses have been 39,113 m^3. **Therefore, this iteration of the BMP will be costed on the requirement of 51,000m^3 in year 1 to bring the beach up to the required design volume for Eastoke, thereafter 39,000 m^3 will be required for year 2, 3, 4 and 5.**

This section has discussed beach volume changes across the south Hayling frontage, as well as extraction and deposition quantities. It should be noted that previous Beach Management Activities have utilised the arisings from maintenance dredging of the Chichester entrance channel, being comprised of material similar in composition to the nourished beach. In the last 5 year phase of the BMP, there were two maintenance dredges of the Chichester Bar; one in November 2015 (6,273 m^3) and one in October 2016 (22,987 m^3) (Appendix B). **Arisings from maintenance dredging of the Chichester entrance channel should be a preferred source of material for the next phase of the BMP. This is an excellent beneficial re-use of material; material that has arisen from this sediment cell.**

(e) Beach profile storm response

Along the nourished frontage the general post-storm response of the beach starting at the design profile is as follows:

- Rotation of profile around approx. MSL (mean sea level)
- Upper mobile beach face lowers
- Lower mobile beach face rises
- Cliffing develops in beach crest at upper limit of run-up
- If run-up exceeds crest elevation then material thrown over the beach crest and gathers on promenade to rear
- If overtopping severe then crest elevation reduced through overwashing and crest drops to 'failure' profile level, which is the height of the redundant sea wall

If the beach levels are low compared to the height of the timber groynes then long period waves have been observed to interact with the groyne, increasing run-up along the updrift side and eroding the beach crest. Initially this removes material from the beach crest leaving a cliff which blocks the wave from running up and over the crest. If conditions are severe enough then the waves overwash alongside the groynes, causing fans of beach material to be deposited on the promenade. In November 2005 the entire beach was overtopped with

the areas of the nourished beach performing least well corresponding with the three original erosion hot spots; Eastoke Corner, Creek Road and Eastoke Point (although Eastoke Point is no longer a hotspot following the 2013 scheme). It should be noted that at both Eastoke Point and Eastoke Corner the beach profile was not at the design profile prior to the storm event occurring. The beach at Eastoke Corner failed in the centre of one bay and was level with the promenade with no beach crest remaining. This happened again in 2016. At Eastoke Point the last bay on the promenade (Groyne 7 – Groyne 8) actually gained a small amount of material on the beach crest, presumably benefitting from material transported alongshore from the adjacent eroding nourished bays. At the Creek Road car park and the drift divide the crest cut back markedly but did not fail completely. Significant volumes of beach material were deposited on the promenade to the rear, resulting in water levels approaching the top of the rear splash wall in places as water was unable to flow to the normal discharge points and into the drainage system in Southwood Road.

Since the 3rd November 2005 storm, there have been storms which have generated larger waves and higher sea levels (although the 3rd November event was exceptional in terms of wave period). This includes the 10th March 2008, and during the winter of 2013/14 (particularly early January 2014 and the 14th-15th February 2014 event). The March 2008 event affected the Solent more severely than the 2005 event, although was not as severe on Hayling (still, floodwater was present on Creek Road, Nutbourne Road, Bosmere Road, and Southwood Road). Most recently during 'Storm Katie' on the 28th March 2016 the highest wave height was recorded since deployment of the Hayling Island wave buoy (in 2003) (Section 2.2.2). Still, the flooding was less severe for these events (with no recorded flooding in 2016 as the storms did not coincide with particularly large tides) than it had been in November 2005. Events that have caused flooding generally occur when large wave conditions coincide with large enough sea levels: at Portsmouth total sea level of approximately 5.17 mCD is the minimum still water level that has been associated with flooding at Hayling (when accompanied by large waves). The reduction in flood events despite a large number of storms and high tides since 2013, is mainly attributed to the Eastoke Point scheme which has reduced overtopping rates of the beach and flow of water onto the roads behind. There are other elements that require future assessment such as storm duration and localised factors (e.g. drainage). **It is recommended a feasibility study be undertaken to appraise options for an Eastoke Drainage Scheme. This scheme would look to improve drainage of overtopped seawater from the Eastoke promenade back into the sea during storm events. This could include for example new porous control structures, such as a rock revetment/rock groynes at key erosion hotspots along the frontage, to improve drainage and reduce beach losses.**

(f) Predictions of future shoreline evolution

The general pattern of erosion along the Eastoke frontage (BMP U3) and accretion at Gunner Point is predicted to continue into the future. If nourishment were to cease, the main Eastoke beach would overtop heavily, accelerating beach erosion, leading to the eventual collapse of the previously buried seawalls. In turn the beach would roll back, eroding the

Eastoke Peninsula. As the hinterland is low-lying little additional material would be supplied to the wider frontage as the beach rolled back. As the nourished frontage is the supply of material to the wider frontage, cessation of nourishment activities would lead to erosion becoming prevalent around the wider frontage until a more stable plan shape was attained.

Within the overall trend there is the potential for dynamic changes in the beach plan form associated with the influence of the East Winner, and potential temporary drift reversals around Gunner Point. This could lead to further erosion or accretion at the boundary of BMP U6 and U7. Further changes in beach plan form are also anticipated in relation to the Inn-on-the-Beach and timber breastwork just to the west (Ref 2.23). If the remaining structure were removed from the system there would be a realignment of the frontage with erosion on the central beach updrift, and accretion downdrift.

Recent research into the evolution of the Langstone and Chichester ebb-tidal deltas has identified the possibility of West Pole Sands in Chichester Harbour decreasing in size in the future (Ref 2.23), in a similar manner to the West Winner in Langstone Harbour. Figure 2.17 shows the decline of the West Winner at the Langstone Harbour entrance between 1841 to 2008. The most recent hydrographic data is presented in Figure 2.18 for the Langstone Harbour entrance and Figure 2.19 for the Chichester Harbour entrance. If the West Pole Sands were to follow a similar pattern, the rate of sediment losses from the Eastoke nourished frontage are anticipated to increase, and the increase in wave energy would exacerbate wave overtopping. **These changes are not anticipated within the 5 year period of this BMP but ongoing monitoring is designed to detect the early signs of a decline in the West Pole (Section 4.2).**

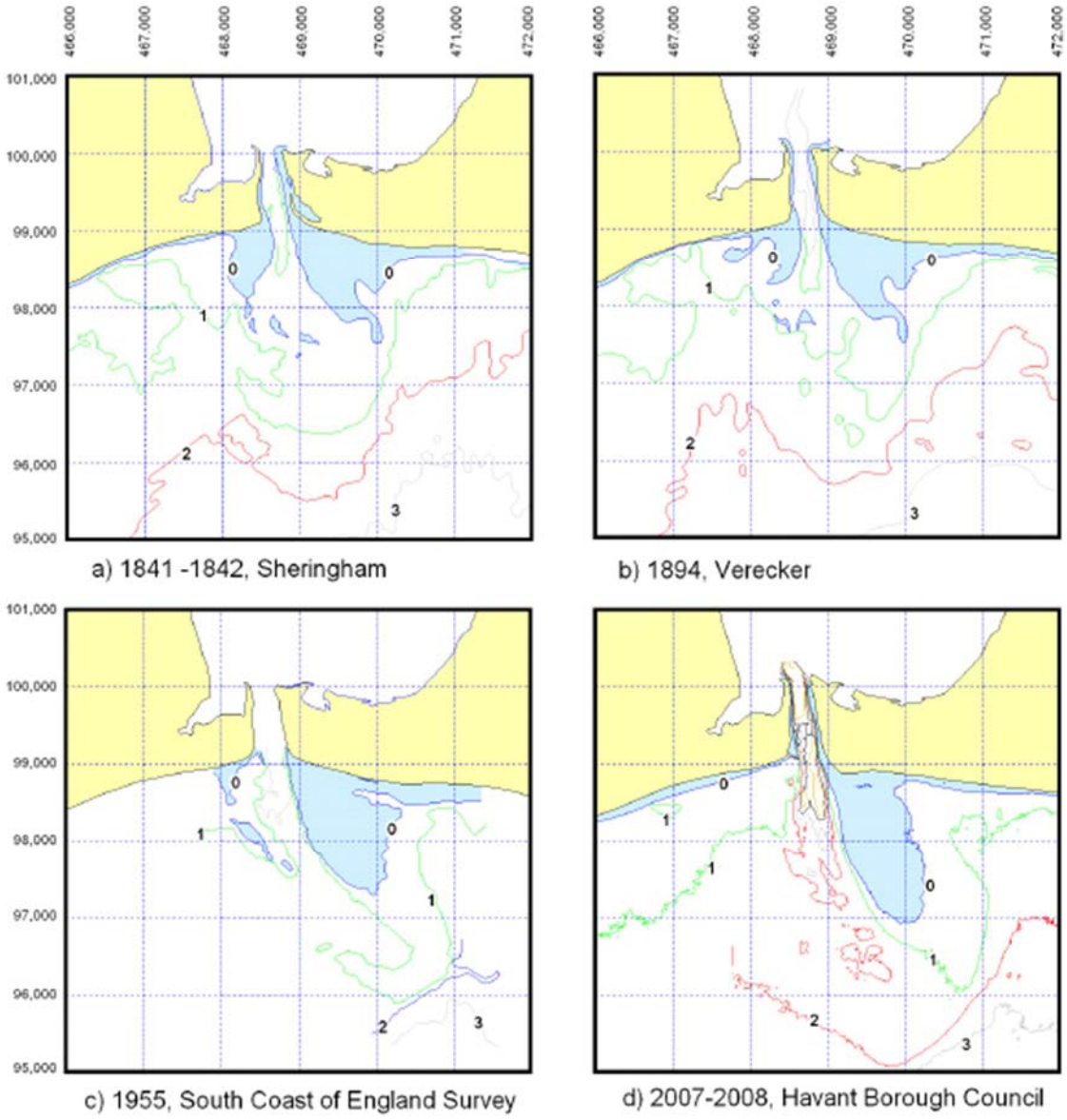

Figure 2.17 Evolution of Langstone ebb-tidal delta morphology, 1841 – 2008. Contours shown in fathoms relative to chart datum (1 fathom = 1.8288m) (Ref 2.24)

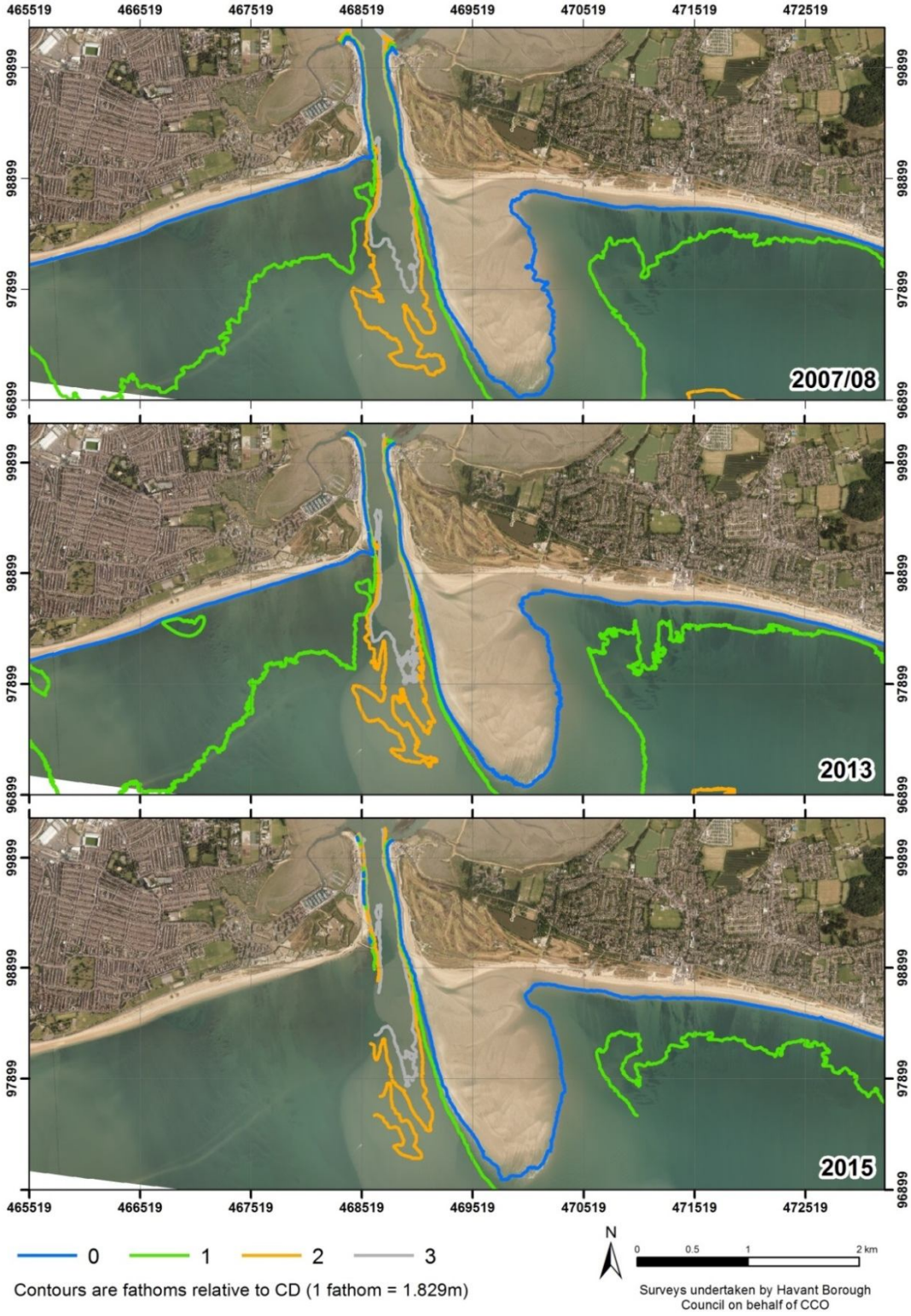

Figure 2.18 Evolution of Langstone ebb-tidal delta morphology; 2007/2008, 2013 and 2015. Contours shown in fathoms relative to chart datum (1 fathom = 1.8288m) (Ref 2.24)

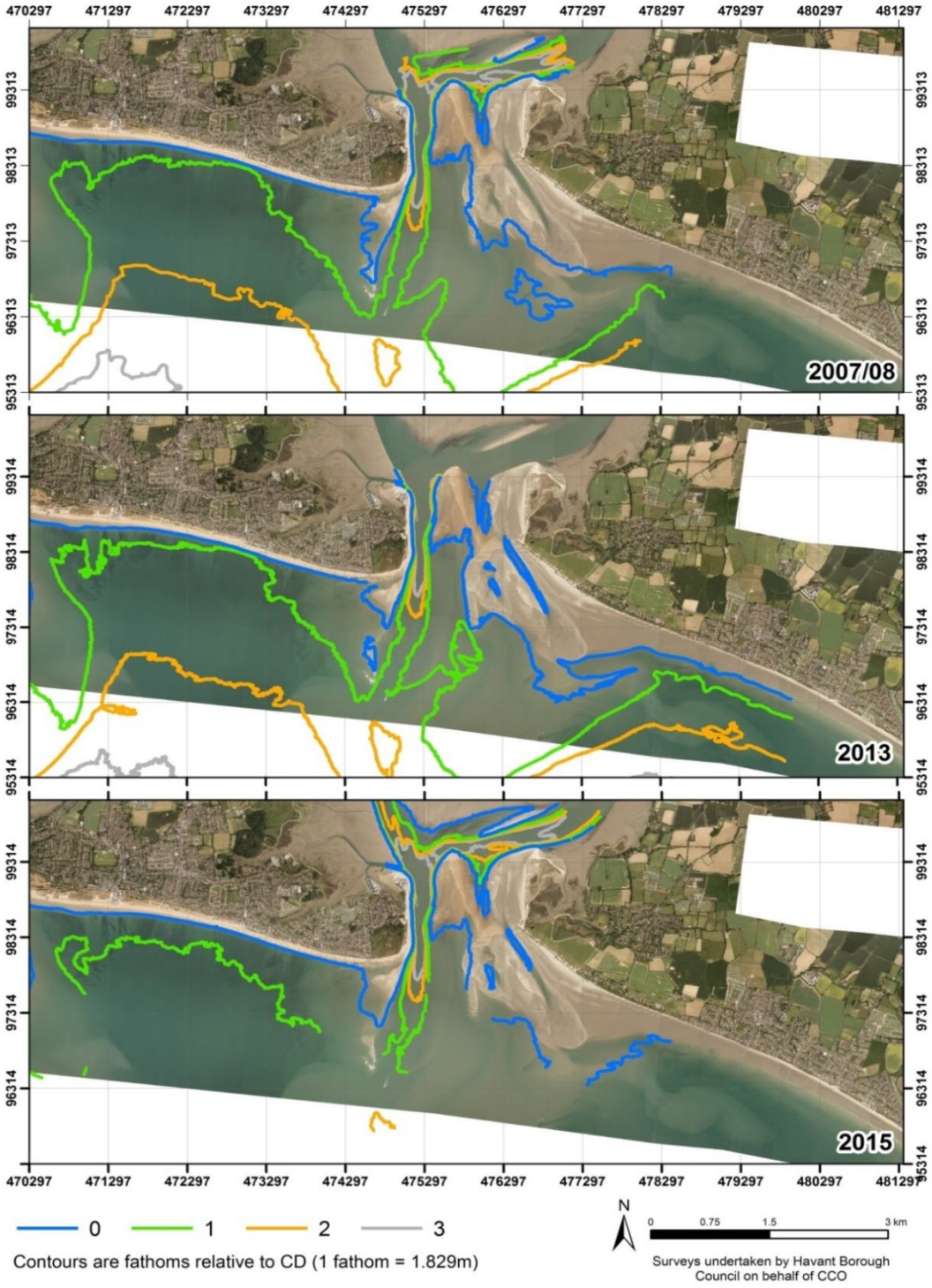

Figure 2.19 Evolution of Chichester Bar and Channel entrance: 2007/08, 2013 and 2015. Contours shown in fathoms relative to chart datum (1 fathom = 1.8288m) (Ref 2.24

2.6 Beach Stability

In general the western end of the Hayling Island shoreline is largely undeveloped and has tended to accrete. This is particularly so at Gunner Point where the shoreline has moved seaward by up to 350m since 1832, resulting in the development of multiple shingle ridges. The eastern end of the frontage has tended to erode, creating the need for intervention to manage the impact of flooding and coastal erosion. The spit at Black Point is slowly accreting sand, which has also resulted in operational difficulties at the Hayling Island Sailing Club.

Figure 2.20 shows the location of all the erosion hot spots (current issues), watch spots (potential issues) and other issues around the South Hayling frontage. These are discussed in more detail below.

Figure 2.20 Erosion hotspots, erosion watch spots and other issues

(a) Erosion Hot Spots

Eastoke Corner

The section of nourished frontage between groynes 28 and 35 is frequently below the required design level after relatively minor storm events. Shingle is regularly washed over onto the promenade and the beach crest is often eroded back to the promenade over the winter months. Where possible, coarser material should be used to construct the beach crest and improve stability at this site. **Further investigations into adjusting the control structures in this area should be carried out.**

Creek Road Car Park

The section of nourished frontage just east of Creek Road car park is situated over the drift divide. It has proved difficult to maintain the design profile in this area in the past. **Further investigations into adjusting the control structures in this area should be carried out.**

(b) Erosion Watch Spots

Langstone Entrance

The beach flanking Langstone Harbour is dynamic and pulses of material periodically move up into the harbour. This section of beach is privately owned but the car park is leased to HBC. In the past, small scale beach management works have been undertaken to protect the car park, and an earth embankment constructed in 1993 is currently being eroded to the adjacent to the public car park. Material has also been removed from borrow pits on Hayling Golf Club (HGC) land and used to protect the access road adjacent to the 13th hole. **The new planning application will cover this area to allow small scale movements of material.** Works would need to be undertaken on a local scale.

West Beach and The Driving Range

The length of beach west of Inn-on-the-Beach has undergone rapid periods of accretion and erosion historically, with the beach in front of the driving range undergoing long term erosion. The burial of the western end of the West Beach sloping timber breastwork in the 1990s was associated with a temporary littoral drift reversal in this area.

Sections of the remaining timber breastwork at West Beach could fail within the BMP period and would need to be removed from the beach on health and safety grounds. This could reduce the potential supply of recycling material thrown over the existing structure. Still, recent discussions with Hayling Golf Club have agreed that if material is extracted from Gunner Point and recycled back to Eastoke, less material would need to be extracted from West Beach and the open beach, thereby improving the feed of material flowing past the vulnerable southeast corner of the golf course. The construction of a suitable haul road to

extend the recycling operations would also help stabilise the current beach crest in this area.

East of Inn-On-The-Beach

Erosion of the beach crest immediately to the east of Inn-On-The-Beach has become an issue since 2014. Extraction from the beach in this area and immediately updrift should only take place where there is enough material.

(c) Other Issues

Black Point

General accretion of sand at the distal end of Black Point Spit has caused concerns to arise in this area. Prior to 2012, the operators of Sparkes Marina commissioned investigations into the cause of a bar forming in the channel north of Black Point (Ref 2.26). It appears to be the result of sand dredged from a visitors berth and deposited in the channel. Discussions were held about incorporating any further dredging with the annual beach recycling operation. The volumes being discussed were relatively low, and land-based transport to the southern frontage was discussed. There are various environmental considerations and constraints to be considered before any works could take place. The operator has not been in contact since but the issue could re-emerge over the period of the BMP. **Liaison with MDL Marinas should continue if requested and the possibility of incorporating some sand extraction into the recycling operations considered if requested.**

Accretion of sand around the HISC slipway has caused issues launching and recovering yachts. HBC have provided advice on this matter over a number of years and the problem is episodic. Prior to 2012, discussions were held in conjunction with the operators of Sparkes Marina about recycling sand back onto the southern frontage as part of the annual recycling operations. The new planning application will cover this area to allow small scale extraction of sand back onto the southern frontage. Works could tie in with annual recycling operations and would most probably be funded by private parties. **Liaison with HISC should be ongoing and the possibility of incorporating some sand extraction into the recycling operations considered if requested.**

Chichester Harbour Entrance

The natural movement of shingle moving up towards Black Point forms a ridge of shingle across the RNLI slipway. This prevents the RNLI from launching, and therefore the shingle is pushed down the beach using a launching tractor. In previous years this material has been cleared from the area surrounding the launching area during the recycling operation and moved back onto the Southern frontage**. If the material is of the right grade and can be used for Beach Management, then clearance of the shingle ridge in front of the RNLI station should be considered prior to each recycling operation**.

2.7 Environmental Characteristics

The following chapter details the key environmental considerations relevant to the BMP.

2.7.1 Natural Environment

As already highlighted in Section 2.7, the BMP area is within or near to (within 2km of) a number of designated areas. These areas are shown on Figure 1.5 to Figure 1.7. Further detail on each of the designations is presented in Appendix E.

(a) International and European Designations

There are three international or European nature conservation designations within or near to the BMP area:

- Solent Maritime SAC.
- Chichester and Langstone SPA.
- Chichester and Langstone Harbours Ramsar Site.

The proposed Solent and Dorset SPA is currently under consideration with the consultation phase due to close in January 2017. It would be put in place to protect internationally important populations of common tern, Sandwich tern and little tern. This would include the South Hayling frontage between Gunner Point and the Eastoke Point Scheme up to the MHW mark. As this SPA is currently proposed, we have considered impacts on the interest features it will protect, assuming the SPA has been designated. No additional environmental mitigation over an above that already being proposed is expected as a result of this proposed SPA.

(b) National Designations

There are three national nature conservation designations within or near to the BMP area:

- Chichester Harbour SSSI.
- Sinah Common SSSI.
- Langstone Harbour SSSI.

Non-Statutory Local Designations:

There are three local designations within the study area:

- Sandy Point Local Nature Reserve and Countryside Heritage Site
- Southern Eastoke Frontage SINC, which includes the nourished beach (BMP U4)
- Beachlands SINC, which includes area of the open beach in BMP U4.

There is one local designations near to the study area:

- The Kench Local Nature Reserve, which is adjacent to BMP U8.

The Planning Application and Marine Licence Application, seeking permission for the BMP,

will include an Environmental Statement and 'Information for Habitat Regulations Assessment (HRA)' to demonstrate how the designated and natural local environment has been considered during the development of the BMP. These documents summarise the background environment, the proposed works, and the impacts the proposed works could have on the background environment. Where negative impacts could occur, appropriate mitigation has been discussed with Natural England, to ensure the works can be completed without having any Likely Significant Effect on the environment. Planning permission remains in place until 30th September 2019 for the existing BMP activities, demonstrating that the BMP activities are environmentally acceptable, however a new application will be submitted in early 2017 (to incorporate the full BMP frontage). The application will be guided by the outputs of the environmental scoping work, and Discretionary Advice provided by Natural England (see Sections 1.3.2 and 2.7 and Appendix E). This has resulted in a letter of support from Natural England (included within Appendix E) to highlight that the full BMP proposal is expected to be environmentally acceptable.

2.7.2 Landscape

(a) National Character Areas

The BMP study area lies within the South Coast Plain and Hampshire Lowlands National Character Area (NCA), and is comprised entirely of the generally open and often featureless landscape of the coastal plain.

Most of the length of the study area consists of a shingle barrier beach, bounded by two distal recurved spits adjacent to the harbour entrances. There are man-made sea defences at various locations along the frontage, with the largest natural sections of beach around Gunner Point (BMP U6) and central Beachlands (BMP U4). The beach frontage consists of shingle, a mixture of sand and gravel, overlaying Bracklesham Beds, with the foreshore dominated by sand where the influence of the ebb-tidal shoals is strongest. Urban development close to the beach is mainly confined to the Eastoke Peninsula, with a few individual properties located within the active beach zone along the wider study area, e.g. the Inn-on-the-Beach and the Ferryboat Inn.

(b) Marine Conservation Zones

The Marine and Coastal Access Act (2009) created a new type of Marine Protected Area (MPA), called a Marine Conservation Zone (MCZ). Natural England and JNCC provided advice on how MCZs should be selected, with the government using these recommendations as a basis for selecting MCZs for designation in 2012. Following a second tranche of designations in January 2016, there is now a total 50 designated sites, the nearest of which are offshore the east coast of the Isle of Wight and Pagham Harbour. The South Hayling frontage is not directly adjacent to any MCZ's. MCZs will protect nationally important marine wildlife, habitats, geology and geomorphology. Sites will be selected to protect not just the rare and threatened, but the range of marine wildlife.

2.7.3 Ecology

Maritime vegetated shingle structures and sand dunes are rare and specialised habitats supporting internationally important vegetation types, several types of which are listed as priority habitats in Annex I of the EU Habitats Directive (Figure 2.21 and Figure 2.22). The South Hayling Island BMP frontage includes areas of well established vegetated shingle, and drift line vegetation. The BMP study area is also adjacent to areas containing Mudflats and Eelgrass Beds, Saltmarsh, Saline Lagoons and Coastal Wet Grassland in the harbour. All of these features are protected within the designated sites, and Appendix E contains more details on these.

Sand dunes are windblown sand formations associated with dune slacks, grassland and scrub. The larger areas of sand dunes are associated with shingle habitats, particularly shingle spits, with the most important sites in the county on the South coast of Hayling Island presenting a rich mosaic of sand dune and shingle habitats and associated species.

Hayling Island has a good range of foredune, mobile dune and fixed dune types (all acidic), dune slacks, sandy and fixed shingle beaches, and rich dune and shingle acid heath, including important moss and lichen communities. Transitions between sand dune, shingle and saltmarsh occur. These habitats are of particularly high biodiversity for their parched coastal grasslands, which may take many decades, even centuries to develop. They are, along with a site on the Isle of Wight and one in Pagham Harbour, among the botanically richest in Britain.

Vegetated shingle is a Priority habitat, and as such has habitat objectives:

- Maintain total extent of coastal vegetated shingle habitat throughout the UK, and the structures, sediment and coastal processes that support them. This is a 'no net loss' target to take account of the dynamic nature of shingle. This includes the maintenance of transitions to other habitats landward and seaward.
- Achieve favourable or recovering condition by appropriate management of coastal vegetated shingle systems currently in unfavourable condition by 2010. This should achieve the retention or enhancement of populations of priority species associated with vegetated shingle.

Detailed ecological considerations are included in the Environmental Statement and Habitat Regulations Assessment (HRA), being completed for the full BMP.

Figure 2.21 Habitats on the Hayling Frontage – Eastoke, Sandy Point and Black Point Spit

Figure 2.22 Habitats on Hayling Frontage- Eastoke Corner

Fig 2.23 Habitats on Hayling Frontage- Beachlands

Figure 2.24 Habitats on the Hayling frontage – Gunner Point, West Beach and Langstone Harbour entrance

2.7.4 Water Framework Directive

As discussed in Section 1.3.3, a Water Framework Directive (WFD) Assessment is being completed to demonstrate that the beach management works will not prevent the adjacent Water Bodies meeting their objectives and to ensure there is no deterioration to these water bodies. It will identify and promote the delivery of any objectives and mitigation measures that may be required. It will also consider scheme impacts on other European protected sites, including Shellfish Waters, Bathing Waters and Natura 2000 sites. The WFD Assessment will support the Planning and Marine Licence Applications.

2.7.5 Cultural and Archaeological Heritage

The Eastern Solent coastline and adjoining harbours comprise historic landscapes which have been utilised from pre-historic periods to the present day. There are a number of cultural heritage features that lie close to the BMP area, as shown on Figure 1.8.

Successive phases of sea level rise have created the Solent and enabled archaeological deposits to be submerged and preserved. As a flooded former river valley that was drowned during the Holocene marine transgression, Chichester Harbour is known to be an area of particularly high archaeological importance.

Prehistoric Period

A prehistoric settlement has been identified at East Head and at Gutner Common on North Hayling. A thin layer of burnt material extending 23m along a low sea cliff and containing burnt flint pot boilers sealed by alluvium has been interpreted as representing prehistoric land clearance. The potential for exposing prehistoric archaeology is unknown.

Bronze Age (2000-600 BC)

In the early Bronze Age, Chichester Harbour was used for seasonal grazing as well as butchering and tanning. There is extensive evidence of Middle to Late Bronze Age settlements including farming systems and enclosures. Round houses have been found on the coastal plain at Creek Field, Hayling Island and a rare, Late Bronze Age structure comprising timbers and wattle has been found on the northern frontage of the Island. Six Middle Bronze Age palstaves were located on the east coast of Hayling in 1985. These may be associated with an urn field.

The potential for recovery of Bronze Age artefacts is unclear but this possibility must be considered.

Iron Age (600BC – AD43)

A small rise in sea levels in the Iron Age is likely to have had a significant impact on the study area. There are important links between salt workings and sites on Hayling Island including Tournebury hill fort which guarded the western part of the entrance to Chichester Harbour. There is little potential for exposing Iron Age artefacts.

Roman Period (AD43-410)

The Roman invasion of AD43 resulted in major social and economic changes. There is evidence of an early Roman military presence in Chichester and many artefacts have been found in the area including a bronze helmet dredged from the Harbour and disparate pottery finds. The potential for the recovery of Roman artefacts is low.

Early Medieval Period (AD410-1066)

During the Early Medieval Period, there may have been trade in Chichester Harbour. Chichester was one of the five fortified sites mentioned in the Burghal Hidage, that was probably compiled in around AD919. Chichester evolved into a major town in the 10th century and increasing trade is likely to have led to the creation of a port.

Later Medieval Period (AD1066 -1550)

During this period, the landscape would have comprised villages centred on parish churches. The harbour industries would have included fishing, salt-working, boat building and oyster farming and trade would have formed a significant proportion of the Harbour's economy. Wool appears to have been an important commodity passing through Chichester Harbour during the 13th century. By the end of the 13th century, there seems to have been a period of increased flooding within the area that has been linked to growing storminess and a slight rise in mean sea level. A considerable area of land belonging to the Priory on Hayling Island was inundated during the 14th century.

In South Hayling, three salterns are known; one medieval and two post-medieval. The medieval was the largest, known as Menghams and recorded in the Doomsday book. The salterns went out of use in the 1870s and by the 1950s there was no recognisable trace of them. Due to the inundation of Chichester Harbour, the potential for exposing artefacts from this period is low.

Post Medieval (AD1550-1800) and Modern Period (AD1800+)

The area comprises a number of post Medieval and industrial features that include mills (e.g. Hayling Island Tide Mill), harbour piles, salterns in North Hayling and oyster beds. The Sexton map of 1575 is one of the earliest maps of the area and shows Hayling Island as detached from the mainland, with channels shown as extending to Chichester. Due to the inundation of Chichester Harbour, the potential for exposing artefacts from this period is low.

2.8 Relevant Information

The following provides a list of sources of information that has been referenced in this section of the beach management plan.

Ref 2.1 **Admiralty Tide Tables Volume 1 2012: United Kingdom and Ireland (including European Channel Ports);** United Kingdom Hydrographic Office (2011)

Ref 2.2 **EasyTide** tool at the United Kingdom Hydrographic Office website: http://easytide.ukho.gov.uk/EasyTide/EasyTide/index.aspx (Accessed 01/12/2016)

Ref 2.3 **National Tide and Sea Level Facility** at the British Oceanographic Data Centre website: http://www.bodc.ac.uk/data/online_delivery/ntslf/ (Accessed 01/12/2016)

Ref 2.4 CHIMET tide gauge website: http://www.chimet.co.uk (Accessed 01/12/2016)

Ref 2.5 Environment Agency (2011a); **Coastal flood boundary conditions for UK mainland and islands; Project: SC060064/TR4: Practical guidance design sea levels.** February 2011.

Ref 2.6 Environment Agency (2011b); **Coastal flood boundary conditions for UK mainland and islands; Project: SC060064/TR5: Practical guidance swell waves.** February 2011.

Ref 2.7 HR Wallingford, 1997. **East Solent Shoreline Management Plan**, Volumes 1 and 2: The Open Coast. Reports EX 3441(A) and (B). Report to East Solent SMP Project Group (Lead Authority: Havant Borough Council).

Ref 2.8 **North Solent Shoreline Management Plan**, New Forest DC (2010)

Ref 2.9 Whitcombe, L. J., 1995. **Sediment Transport Processes, with Particular Reference to Hayling Island**. Unpublished PhD thesis, Department of Oceanography, University of Southampton, 294pp.

Ref 2.10 HR Wallingford, 1995. **Pagham Harbour to River Hamble Coastal Strategy Study, Volume 1: Pagham Harbour to Portsmouth Harbour**. Report EX 3121. Report to Pagham to Hamble Coast Strategy Group (Lead Authority: Chichester District Council), 134pp

Ref 2.11 **Annual Report 2008, Selsey Bill to Southampton Water**. Reference AR43, Southeast Strategic Regional Coastal Monitoring. CCO (2008).

Ref 2.12 Bradbury, A., **Extreme wave conditions within the SCOPAC region, 2008 - 2010**. http://www.southerncoastalgroup.org.uk/extreme-waves.html (Accessed 01/12/2016)

Ref 2.13 Royal Haskoning (2012), **Eastoke Point Coast Defence Works - Wave and Overtopping Modelling, Technical Note 9X1135.**

Ref 2.14 Environment Agency (2011c); **Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities**. September 2011.

Ref 2.15 Defra (2006); **Flood and Coastal Defence Project Appraisal Guidance FCDPAG3 Economic Appraisal**; Supplementary Note to Operating Authorities – Climate Change Impacts. October 2006.

Ref 2.16 Harlow, D.A., 1980. **Sediment Processes, Selsey Bill to Portsmouth**. Unpublished PhD thesis, Department of Civil Engineering, University of Southampton.

Ref 2.17 Webber, N.B. (1979). **An Investigation of the Dredging in Chichester Harbour Approach Channel, and the Possible Effects on the Hayling Island Coastline.** Report to Chichester Harbour Conservancy, Havant Borough Council and Francis Concrete Limited, 56pp.

Ref 2.18 Wallace, H. (1990). **Sea-level and Shoreline between Portsmouth and Pagham for the past 2,500 Years.** Privately published by the author, 61pp.

Ref 2.19 Defra (2002). **Futurecoast.** Set of three CD-ROMS produced as part of the Futurecoast project by Halcrow for Defra.

Ref 2.20 **Annual Report 2015, Selsey Bill to Southampton Water**. Reference AR73, Southeast Strategic Regional Coastal Monitoring. CCO (2015).

Ref 2.21 SCOPAC (2004); **Sediment Transport Study** website: http://www.scopac.org.uk/scopac_sedimentdb/index.htm (Accessed 01/12/2016)

Ref 2.22 Telephone conversation with R. Craven, CHC Harbour Master, 4th Sept 2012.

Ref 2.23 Moon, C.R. (2008). **South West Hayling Island Beach Management Study, Inception report.** HBC Technical Report CEI-2008-001.

Ref 2.24 **Improving Beach Management on a Nourished Beach; Morphodynamics at Hayling Island, UK**, Unpublished MPhil Transfer Report, School of Environment and Civil Engineering, University of Southampton. Moon, C.R. (2010).

Ref 2.25 **Hayling Island : Eastoke Sectoral Strategy Study**; Joint report to Havant Borough Council and Environment Agency, W.S. Atkins Ltd (2006)

Ref 2.26 **Sparkes Marina: A review of maintenance dredging, Technical Note DDM6611-01.** HR Wallingford (2011).

Ref 2.27 **Biodiversity Action Reporting System** (BARS) website (www.ukbap-reporting.org.uk, accessed 14/08/12)

Ref 2.28 **Hampshire Biodiversity Action Plan** (BAP), (http://www.hampshirebiodiversity.org.uk/hampshire%20BAP.html, accessed 14/08/12)

Ref 2.29 **Eastoke Point Coastal Defence Study**, HR Wallingford (2008).

Ref 2.30 CCO – Channel Coastal Observatory (2016) **Hayling Island Interim Wave Report 2015/2016.** Southeast Strategic Regional Coastal Monitoring Programme.

Ref 2.31 HORSBURGH, K.J. and WILSON, C. (2007) Tide-surge interaction and its role in the distribution of surge residuals in the North Sea. *Journal of Geophysical Research Oceans*, 112, C08003, doi:10.1029/2006JC004033

Ref 2.32 Matthews, T., Murphy, C., Wilby, R. L. and Harrigan, S. (2014). Stormiest winter on record for Ireland and UK. *Nature Climate Change*, *4*(9), 738-740.

Ref 2.33 Wadey, M. P., Haigh, I. D. and Brown, J. M. (2014). A century of sea level data and the UK's 2013/14 storm surges: an assessment of extremes and clustering using the Newlyn tide gauge record. *Ocean Science*, *10*(6), 1031-1045.

Ref 2.34 Wadey, M. P., Haigh, I. D. and Brown, J. M. (2014). A century of sea level data and the UK's 2013/14 storm surges: an assessment of extremes and clustering using the Newlyn tide gauge record. *Ocean Science*, *10*(6), 1031-1045.

Ref 2.35 HBC, 2013 – **Beach Sediment Tracer Study 2010 – 2012:** Beach Tracer Report for Portsmouth and Hayling Island Frontage

3. SCHEME DESIGN

3.1 Scheme Description

The current buried seawall and timber revetment at Eastoke were largely constructed in the 1970s and 1980s, as discussed in Section 1.3.6, with the advent of beach management commencing in 1985. Although the South Hayling Beach Management Plan (BMP) considers the wider Hayling frontage from Hayling Island Sailing Club round to the Ferry Boat Inn, the scheme is focused on delivering flood and coastal erosion protection to the Eastoke Southern Frontage.

There are no nourishment works currently planned outside of BMP U2 and BMP U3 (Figure 1.3), only a haul route to be maintained in front of the Hayling Island Golf Club driving range in BMP U6 if recycling from Gunner Point (BMP U7) is permitted by the landowner (Figure 3.1). Allowing the nourished material to travel further along the frontage before recycling it back to Eastoke benefits the wider South Hayling frontage, as opposed to trapping the material on the nourished frontage and starving the adjacent sections of coastline. As such there is no scheme design for the wider frontage as there are few assets at flood and erosion risk, rather efforts will be made to minimise any impact of the ongoing Beach Management Activities on these areas. Table 3.1 refers to the definitions of recycling and recharge in the context of this BMP.

Table 3.2 Definitions of recycling and recharge for this BMP

	Definition	Locations
Recycling	Material brought into the nourished frontage within the same sediment cell	The Ness, Coastguard Revetment, Open Beach, West Beach and Gunner Point & Chichester Harbour Approach Channel
Recharge	Material brought into the nourished frontage from outside the sediment cell	Material imported via road and dredged material from licenced offshore sites

3.1.1 Managed Beach

The nourished frontage over the past 5 year BMP has extended from groyne 7 at Eastoke Point to groyne 35 at Eastoke Corner, a distance of 2.2 kilometres (Figure 3.2).

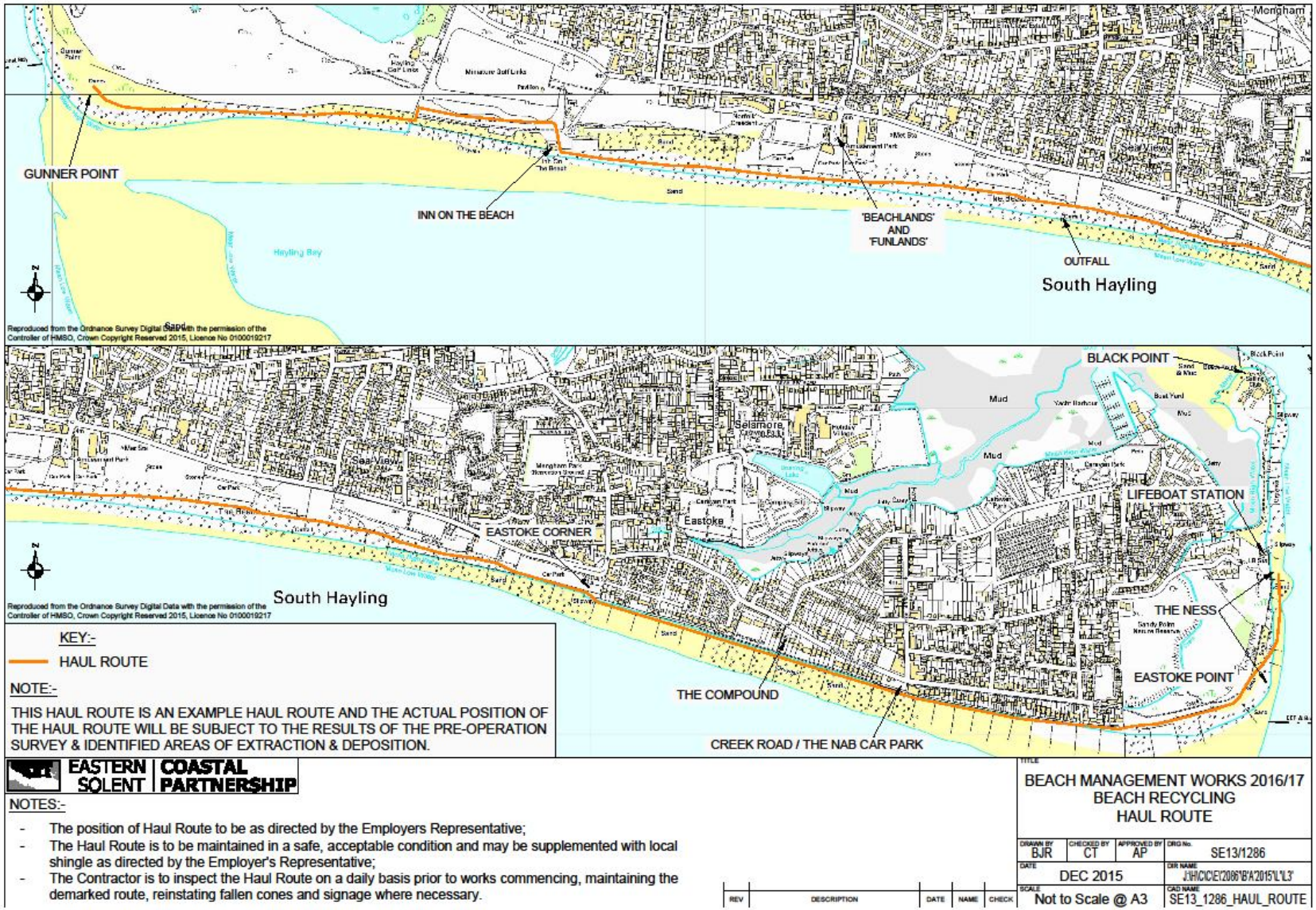

Figure 3.1 Haul route to be used for Beach Management Activities

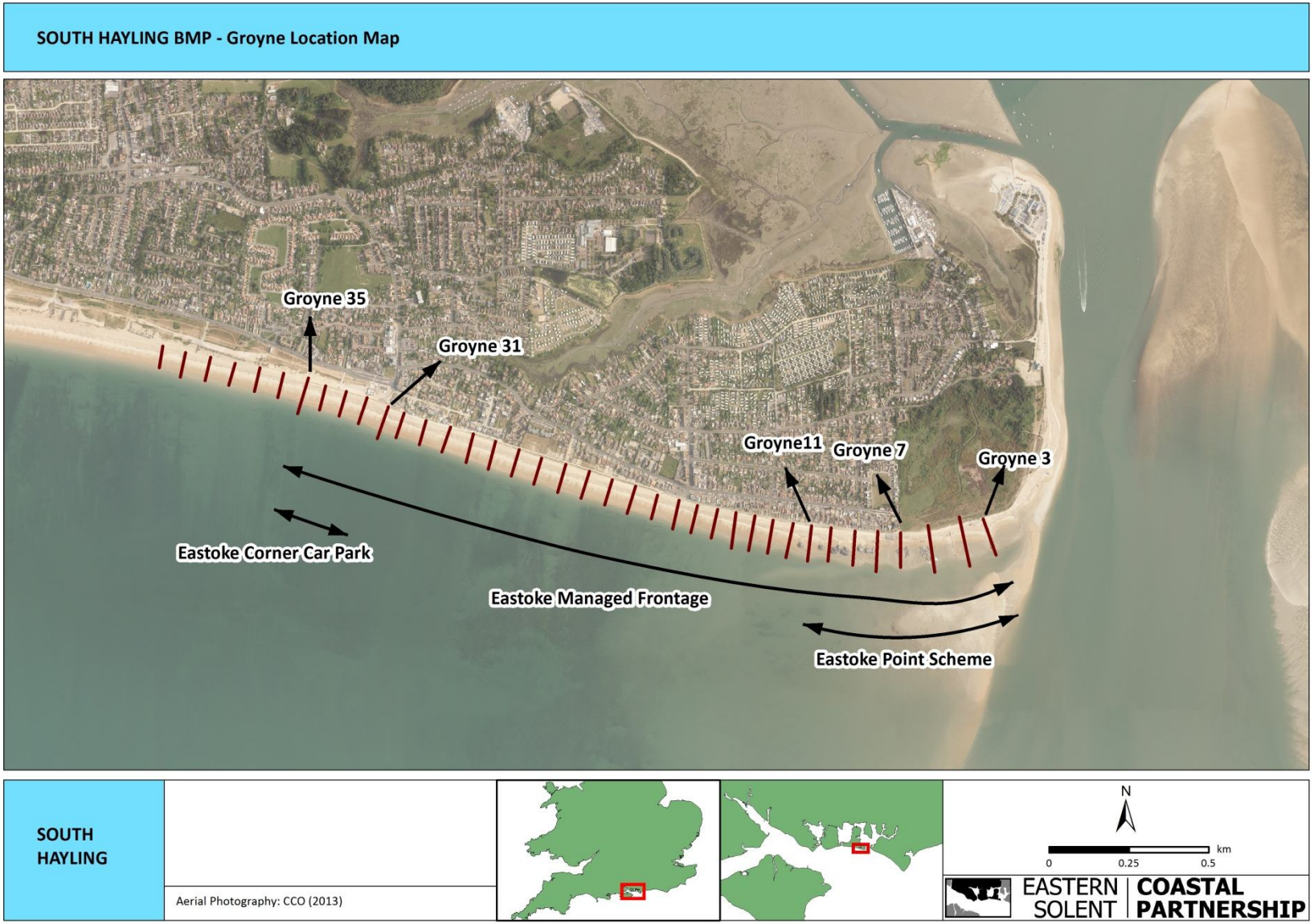

Figure 3.2 The location of groynes along the Eastoke Managed Frontage

Appendix B details the quantities of material recycled and imported along this frontage between 2006 - 2016. In summary, since 2006, approximately 30,000 m^3 of periodic recycling per annum has been undertaken to maintain the beach levels. In addition, 105,023 m^3 has been extracted in total from the Chichester Bar at the entrance to Chichester Harbour, averaging 10, 500 m^3 per annum. Approximately 2,000 m^3 per year of land based material has been imported to top up the beach, thereby helping to coarsen the beach. The last major import of 90,000 m^3 was in 2009 and was from an offshore dredge, averaging 9,000 m^3 per annum. Lastly, there was a 25,000 m^3 extraction from Gunner Point in 2014 for emergency works.

The timber groynes along the nourished frontage act to hold more material on the upper beach (Section 3.1.2). The groynes are maintained to a consistent height by HBC and are effectively buried at the beach crest.

The losses from the nourished frontage have supplied sediment to the wider Hayling Island sediment cell (Section 2.5). The rapid losses observed to the east at Eastoke Point led to the construction of a terminal rock groyne in the early 1990s. The resulting downdrift erosion lead to emergency works, involving the construction of a rock revetment and stub groynes to prevent a breach forming into the Eastoke Point Nature Reserve. This serves as a good illustration of the risks associated with completely cutting off the supply of sediment and the merits of allowing material to be recycled from further along the system.

As previously mentioned, until the Eastoke Point scheme was built in 2013, recycling and recharge operations focused on the beach directly in front of the Eastoke promenade, between groynes 7 – 35 as the area east of groyne 7 was difficult to maintain with beach nourishment alone. The Strategy identified the need for a separate scheme to deal with the erosion hotspot at the eastern end of the nourished frontage and in November 2013 a £5 million scheme was built at Eastoke Point comprising a rock revetment, rock groynes and 25,000 m^3 of imported beach material (Section 3.1.3). The Eastoke Point scheme was designed with a beach acting as the primary defence to minimise overtopping.

Analysis of the last 10 years of data for the Eastoke BMP frontage indicates approximately 51,000 m^3 of material per year from recycling, import and nourishment is brought into the nourished frontage to maintain the current design profile between groynes 7 – 35. This iteration of the BMP will be costed on the requirement of 51,000m^3 of material in year 1 to bring the beach volume back up to 1 in 200 year SoP. Thereafter, 39,000 m^3 will be required on an annual basis for year 2, 3, 4 and 5 based on analysis of the last 4 years of data since construction of the Eastoke Point scheme (see Section 2.5). It is felt that there is no need for additional material over and above the 207,000 m^3 total for the 5 year BMP period for the Eastoke Point scheme as it has been performing well (e.g. 2013/14 storms). This current BMP will work on the assumption that some of the material from the Eastoke drift divide is transported east, thereby feeding Eastoke Point before reaching The Ness and West Pole Sands in Chichester Harbour where it can be recycled back into the system. **However, the beach levels at Eastoke Point will continue to be monitored and where**

necessary, additional material will be sought if there is an undermining risk to the toe of the rock revetment.

In summary, the managed frontage is now broken down into three sections depicted in Figure 3.3:

- Eastoke Point Scheme (Groynes 3 – 11)
- Eastoke Beach (Groynes 11 – 31)
- Eastoke Corner Car Park (Groynes 31 – 35)

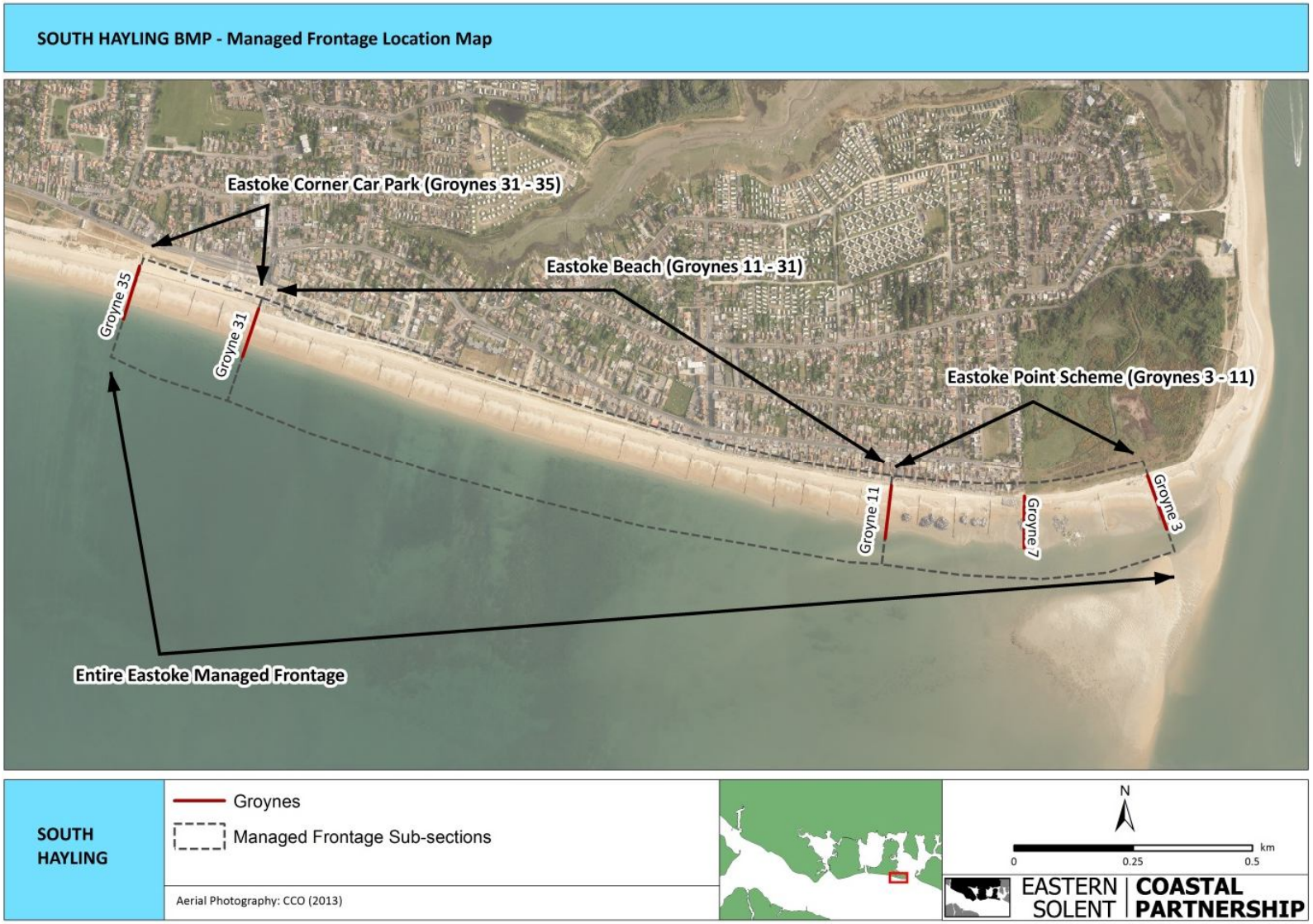

Figure 3.3 Eastoke Managed Frontage

3.1.2 Existing Control Structures

The managed beach relies on 27 timber groynes and 4 rock groynes (maintained by Havant Borough Council (HBC), with the new Eastoke Point scheme helping to retain material on the Eastoke southern frontage. The groynes are generally in fair/good condition.

3.1.3 Eastoke Point Scheme

The section of beach covered by the Eastoke Point Scheme contained 9 timber groynes that were vulnerable to rapid failures due to the low and dynamic beach levels in this area. Therefore, 5 of the timber structures were removed and replaced with 3 rock groynes and 1 shortened rock groyne. This has helped to stabilise this section of coastline, and reduce the loss of nourished material east of the frontage. It should be noted that a feed of material eastwards must be maintained to avoid erosion on the drift aligned section of beach from The Ness up to Black Point. As such, the rock structures are not designed to act as terminal structures for the nourished beach but will slow the loss of material around Sandy Point.

The Eastoke Point scheme was completed in November 2013 to bring the standard of protection up to the required 1 in 200 year level for 100 years in an area where coastal processes are highly dynamic (Figure 3.4**Error! Reference source not found.**). The following was designed and built:

- A 650m (27,700m^3) rock revetment was constructed as a 'long-stop' defence to manage the risk of a breach occurring and help maintain the beach crest height at +4.6m OD in line with the design profile for the wider Eastoke frontage. The revetment runs from groyne 11 eastwards to groyne 2.
- Four existing dilapidated timber groynes were removed and replaced with three new rock groynes, each 90m in length (7,000m^3 of rock). In addition, timber groyne 2 was replaced with a shortened rock groyne and the four timber groynes (11-8) were tied in with the new rock revetment.
- There were repairs to the splash wall to extend its residual life.
- A total of 25,000m^3 of beach recharge material was imported to raise the beach levels in front of the nature reserve. Historically it has been difficult to maintain an adequate beach profile along this section to afford the required standard of protection. This scheme is designed to retain sediment in order to maintain the required beach level.
- Ongoing requirements for beach management of this section are incorporated into the South Hayling Beach Management Plan and as such it will be managed within the holistic approach of the wider South Hayling frontage.

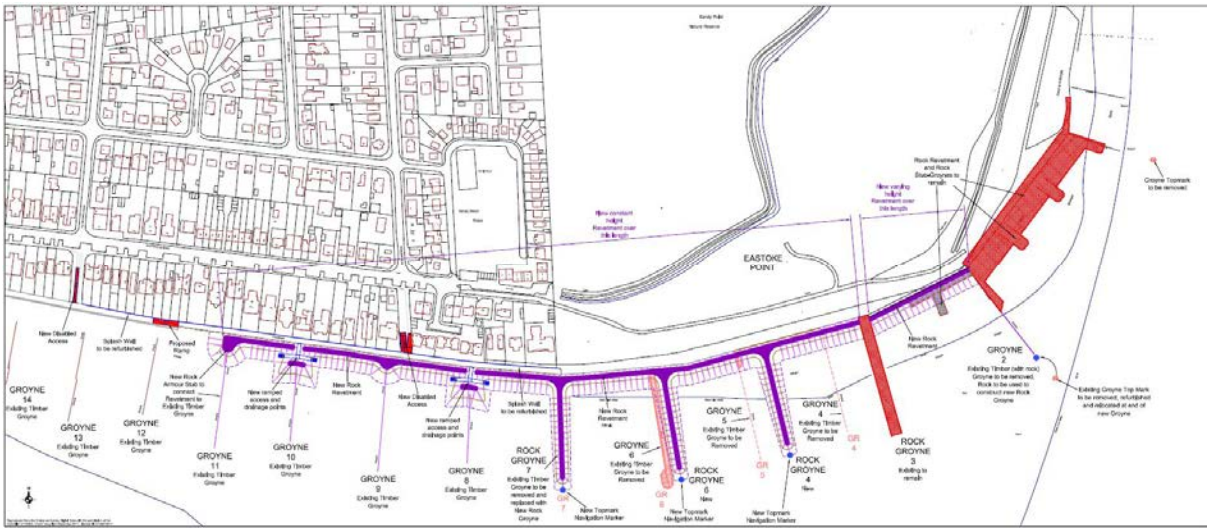

Figure 3.4 Eastoke Point Scheme design

Prior to the Eastoke Point scheme, an average annual volume of 4397m^3 was deposited in groyne bays 11 – 6 between 2004 – 2012 (Figure 3.5). Since construction and import of 25,000m^3 of material in 2013, only a nominal amount of 31m^3 has been deposited between groyne bays 6 – 11 (Figure 3.5) as the scheme has been performing well.

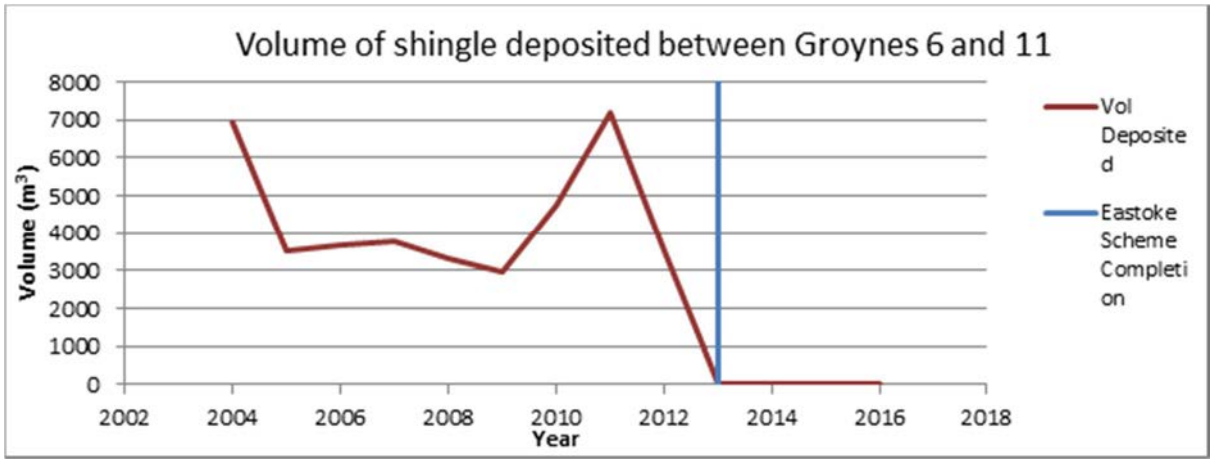

Figure 3.5 Volume of shingle deposited between groynes 6 and 11 between 2004 and 2016

3.2 Standard of Protection

The Eastoke Peninsula is a large urban area, densely populated with a mixture of residential and commercial property. The assets at risk from flooding, coastal erosion and overtopping on the Eastoke peninsula under a do nothing scenario over the next 100 years are listed below:

- The primary road network on the peninsula

- 1743 residential properties
- Sparks Marina
- Sandy Point Local Nature Reserve
- Hayling Island Sailing Club
- Extensive holiday chalets and caravan parks

This iteration of the BMP includes benefits for the life of the scheme which is 5 years. The assets at risk from flooding, coastal erosion and overtopping on the Eastoke peninsula under a do nothing scenario over the next 5 years are listed below:

- 1555 residential properties and 170 commercial properties

The Peninsula has been subject to coastal flooding on a number of occasions (1978, 1979, 1985, 2005 and recently in 2014) and flooding from an extreme surge in 1989. The key concern along the coastal frontage is that, if unmanaged, the shingle beach would erode leading to significant overtopping of the existing seawall (and ultimate failure) causing widespread damage to properties, the loss of the main feeder road onto the Peninsula and frequent flooding to the many properties constructed below Mean High Water.

The North Solent Shoreline Management Plan (SMP) (Ref 3.1) has confirmed a Hold the Line policy for the whole of the Southern frontage of Hayling Island. The Eastoke Sectoral Strategy Study (Ref 3.21.6.2) identifies the Approved Option for the Southern Frontage - Main Section as:

> 'Hold the Line to a 1 in 200 year Return Period standard of defence through beach recharge and annual recycling.

3.2.1 Beach profile response analysis

The original 1985 design of the beach nourishment was based on constructing a beach to the same elevation as the adjacent undefended sections of coastline. The crest elevation of the 1985 scheme was increased in the winter prior to construction from 5.0m OD to 5.6m OD in response to wave overtopping observed along the open beach (Ref 3.3).

The approach adopted in the South Hayling BMP (2012) for establishing the appropriate crest width and elevation to deliver the required standard of protection for both erosion and wave overtopping was to:

- Derive joint probability of wave and water levels
- Establish critical combination (maximum crest retreat)
- Test design conditions against typical beach profiles / design options
- Test failed profile for overtopping rates using the SWALLOW model
- Establish overall overtopping discharge for each scenario tested
- Derive minimum berm dimensions for each return period

The minimum design profile for a 1 in 200 year event has been updated several times since the original model runs in 1998 (Ref 3.4). In 2009 HR Wallingford amended their model results, following an update of the SHINGLE model, reducing the crest width required from an erosion perspective to 11.6m for a 1 in 200 year storm event (Figure 3.6 – Ref 3.5). This analysis does not account for bi-modal waves and was therefore not applied in the previous 5 year BMP given the beach width was eroded by 11m over a single high water during the bi-modal wave event in 2005.

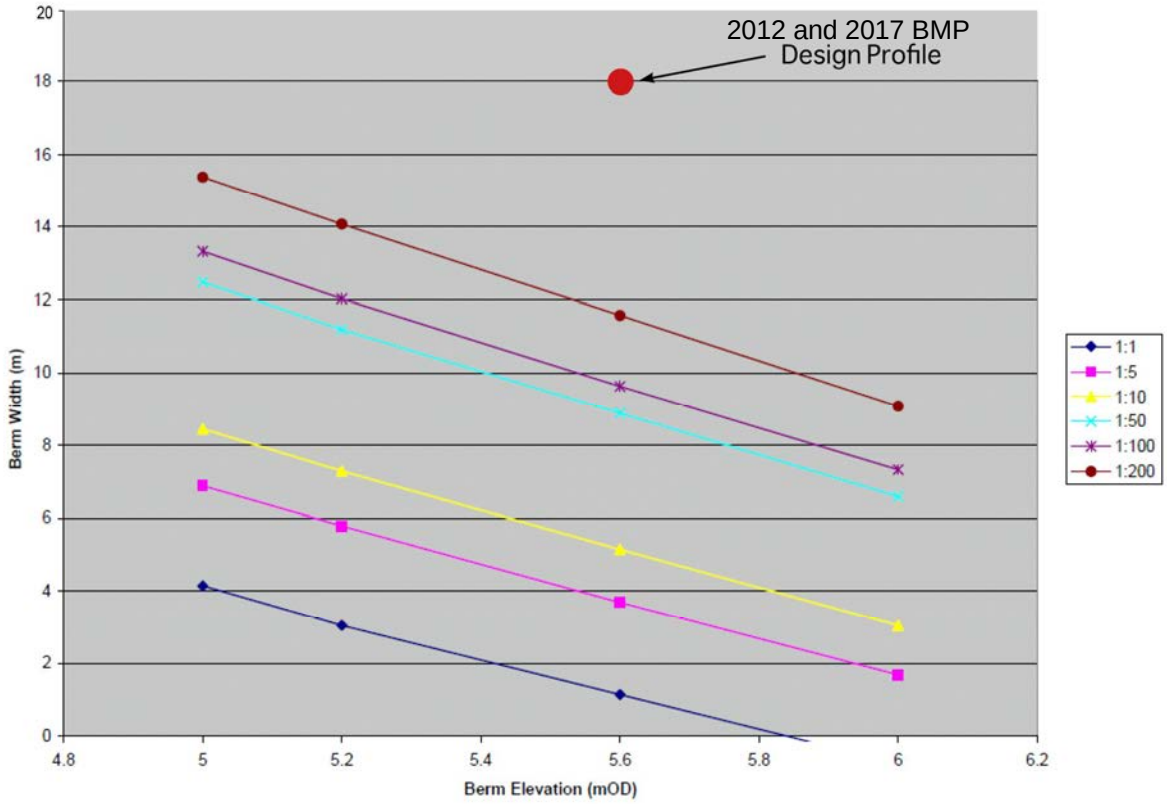

Figure 3.6 Beach Design Profile Parameters (adapted from Ref 3.5) for varying overtopping standards of protection. Current design profile added to graph.

3.2.2 Overtopping analysis

Various studies have assessed wave overtopping over the nourished beach (Ref 3.4, 3.6 and 3.7). The methods utilised have included the SWALLOW model, AMAZON and Eur0top Neural Network. The results of previous overtopping analysis (Ref 3.4) comparing the pre-nourishment profile and failed post-nourishment profile (crest reduced to level with old seawall) are illustrated below (Figure 3.7).

The South Hayling BMP (2012) work used the wave and water levels from Section 2.1 and 2.2 and the Eur0top Neural Network to predict overtopping over the 1 in 200 year design profile, which indicated average overtopping rates in the order of 7 l/s/m. There is significant

uncertainty associated with this value due to the limited data available on overtopping on mixed sand and gravel beaches, and the impact of a bi-modal wave climate. As such the overtopping rates are regarded as indicative rather than absolute values.

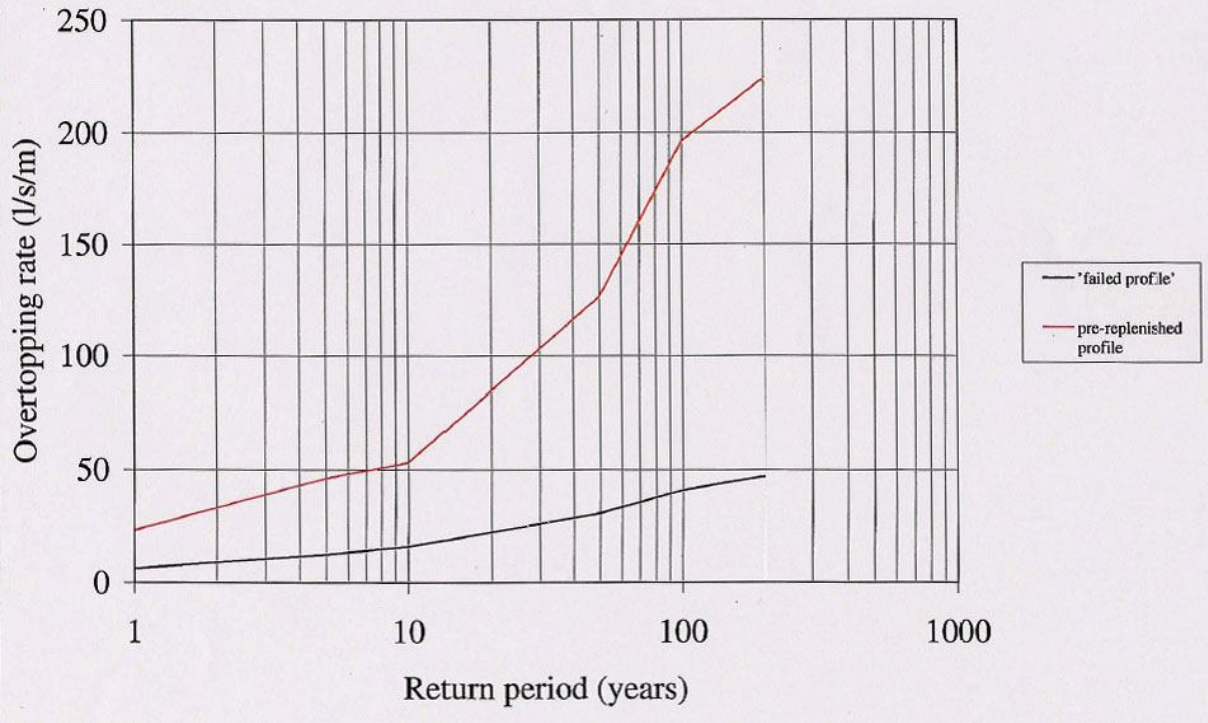

Figure 3.7 Overtopping rate of failed and pre-nourishment profile (Ref 3.4)

3.2.3 Design Profile History

Experience gained over 31 years managing the Eastoke nourished frontage indicates that long period swell waves can overtop the beach at 5.6m ODN crest heights, doing so several times since the 1985 Hayling Island Beach Replenishment Scheme was constructed. A wider berm helps reduce this overtopping, although significant overtopping was observed in the bi-modal wave event in November 2005 over a beach at 5.6m ODN crest height and 18m width from the promenade to the crest. At Creek Road car park the crest was reduced in width by approximately 11m over a single high water. If the minimum crest width of 11.6m suggested in 2009 (Section 3.3) was adopted for the frontage this would have likely resulted in failure of the beach (crest back to promenade), and an increase in overwashing. It should be noted this minimum crest width did not account for bi-modal wave events and therefore, the resilience of the beach against these events and consecutive storms, increases the likelihood of profile failure. As a result, the design profile established by HR Wallingford in 2005 (Ref 3.8), with a crest width of 18m at a 5.6m elevation for a 1 in 200 year SoP, has been applied to the beach since 2007 and has worked successfully for 'typical' winter events, although still requires testing against bi-modal events using SHINGLE-B and storm clustering (Section 3.2.4).

The beach at Hayling Island has been tested during the past 5 year BMP phase, with the

stormiest winter in 2013/14; the highest percentage of bi-modal seas in December 2015 at 38% (the 13 year average is only 11%) and the highest recorded wave height on the 28th March 2016, all since the Hayling Island wave buoy was deployed in 2003. The summer baseline topographic data depicted in the design profile graph (Section 2, Figure 2.16) shows the beach volume has been below design profile since 2013. As mentioned in Section 3.1.1, this iteration of the BMP will be costed on the requirement of 51,000m^3 of material in year 1 to bring the beach up to the required standard of protection for Eastoke, thereafter 39,000 m^3 will be required on an annual basis for year 2, 3, 4 and 5 (see Section 2.5)

3.2.4 Sensitivity testing of the 2012 Hayling design profile for bi-modal events

During the latter months of this BMP review, a new tool commissioned by the Channel Coastal Observatory (CCO), based on physical model tests at HR Wallingford was launched. SHINGLE-B enables bi-modal wave conditions to be tested on a shingle beach profile. This tool requires bi-modal wave and water level input parameters for which joint probability extremes do not currently exist for Hayling Island.

Therefore, a sensitivity test was undertaken on the 2012 design profile (18m crest at 5.6mAOD) using data from the Hayling Island wave buoy for known bi-modal storm events. In addition, the 1 in 200 year swell conditions developed for the 2012 Hayling BMP were also run. These tests were not deemed reliable enough to change the design profile, therefore the beach design profile between groynes 11 and 35 will remain the same over the next 5 years as the 2012 BMP.

The conditions that had the worst beach response were the 'swell only' conditions. These long-period waves showed the furthest cut-back of the beach. Following this were the 'bi-modal' and then the 'wind only', which showed the least erosion. The results indicate that an increase in wave period has a more damaging effect than an increase in wave height. The 'swell only' conditions showed approximately 10m greater erosion than the 'wind only' conditions, despite having a lower wave height.

It is recommended that joint probability bi-modal extremes are established for Hayling Island and that these are tested on the design profile over the next 5 years to explore the robustness of the design profile to withstand a 1 in 200 year bi-modal storm event.
Until these new datasets are available, the SHINGLE-B model test results mentioned above should be interpreted with caution.

3.3 Design Profile

The 1 in 200 year design profile based on the design rationale in Section 3.2.3 is illustrated in Figure 3.8. A width of 18m from the beach crest to the promenade and 5.6m OD elevation are constant along the entire frontage. The rear slope varies according to the construction of the promenade and seawalls behind the nourished beach. The lower beach slopes are based on an average of several years measured beach profiles and alter along the

nourished frontage. A summary of the individual design profiles is tabled in Appendix D. The +5.6mOD design profile is recommended between Groyne 11 to Groyne 35 given the properties and infrastructure at risk (Figure 3.3). East of groyne 11, the design profile is lower at a crest height of +4.6mOD where it intersects with the rock 1m below the crest and a slope of 1 in 12 (Ref 3.9 – Figure 3.3 and Figure 3.9). Rather than add an additional requirement for material east of Groyne 7 for the Eastoke Point scheme, this current BMP will work on the assumption material is being transported east, thereby feeding Eastoke Point before being transported to The Ness and West Pole Sands in Chichester Harbour where it can be recycled back into the system. **However, there is a recommendation that the beach levels at Eastoke Point continue to be monitored and if necessary, will require additional material to be brought in.**

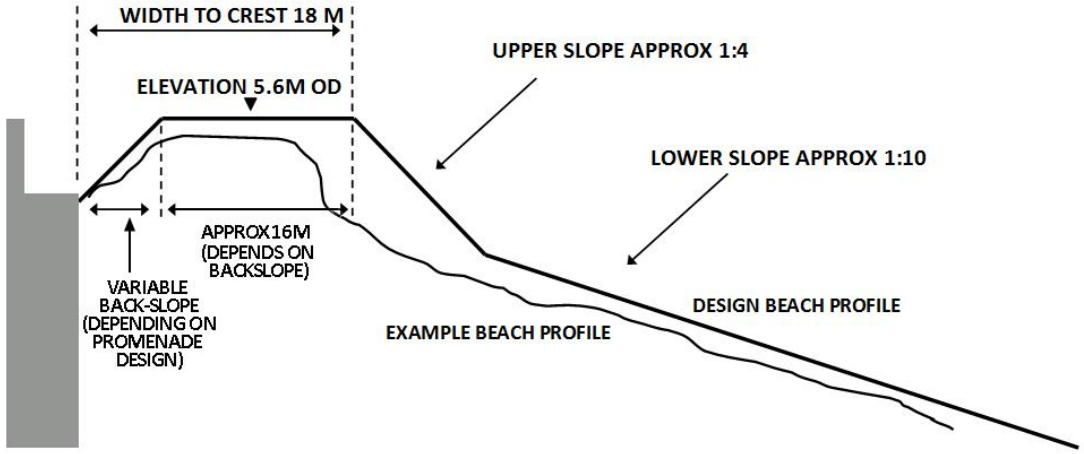

Figure 3.8 Nourished beach design profile

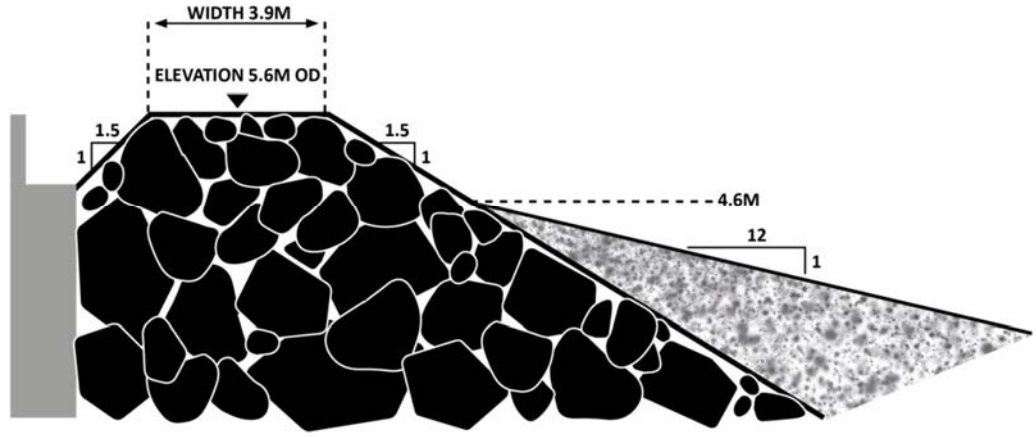

Figure 3.9 The design profile at the Eastoke Point Scheme

A theoretical design volume of 652,831m^{3}has been calculated for the managed frontage (Groyne 3 – Groyne 35) which includes the 5.6m design profile height between groynes 11 – 35 and a 4.6m design profile height between groynes 11 - 3 (Figure 3.3). The design beach surface was generated from the design profiles along the nourished frontage. The volume of

material between this design surface and a datum of MLWS (-1.84m OD) was then calculated for each groyne bay along the nourished frontage. A breakdown of the design volumes for each individual groyne bay is given in Appendix D.

3.4 Trigger Levels

Corresponding with the 2012 Hayling BMP and the experience gained in the 2013/14 storms, the application of trigger level values should not be absolute, and consideration should also be given to sea conditions at the time of the assessment. The best opportunity for beach inspections is immediately following a storm event. However, whilst beaches usually experience significant draw-down and crest width reduction during storms, they usually recover to near their pre-storm level shortly afterwards in calmer conditions. It is therefore recommended that unless further severe weather is expected, several days should be allowed for the beach to recover following the storm before remedial actions are implemented. The trigger levels identified below are provided as a basis for assessing the requirement for emergency works. Each instance should be assessed on its own merits taking into account other factors such as the time until the next planned works.

There are two distinct types of triggers identified for managing the Eastoke Southern frontage; volumetric and profile based. The volumetric thresholds are designed to ensure there is adequate material on the nourished frontage to maintain the design profile. The profile based trigger levels are designed to maintain the required standard of flood and erosion protection, and have been in place since the 1992 BMP. The two thresholds are applied independently, so for example the beach crest will still require topping up to maintain the 1 in 200 year profile even if the overall nourished beach volume is above the required standard.

<u>Alarm</u>

- Three or more consecutive groyne bays depleted below a 1 in 10 year SoP (see Figure 3.6). ACTION: The area shall be monitored daily by suitable officer to assess whether the area is deteriorating or naturally regenerating. If the area is regenerating then daily monitoring shall continue until the standard of protection is in excess of the 1 in 10 year standard.
- The nourished frontage volume falls within 10,000 m^3 of the design volume (Section 3.3). ACTION: Volume of the nourished frontage to be monitored to establish if low levels are a result of a single anomalous survey, e.g. event drawing material down below toe of surveys, or a longer term erosional trend.

<u>Crisis</u>

- Three or more consecutive groyne bays depleted below a 1 in 10 year SoP AND deemed to be deteriorating. ACTION: Emergency works triggered, along with the

appropriate ongoing monitoring (Section 4).

- The nourished beach volume continues to fall below 10,000 m^3 of the design volume before the end of the BMP period. ACTION: Emergency works triggered, along with the appropriate ongoing monitoring (Section 4).
- Individual bay drops below 1 in 1 year SoP (Figure 3.6). ACTION: Emergency works triggered, along with the appropriate ongoing monitoring (Section 4).
- 50% of frontage falls below 1 in 100 year SoP (Figure 3.6). ACTION: Emergency works triggered, along with the appropriate ongoing monitoring (Section 4).

See Section 5.1.1 for sources of material and 5.2 for emergency works.

3.5 Relevant Information

The following provides a list of all sources of information that have been referenced in this section of the beach management plan.

Ref 3.1 **North Solent Shoreline Management Plan**, New Forest DC (2010)

Ref 3.2 **Hayling Island : Eastoke Sectoral Strategy Study**; Joint report to Havant Borough Council and Environment Agency, W.S. Atkins Ltd (2006)

Ref 3.3 **Correspondence about HIBRS initial design**, Harlow, D.H. (2012), Pers comms.

Ref 3.4 **Investigation into beach profile response and overtopping**, Letter C/H/5/0A. HR Wallingford (1998).

Ref 3.5 **Eastoke Point Coastal Defence Strategy: Investigation into minimum berm width**, Technical Note CBR3873-01b. HR Wallingford (2009).

Ref 3.6 **Pagham Harbour to River Hamble Coastal Strategy Study, Volume 1: Pagham Harbour to Portsmouth Harbour**. Report EX 3121. HR Wallingford (1995).

Ref 3.7 Royal Haskoning (2012), **Eastoke Point Coast Defence Works - Wave and Overtopping Modelling, Technical Note 9X1135.**

Ref 3.8 **Beach Nourishment 2005, Hayling Island**, Technical Note CBM5505/01. HR Wallingford (2005).

Ref 3.9 Eastoke Point Coastal Defence Scheme: **Project Appraisal Report,** 2012

4. MONITORING PROGRAMME AND OBJECTIVES

4.1 Monitoring Programme

The recommended monitoring programme incorporates the ongoing monitoring undertaken by the Eastern Solent Coastal Partnership (ESCP) and the Channel Coastal Observatory (CCO) under the South-East Regional Coastal Monitoring Programme (SERCMP). **It is recommended that beach monitoring data continues to be collected to inform the revision of the BMP in five years time**, thereby providing a greater level of quantitative field data to aid improved understanding of the coastal processes, e.g. updating the design profile graph (Figure 2.16) and predictions of beach responses to storm events. Table 4.1 provides an overview of the monitoring requirements over the next 5 years. Items highlighted in 'yellow' are actions already undertaken as part of the ongoing monitoring by ESCP as part of the SERCMP.

Table 4.1 Recommended monitoring programme over the next 5 years

Monitoring Requirement	Year 1 (2017/ 18)	Year 2 (2018/ 19)	Year 3 (2019/ 20)	Year 4 (2020/ 21)	Year 5 (2021/ 22)
2 annual beach profile surveys (Spring: to be extracted from baseline survey; Autumn: designated/intermediate profiles)	X	X	X	X	X
Post-storm surveys (as required)	X	X	X	X	X
Pre- and Post- recycling event surveys (when recycling occurs)	X	X	X	X	X
Full beach baseline topographic survey of frontage (now Spring rather than summer)	X	X	X	X	X
Annual Bathymetry Survey (by SERCMP)		X		X	
Visual walkover inspections of beach (monthly and pre-storm and post-storm as required)	X	X	X	X	X
Visual inspection regime for structures (including pre-storm and post-storm as required)	X	X	X	X	X

Monitoring Requirement	Year 1 (2017/ 18)	Year 2 (2018/ 19)	Year 3 (2019/ 20)	Year 4 (2020/ 21)	Year 5 (2021/ 22)
Detailed inspection of structures (triggered by visual inspections)	X	X	X	X	X
Tracer pebble deployment and monitoring	X			X	
Wave data collection (Hayling buoy 5km offshore)	X	X	X	X	X
Tide level data at CHIMET / Portsmouth	X	X	X	X	X
Capture of recycling events using recycling log sheets	X	X	X	X	X
Bird and Vegetated Shingle Surveys	X	X	X	X	X
Lidar survey of the entire Hayling frontage, including harbour mouths (by SERMP)	X		X		
Aerial Photography (orthophotos by SERMP)			X		
Sediment Sampling		x		x	

4.2 Beach Monitoring

4.2.1 Beach baseline topographic Survey

A full topographic survey of the beach surface is carried out annually as part of the SERCMP. The requirement for quarterly surveys extending over the entire South Hayling frontage and the West Wittering to East Head frontage was first introduced by English Nature in 2001, and later revised down to an annual baseline survey in 2007. This requirement was related to FEPA licence 31563/02/1 and CPA Consent Number 69814. The surveys are currently carried out using RTK-GPS rover units on backpacks and since 2016, a Leica ScanStation C10/C5 is also used. In addition beach profiles are measured using RTK-GPS on a detail pole along predetermined profiles, distributed approximately every 50m around the coastline. This survey has been carried out every summer since 2003 and provides the basis for monitoring the morphology of the Hayling open coastline. The profile data is stored in SANDS for analysis by the ESCP, and made available through the CCO website (Ref 4.1). The full topographic survey is stored as an ASCII text file and combined with Lidar data for further analysis by the ESCP.

With recent efficiencies to the SERCMP, the annual baseline surveys will now take place in the spring rather than the summer by the ESCP. This is so that spring profiles can be extracted from the dataset, thereby negating the requirement for a spring profile survey. It is important these baseline surveys are undertaken as late in the spring as possible (post-April after Beach Management Activity works) to avoid capturing a post-storm beach.

4.2.2 Beach Profile Surveys

Topographic beach profile surveys are carried out by the ESCP as part of the SERCMP. Up until 2017, these were surveyed every spring and autumn. With the baseline topographic survey now being collected in the spring, this dataset will be used to extract the spring profile data.

Profiles are taken at pre-defined locations around the open coast (Appendix A). Data is stored in SANDS (Shoreline and Nearshore Data System) for further analysis by the ESCP, and made available through the CCO website (Ref 4.1). Analysis of beach profile data is also undertaken by CCO and reported annually.

In addition post-storm profiles will be collected when required along predetermined profiles as part of the SERCMP, triggered by H_s exceeding a predetermined threshold set by the CCO. Where required, **further profiles will be collected after all significant storm events** to inform the ongoing beach management response as part of the South Hayling BMP.

Pre-storm surveys could also usefully be undertaken if a forecast storm event is thought likely to result in significant impacts on the beach morphology. Capturing pre-storm surveys as well as post-storm surveys will improve understanding of how the beach responds to storms, and could be better related to wave, tide and beach water level data. It is recommended the Beach Management Activity officer requests pre- and post-storm surveys when necessary.

4.2.3 Beach Recycling Logs and Survey

During Beach Management Activities and beach re-profiling (see also Section 5.3.2), beach recycling logs will need to be maintained by ESCP operations staff. The location and volume of material recycled or recharged should be supplied to the CCO after each operation. This information will allow future analysis of beach volume changes to account for beach recycling and re-profiling work and will enable the underlying natural beach movements to be identified.

Two separate beach surveys, 'in' (pre-recycling) and 'out' (post-recycling), are typically undertaken for every beach recycling operation. This will be used to establish the volume of material required along the nourished frontage before each operation and to build up a long-term picture of losses along the frontage after the works are completed. Where possible, these surveys should reach Mean Low Water Springs to allow comparison with other surveys and to update the design profile graph (Figure 2.16).

4.2.4 Bathymetric Survey

An annual bathymetric survey has been carried out around the entire Hayling Island frontage out to a minimum of 200m beyond mean low water neaps (MLWN) (Appendix A). The requirement for quarterly surveys of the Chichester Harbour entrance and adjacent seabed was first introduced by English Nature in 2001, and later revised down to an annual

hydrographic baseline survey in 2007. This requirement was related to FEPA licence 31563/02/1 and CPA Consent Number 69814. This data will be used to establish the depth at which the toe of the beach profile becomes stable, the 'closure depth'. The survey will also extend out over the Chichester ebb-tidal delta, and the East Winner to cover key areas for dredging material and identifying changes that can influence the adjacent shoreline over yearly timescales. Once every five years this survey was extended out to the 10m CD contour to continue a dataset for longer term monitoring of seabed levels in Hayling Bay and over the adjacent ebb-tidal deltas.

In 2013, multi-beam was collected through the SERCMP for the east Solent, providing a high resolution dataset of the seabed.

It is important the bathymetric surveys are still collected every two years, although there is a risk this may not be funded through the SERCMP. If this is the case, additional funding will be required to continue collecting this data for these highly dynamic ebb-deltas.

4.2.5 Visual beach inspections

Visual inspections are to continue along the Eastoke southern frontage, inspecting beach levels and identifying any major structural defects. Photographs are to be collected of areas where significant changes in beach levels have occurred. The timing of these surveys varies according to need, with increased frequency over the winter months. Visual inspections can also be triggered by individual storm events, or in response to reports of specific issues. Photographs collected as part of the inspections will be geotagged and stored as evidence for any subsequent Beach Management Activities (BMA). A template for recording visual inspections of the beach has been developed (Appendix H).

4.2.6 Aerial Photography and LiDAR

LiDAR (light Detection and Ranging) surveys have been flown periodically by the Environment Agency under the SERCMP, and were flown annually around the Chichester Harbour Entrance Channel. Despite the lower vertical accuracy of ±15cm for the older datasets compared with ±2cm for topographic surveys, the flights are extremely useful for monitoring locations such as Black Point spit and Gunner Point, which are difficult to survey safely and accurately using terrestrial survey techniques. It is planned that LiDAR will be collected through the SERCMP in 2017/18 and 2019/20. The combination of the LiDAR data and the bathymetric data is also extremely valuable for monitoring changes in the nearshore zone.

Aerial Photography in this area is proposed to be flown every five years by the SERCMP to produce orthophotos. An extra set of orthophotos were collected by the programme in the summer of 2016. The next flight is to be confirmed but is believed to be summer 2019.

Continuation of these aerial photography and LiDAR surveys, combined with regular

monitoring of beach levels, will allow future derivation of long term trends and recession rates across the BMP area.

4.2.7 Beach Sediment Tracer Surveys

The regular deployment and tracking of beach sediment tracers should continue along the Eastoke nourished frontage, as well as further deployments around the entire South Hayling BMP frontage. It is recommended two phases of tracer deployments and monitoring are undertaken over the next 5 year BMP. In conjunction with the topographic surveys, the location of the drift divide on the nourished frontage, as well as movement to Gunner Point and The Ness can be monitored, and used to inform the ongoing sediment budget analysis that is the basis for establishing recharge and recycling requirements for the nourished frontage.

4.2.8 Sediment Sampling

A comprehensive set of sediment samples should be collected in Year 2 (2018/19) and 4 (2021/22) of the BMP. Sediment samples should be collected at mean low water (MLW), mean sea level (MSL), mean high water (MHW) and the beach crest on the 23 profiles identified in Appendix A. This will provide a valuable dataset to establish the sediment distribution around the frontage for the next BMP period. It will also allow comparison back to the 2009 and 2017 dataset to monitor the effect of the ongoing beach management on the sediment distribution around the wider frontage. Maintaining or increasing the D_{50} is important to the scheme standard of protection. Due to the coarseness, origin, and large sizes of sediment, it is considered unlikely that contaminants can bind to the beach material that is recycled. The beach material is also regularly washed over by the tide. For this reason, the beach recycling works are not expected to result in any contamination issues. As a matter of good practice, we may undertake sampling to confirm this is the case, (for example, should we be moving large quantities of finer material).

4.3 Structure monitoring

4.3.1 Visual Inspection

Visual Inspections of all coastal structures within the BMP area should be undertaken regularly as part of the Eastern Solent Coastal Partnerships Asset Inspection Programme.

The programme takes a risk based approach to determining the frequency of inspections to each section of the coastline. Areas of high exposure or with known vulnerable structures are inspected more frequently than more low risk areas.

For the purposes of this BMP a description of the structural monitoring undertaken along the nourished frontage is included. The nourished frontage features a number of coastal structures, all of which are visually inspected on an annual basis and are as detailed below;

- Timber Groynes
- Timber Sloping Breastwork
- Rock Armour
- Concrete Splash Wall
- Concrete / Blacktop Promenade
- Concrete Seawall (redundant for most of the frontage)
- Steel Sheet Piles
- Local aids to navigation

The visual inspections are undertaken using a standardised assessment procedure in accordance with The Environment Agency's Condition Assessment Manual.

Visual Inspection data is normally recorded on site digitally using PDA (Personal Digital Assistance) handsets allowing data to be recorded under predetermined data fields to ensure continuity of the information recorded for one survey to the next. The data fields required to be gathered for each structure are detailed in the table below (Table 4.2).

Table 4.2 Structure Monitoring Data Fields

Field	Input Requirements
Asset ID	This is pre-programmed for all existing assets
Date	Date of Inspection
Assessor ID	Assessor ID to identify person undertaking the inspection.
Condition Grade	1 – Very Good , 2 – Good, 3 – Fair, 4 – Poor, 5 – Very Poor
Worst Element Condition	1 – Very Good , 2 – Good, 3 – Fair, 4 – Poor, 5 – Very Poor
Description	Free Text, assessor to provide a description of the condition
Maintenance Urgency	A –Immediate action required B – Include on maintenance programme C – No maintenance required
Residual Life	< 1 Year, 1- 10 Years, > 10 Years
Structure Type	Armour, Apron, Bastion, Breakwater, Cliff, Embankment, Groyne, Outfall, Piling, Promenade, Revetment, Rock, Seawall, Shingle Bank, Beach, Slipway, Splash Wall, Wave Reflection Wall, Wetland/Marshland, Other, None.
Material 1	Identify Primary Construction Material: Bag, Block, Boulder, Clay, Cobble, Mass Concrete, Reinforced Concrete, Masonry, Mastic, Rock, Rubble, Sand, Shingle, Stone, Timber, Steel, other/none.
Material 2	Identify Secondary Construction Material: Bag, Block, Boulder, Clay, Cobble, Mass Concrete, Reinforced Concrete, Masonry, Mastic, Rock, Rubble, Sand, Shingle, Stone, Timber, Steel, other/none.
Material Other	Identify any other significant construction materials.

Primary Asset	Yes / No – Is this structure the primary defence asset?
Photograph	Yes/No - Have photos been taken of structure showing the general condition and any specific defects?
Notes	Additional notes/comments not covered in previous fields.

Collected data is processed and uploaded to the ESCP GIS Asset database, which then allows detailed analysis of the data, maintenance planning and allows users to display the collected data graphically.

4.3.2 Detailed Inspection

In addition to the asset inspection procedure as detailed in Section 4.3 a more detailed defect reporting process should be undertaken as required where the visual inspections highlight specific defects or structures of poor condition.

Defect Reports detail specific structural defects including likely failure modes and make assessment and recommendations as to the possible remedial options.

Visual inspections, intrusive and non-intrusive investigations can be undertaken to build on information collected as part of the original asset inspection and further advise the defect report. Defect reports form the basis of the Maintenance Recommendation Report to undertake required remedial works, with the recommendations taken forward onto the maintenance plan for the area.

4.4 Environmental Monitoring

4.4.1 Habitat Surveys

To provide a baseline, a vegetated shingle survey was undertaken in 2016 to establish the extent of the habitat types; *Perennial Vegetation of Stony Banks* and *Annual Vegetation of Drift Lines*. This survey covered the entire frontage and recorded distinct compartments with species level information. Figures 2.21-2.24 show the current extent of habitats based upon the 2016 survey. Figure 4.1 and Figure 4.2 indicate the areas for ongoing surveys and monitoring and the ecological restrictions that will be applied within each area to mitigate against harm to the various ecological sensitivities.

This baseline survey will be used to plan and demarcate haul routes pre-commencement. An annual re-survey will be undertaken in July, (as recommended by Natural England) to detect any changes in extent and in particular the current front edge of vegetation. Comparison between the baseline and current extent will enable the effect of the works to be monitored. In addition the current extent of *Annual Vegetation of Drift Lines* will be used to calculate the extent of accreted shingle that can be recycled from Gunner Point.

Figure 4.1 Restrictions and surveys along the Hayling Frontage (East)

Figure 4.2 Restrictions and surveys along the Hayling Frontage (West)

4.4.2 Bird Surveys

The bird interest on Hayling Island beach frontage is of two main types of usage, overwintering waders (mainly consisting of Sanderling, Ringed Plover and Dunlin), which utilise the beach for roosting and feeding and small numbers of breeding and ground nesting birds (Ringed Plovers), which will attempt to nest on the shingle beach. Current survey data and anecdotal evidence would indicate that only low numbers of over-wintering waders feed on the frontage, but roosting behaviour can be significant in the Eastoke area with often 3-400 birds present. It is however believed that the roosting behaviour tends to be early season with little significant roosting occurring beyond November, this anecdotal information will be confirmed (or otherwise) via the ongoing monitoring.

Bird monitoring will take three main forms i) Over-wintering bird surveys, ii) watching briefs and iii) pre-commencement walkover surveys for ground nesting birds.

i) Over-wintering bird surveys will be undertaken from September to March annually, covering the Gunner Point area (Ferry Point to Inn on the Beach) and Eastoke (Black Point to Eastoke Corner), with two counts undertaken per month (one each and low and high tide). The purpose of the surveys is to understand the significance and seasonality of the use.

ii) Watching briefs have been undertaken and will continue to be undertaken periodically during 'rainbowing' and road import operations. Currently evidence would indicate that these operations generate minimal levels of disturbance to roosting birds, with minimal displacement only when birds are roosting within the groyne bay being worked on. During each annual campaign a minimum of one watching brief for each type of operation will be undertaken. The observations will build up our knowledge of the operations effects on bird populations and enable future operations to be tweaked if required to further minimise impacts.

iii) Any operations during the bird nesting season (March-August inclusive) will be proceeded by a pre-commencement walk-over survey by a suitably qualified ecologist to identify any active nesting attempts by ground nesting birds (principally Ringed Plover) on the shingle beach. Depending on the location a decision will be reached on whether to a) demarcate a minimum of a 5 metre buffer zone around the nest, b) alter work plans, including haul routes and working areas to avoid nesting area c) delay works until the nesting attempt has naturally completed.

4.4.3 Water Quality

No water quality surveys are currently carried out by the ESCP, however the Environment Agency does carry out sampling within the harbours. The ESCP are currently investigating with the Environment Agency if there is any need for sampling sediments from within the plan area on a risk based approach to ensure that there will be no impact on the water bodies under the Water Framework Directive.

4.4.4 Monitoring and Mitigation

The environmental monitoring set out in this section, will help to build a better understanding of the environment along the frontage. Monitoring data is to be shared with our regulators (i.e. Natural England), which may lead to future refinement of our activities, from which conditions and restrictions on works may be altered or lifted in future.

Any environmental requirements stipulated as part of the planning and consents necessary to carry out the proposed works will be incorporated into the BMP monitoring programme.

Table 4.3 Mitigation Table for Beach Management Activities

Activity	Location	Impacts	Mitigation
Rainbowing shingle ashore from Chichester Harbour dredge / Offshore dredge	Eastoke	Damage and disturbance to breeding and ground nesting birds	Ecological walkover immediately prior to works in nesting season (March to August inclusive). Provide exclusion area if nesting birds discovered (minimum of 5 metre buffer distance). Additional surveys will be carried out if required to ensure that birds have not nested in the meantime.
		Disturbance to Roosting Birds	Can only be undertaken at high tide guided by ship availability. Employ watching brief if activity occurs between October and February inclusive (matching existing planning conditions / work pattern at this location). Stop works if significant impacts are observed in consultation with Natural England. Works to be stopped during extreme weather events (frozen ground conditions for more than 1 week). Curtailing the work will prevent any significant effect on the SPA birds which will be under additional feeding pressure from said environmental conditions.
		Material source site	Material will only be sourced from licenced sites / permitted navigational activities.

Activity	Location	Impacts	Mitigation
Open Beach Recycling	Open Beach and the Ness to Eastoke.	Damage and disturbance to breeding / nesting birds	Ecological walkover immediately prior to works in nesting season (March to August inclusive). Provide exclusion area if nesting birds discovered (minimum of 5 meter buffer distance). Additional surveys will be carried out if required to ensure that birds have not nested in the meantime.
		Disturbance to Roosting Birds	Undertake activity outside overwintering bird period where possible. If recycling undertaken between October and February inclusive, stop works 1.5 hours before, and 1 hour after high tide along Eastoke frontage only (see Figure 4.1). Extraction and stockpiling may still occur during high tide, west of Eastoke, outside of sensitive bird areas.
		Vegetated shingle / drift line habitats	Undertake vegetation surveys (preferably in late July, as recommended by Natural England), to guide winter works. Plan haulage routes to avoid vegetated areas. Measures will be deployed to prevent impact to vegetated shingle communities.
Extraction of shingle	Gunner Point	Damage and disturbance to breeding / nesting birds	Works will avoid bird breeding season (no extraction here from Mid Mar to End Aug).

Activity	Location	Impacts	Mitigation
		Disturbance to Roosting Birds	Works will only take place here between September and mid March to avoid other impacts. September is the preferable month for extraction to avoid overwintering period. If extraction takes place between 1st Oct and mid March stop works for 1.5 hours before, and 1 hour after high tide (more sensitive than Eastoke and the open coastline). Works to be stopped during extreme weather events (frozen ground conditions for more than 1 week). Curtailing the work will prevent any significant effect on the SPA birds, which will be under additional feeding pressure from said environmental conditions.
		Vegetated shingle	Undertake vegetation surveys (preferably in late July, as recommended by Natural England), to guide winter works. Plan haulage routes to avoid vegetated areas. Measures will be deployed to prevent impact to vegetated shingle communities. This habitat is landward of the drift line habitats that require additional mitigation.
		Drift line habitats	Undertake drift line habitat surveys (preferably in late July), to guide winter works. Drift line habitat survey undertaken in 2016, show seaward boundary of habitat type. Extraction in 2017 to be seaward of this boundary. From 2017 onwards, only material accreted in front of this line will be extracted with permission from the landowners.

Activity	Location	Impacts	Mitigation
		Natural Coastal Processes	On-going detailed monitoring of beach levels to guide operations. Working with natural coastal processes for the benefit of this frontage. Recycling from this point will maintain a flow of material to Gunner Point. This is a benefit, as lack of recycling and beach management would eventually lead to erosion at Gunner Point.
Extraction of shingle	Between the Ness and Black Point	Damage and disturbance to breeding / nesting birds	Ecological walkover immediately prior to works in nesting season (March to August inclusive). Provide exclusion area if nesting birds discovered (minimum of 5 metre buffer distance). Additional surveys will be carried out if required to ensure that birds have not nested in the meantime.
		Disturbance to Roosting Birds	Undertake activity outside overwintering bird period where possible. If recycling undertaken between October and March inclusive, stop works 1.5 hours before, and 1 hour after high tide (more sensitive than Eastoke and the open coastline). Works to be stopped during extreme weather events (frozen ground conditions for more than 1 week). Curtailing the work will prevent any significant effect on the SPA birds, which will be under additional feeding pressure from said environmental conditions.

Activity	Location	Impacts	Mitigation
		Vegetated shingle / drift line habitats	Undertake vegetation surveys (preferably in late July, as recommended by Natural England), to guide winter works. Plan haulage routes to avoid vegetated areas. Measures will be deployed to prevent impact to vegetated shingle communities. Check for any drift line habitats (none present at time of application in 2016).
		Intertidal sandflats	Any sand to be extracted in this area is intertidal sand. With the planned extent/depth of extraction area will remain intertidal. Extracted material to be recycled back to Eastoke, therefore material not lost from the system. It will work back to Black point over time, therefore no loss of intertidal habitat.
		Subtidal sand flats	No change in subtidal habitat. Material will not be removed from the subtidal area.
		Natural Coastal Processes	On-going detailed monitoring of beach levels to guide operations. Working with natural coastal processes for the benefit of this frontage. Recycling from this point will maintain a flow of material to Black Point, as all material will remain in the system.
Gentle beach profiling	Langstone Harbour entrance	Damage and disturbance to Nesting birds	Ecological walkover immediately prior to works in nesting season (March to August inclusive). Provide exclusion area if nesting birds discovered (minimum of 5 metre buffer distance). Additional surveys will be carried out if required to ensure that birds have not nested in the meantime.

Activity	Location	Impacts	Mitigation
		Disturbance to Roosting Birds	Undertake activity outside overwintering bird period where possible. If recycling undertaken between October and March inclusive, stop works 1.5 hours before, and 1 hour after high (more sensitive than Eastoke and the open coastline). Works to be stopped during extreme weather events (frozen ground conditions for more than 1 week). Curtailing the work will prevent any significant effect on the SPA birds which will be under additional feeding pressure from said environmental conditions.
		Vegetated shingle / drift line habitats	Undertake vegetation surveys (preferably in late July, as recommended by Natural England), to guide winter works. Plan haulage routes to avoid vegetated areas. Measures will be deployed to prevent impact to vegetated shingle communities. Check for any drift line habitats (none present at time of application in 2016).

4.5 Physical Conditions

4.5.1 Sea Conditions

Wave climate is monitored at Hayling Island by a wave buoy 5km south of Eastoke (refer to Section 2.2.2). Continued monitoring of the wave climate from this device will improve the understanding of return periods and the response of the beach to storm events. Additional monitoring of the inshore wave climate could be justified for this frontage due to the complex bathymetry influencing waves as they approach the nourished frontage, and the need to improve the understanding of wave overtopping and relative sediment losses each side of the drift divide.

A wave model should be developed for the East Solent as part of the new Strategy Study for Hayling Island with adequate detail around the nourished frontage to improve the understanding of sediment transport around the drift divide under various wave conditions. This will also provide information about how wave heights and overtopping vulnerability alters along the 2km nourished frontage, in turn influencing the

design profile. **The temporary deployment of suitable wave monitoring equipment, e.g. AWAC, at different points along the nourished frontage could be investigated by the ESCP.** This would provide calibration data for the numerical modelling, which is key given the complex and varying bathymetry in the nearshore zone. **This information could be related to run-up measurements collected by the ESCP at representative locations along both the nourished and open coastline.**

Tide levels are available locally at Chichester Entrance channel (Section 2.1), immediately to the south of the Eastoke nourished frontage. The continued capture of this data is considered appropriate to inform beach management, especially as a record of surge during storm events. Tidal levels are also recorded at Portsmouth entrance channel with additional statistics, such as surge heights, generated automatically by the National Tidal and Sea Level Facility.

4.5.2 Storm Events

The rate of loss of material from the Eastoke frontage and the rate of change elsewhere along the frontage is likely to increase during storms as a result of increased wave action. In order to understand the effect of storm events upon the beach response, **details of the storm conditions (waves and water levels) will need to be recorded in support of the post-storm profile surveys** (refer to Section 4.2). This will be the responsibility of the Beach Management Activities officer to keep a log of storm events in the annual report (Section 6.3), as well as present the wave and water level conditions and the impact on the beach.

4.6 Warning and Emergency Procedures

The ESCP have an established coastal flood risk response procedure in place for Eastoke (Appendix G). This includes passing information to the EA Flood Incident Duty Officer (FIDO) about the current status of the nourished beach to allow flood warnings to be adapted.

The Eastoke Peninsula is covered by the following Environment Agency Flood Warning Areas:

- Hayling – Coast of Hayling Island
- Eastoke Seafront and South Hayling – Coast of Eastoke Seafront and South Hayling
- Eastoke – Coast at Eastoke.

The existing flood warning regime is based on flood watch warning trigger levels as defined by the Environment Agency. The following levels are defined in the Environment Agency Area Flood Warning Duty Officer Procedures kept in the area incident room and held by duty officers:

- Flood Alert = 5.3m CD at Portsmouth (5.2mCD with E,SE,S,SW Winds F6+)

- Flood Warning = 5.5m CD at Portsmouth (5.2m CD if swell is high)
- Severe Flood Warning = 5.93m CD at Portsmouth (5.73m CD if swell high and beach poor condition).

The greater level of monitoring set out in this section aims to provide improved information for future understanding the whole beach system resulting in the potential for improved accuracy of flood warnings.

It is recommended that these flood warning levels be continually reviewed in the future to ensure they adequately reflect developing knowledge. For example, improvements in the estimation of run-up and overtopping over nourished beaches planned as part of the current Environment Agency South-East BMP project (Ref 4.2) could alter the water levels and wave period design thresholds.

4.7 Data

Having collected the beach monitoring data, it is important that all of the information is stored and analysed to allow decisions to be made with respect to ongoing maintenance and future management of the area covered by this BMP.

Following each scheduled beach walkover or profile survey, the information collected should be uploaded for storage and analysis to the ESCP GIS and database systems which are compatible with those used by the SERCMP and copied to the CCO as appropriate. Surveys scheduled in addition to the regional monitoring programme, e.g. pre- and post-operation walkover surveys, will be made available to CCO to enable wider use of the data via their website.

After each scheduled beach topographic and profile survey, the ESCP should analyse the data to assess the range of beach parameters discussed in Section 4.2. The results of this analysis should be recorded and distributed defining a summary of profile changes, volume changes, plan shape and crest width above a stated level. Assessment of beach level in relation to design profiles (in line with the trigger levels discussed in Section 3.4) should also be undertaken in order to provide a record of the logic for undertaking further beach maintenance and recycling works.

Additional beach monitoring data, obtained from sources such as the post-storm visual walkover inspections (with associated storm event data – see Section 4.5.2) or beach recycling logs (see Section 4.2.3), as well as information about the condition of structures (see Section 4.3) should also be stored in compatible databases (include photographs taken during each survey).

Following any sediment sampling the results should be stored in an appropriate format, including key information such as the position and timing of sampling. **After the scheduled sediment sampling survey, ESCP should analyse the data to assess the sediment**

grading around the Hayling frontage. This information will be used to improve the targeting of appropriately sized recycling material, and assess the longer-term impact ongoing recharge and recycling is having on the sediment grading around Hayling Island.

All this information should be used by the ESCP to compile an Annual Beach Monitoring report, recording key parameters such as crest width and height, beach volume, SoP. This will form an appendix to the Annual Beach Management report, summarising the Beach Management Activities carried out over the previous year. This Annual Beach Management report will be used as a basis for the following years Beach Management Activities, identifying any works required e.g. initial estimates for recycling volumes, any forthcoming structural works, etc. In addition, an Annual Vegetated Shingle and Bird Monitoring Report will form an appendix to the Annual Beach Management report (see Section 6 for more information).

4.8 Relevant Information

The following provides a list of all sources of information that have been referenced in this section of the beach management plan.

Ref 4.1 **Channel Coastal Observatory (CCO) website**. http://www.channelcoast.org. Accessed, 27/10/2016.

Ref 4.2 **South East Coast Beach Management Plan Programme**, Project Code IMSE100035, Environment Agency (2011).

Ref 4.3 **Flood Response Procedures**, Eastern Solent Coastal Partnership (2016)

5. MAINTENANCE REGIME

5.1 Ongoing Works

This section describes the beach management works that are to be carried out over the next 5 years in order to maintain a 1:200 year SoP for the managed frontage at Eastoke.

5.1.1 Beach

Potential Sediment Sources

For the past 10 years, the design profile at Eastoke has been maintained between groynes 7 and 35 through sediment recycling (material extracted from areas of accretion at West Beach, the Open Beach, Coastguard Revetment and the Ness and returned to the nourished beach – Figure 5.1); recharge from import via road; recharge from marine based import; maintenance dredging's from Chichester Bar and a one off emergency extraction from Gunner Point (see Appendix B).

The sources of material for recycling that are readily accessible can be split into:

a) The Ness (BMP U1)
b) West Beach, the Open Beach and Coastguard Revetment (BMP U4 and U5)

a. <u>The Ness</u>

The first area is the "Ness" just north of the Nature Reserve at Eastoke Point. Extensive monitoring, undertaken in-house by the ESCP, has shown that this area historically accumulates material carried easterly from the drift divide at Creek Road. Material protruding into the channel is removed to make the navigation safe and to avoid it being eroded by the ebb dominant tide and deposited on the bar across the entrance channel. Material from this area has a higher sand content and tends to cliff if left exposed on the front face of the nourished beach. Extraction of this material now depends on the quality (coarseness) of the material and whether a haul route needs to be constructed over the Eastoke Point rock revetment for the plant to access the "Ness".

b. West Beach, Open Beach and Coastguard Revetment

The wide shingle storm beach in the centre of Hayling Bay is a good source of material, especially the coarse berm that often forms just above MHW. The ESCP undertake surveys before any beach management operation to identify areas that have accreted over the previous year. Beach material can be extracted from the face of the storm beach and care must be taken not to reduce the berm height or width, particularly just east of Inn-On-The-Beach (see Figure 2.20 - where an erosion watch spot is located). In addition, there is vegetated shingle on the beach crest which must not be disturbed during recycling operations.

There are two main extraction areas behind sloping revetments in the study area; one at the Coastguard station and one at West beach (to the west of the “Inn on the Beach”). Material is periodically thrown over the structures by storm waves and thereby removed from the sediment transport system. This material is usually coarser, well sorted gravel that performs well as a front face to the nourished beach crest. This source may reduce if the remaining sections of timber revetment west of the “Inn on the Beach” are removed on health and safety grounds. The same applies to the Coastguard revetment if this structure were deemed to be redundant and removed on health and safety grounds. In both incidences, material would initially be released into the system but no longer provide a possible recycling store

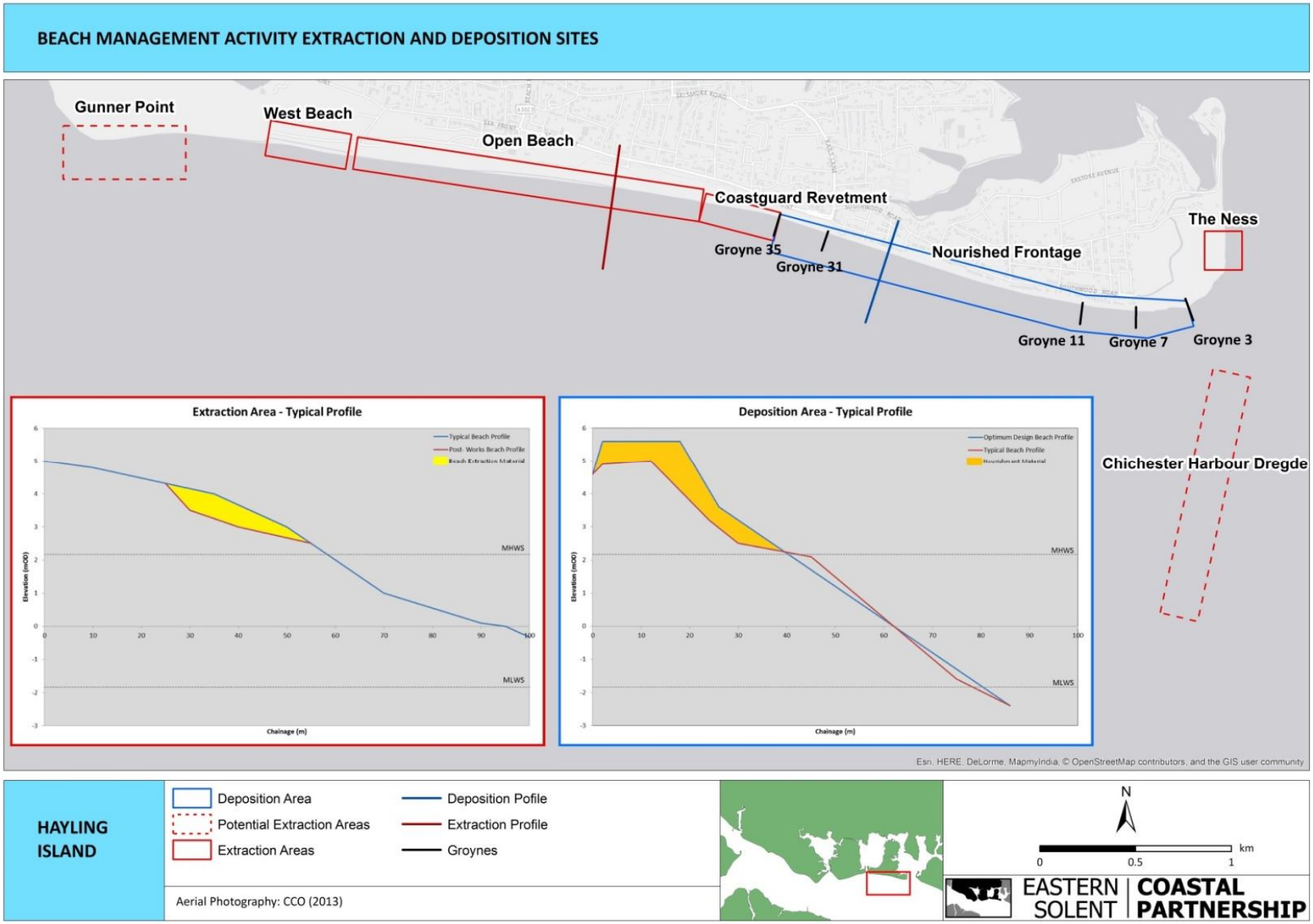

Figure 5.1 Extraction and deposition areas along the South Hayling frontage

Table 5.1 presents the advantages and disadvantages of using material from road or marine based recharge, as well as the Chichester Bar and Gunner Point (see Figure 5.1 for locations). The latter two options are excellent sources of material and are preferred sources to the recharge options although are conditional on the material being available and the landowner's consent.

Table 5.1 Advantages and disadvantages of different sources of material

Ref.	Sources of material	Advantages	Disadvantages	Conclusions
1	**Recharge** via road	Guaranteed supply of material. Coarser grading of material improves beach performance. Able to profile material on beach crest without need to bring in additional plant. Non-weather dependent delivery. Able to procure jointly with Beach Recycling operation under Minor Works Framework. Able to import smaller volumes on an annual basis, reducing losses due to overfilling of groyne bays.	Increased vehicle movements onto Hayling. Requires stockpiling prior to placement on beach. More expensive than offshore marine-based material above approx. 45,000 cu. m. overall volume. Potential impact on transport network and local residents.	**Suitable as a source** to maintain overall beach volumes but not preferred source.
2	**Recharge** form marine-based source (Offshore licenced dredge site)	Guaranteed supply of material. No impact on transport network.	Higher costs make smaller annual operations unviable. Disruption to residents due to 24hr working. Susceptible to down-time due to poor weather conditions. Less control on placement of material as 'rainbowed' ashore. Material grading less similar to beach material than Chi Entrance source (increased losses)	**Suitable as a source** to maintain overall beach volumes but not preferred source.

Ref.	Sources of material	Advantages	Disadvantages	Conclusions
3	Chichester Harbour Bar	Material grading closer to beach material than offshore source (reduced losses) Cheaper source of material. Possibility to remove smaller volumes on an annual basis under term agreement. No impact on transport network.	Effectively recycling material within littoral system so may not be as beneficial to overall Hayling Island volumes as land-based or offshore source. Not a guaranteed quality or supply of material. Disruption to residents due to 24hr working. Susceptible to down-time due to poor weather conditions. Less control on placement of material as 'rainbowed' ashore.	**Over-riding option** if dredging must take place due to removal of hazard to navigation.
4	Gunner Point	Material grading closer to beach material than offshore source (reduced losses) Cheaper source of material. Possibility to remove smaller volumes on an annual basis. No impact on transport network.	Effectively recycling material within littoral system so may not be as beneficial to overall Hayling Island volumes as land-based or offshore source. Not a guaranteed supply of material as landowner consent required. Disruption to residents during September. Quantities to be extracted dependent on accretion in front of annual vegetation of drift line habitats. Limited to month of September only due to wider environmental factors.	**Over-riding option** if material is available in September and landowner agrees to the quantity to be extracted.

Any recharge via road should be single-size graded 20-63mm aggregate transported to site by lorry. The material is dredged at licenced offshore sites before being landed and graded ashore. The material is therefore of a similar type and appearance to the coarser fraction of material already on the beach. This material performs well on the nourished beach, and has been used as part of previous operations to armour the front face of the beach crest. Unlike dredged material pumped directly ashore there is no loss of fines from the beach as it is reworked by wave action. The absence of sand in the material prevents the occurrence of

cliffing, and improves drainage down through the beach crest.

Appropriate licenced offshore dredge sites will be considered should the need arise, however this is not the 'preferred sediment source' as losses due to fines are estimated at around 20-30%. This represents the fraction of material too small to remain stable within the mobile beach and are winnowed out.

If a maintenance dredge becomes necessary to remove the Chichester Bar from the Chichester entrance channel, this material should be utilised rather than lost as part of the wider sediment budget feeding the Eastoke frontage. The sediment in the entrance channel is a good match to the current beach material, although losses due to fines are still estimated at 30-40%.

Gunner Point at the far western end of Hayling Island has been a sediment store since the beginning of the 20th century (Figure 2.8 and Figure 2.13). With a large proportion of imported material travelling west from the drift divide at Eastoke, Gunner Point has accreted substantially since the 1985 replenishment scheme and continued BMAs (approximately 20,000 m^3 per year since 2003). Gunner Point is therefore an excellent source of material for recycling back to Eastoke given the mix of native and imported material. Recent agreement with the landowners at Hayling Golf Club permits annual extraction of material from Gunner Point pending agreement on the quantities prior to works. This source of material along with Chichester Bar is not guaranteed in terms of timing and volume but both are considered 'over-riding' options and preferred sediment sources to recharge material. All environmental considerations will be adhered to if extraction takes place (Table 4.3).

Sediment Volumes

This iteration of the BMP will be costed on the requirement of 207,000m^3 of material in total over the 5 year phase for the Outline Business Case. This will comprise 51,000m^3 of material in year 1 to bring the beach volume back up to 1 in 200 year SoP, after which 39,000 m^3 will be required on an annual basis for year 2, 3, 4 and 5 (see Section 2.5.2 - d for calculations). This current BMP will work on the assumption that some of the material from the Eastoke drift divide is being transported east, thereby feeding Eastoke Point before being transported to The Ness and West Pole Sands in Chichester Harbour.

In terms of estimating the volumes of material available from various sources for the next 5 year phase, the following summarises the average quantities per year utilised between 2006 - 2016 (see Appendix B):

Recycling ~ average 30,000 m^3 per year

~3,000 m^3 from 'West Beach'
~16,000 m^3 from the 'Open beach'
~3,000m^3 from behind the Coastguard Revetment
~11,000 m^3 from the 'Eastoke Point and the Ness'

Recharge ~ average 11,000 m^3 per year
~2,000 m^3 road import
~9,000 m^3 offshore dredge (one off campaign between 2007 and 2009)

Alternative material ~ average 13,000 m^3 per year
~2,540 m^3 from Gunner Point (one off emergency works in 2014)
~10, 500 m^3 from the Chichester Harbour maintenance dredge

Based on the averages listed, it is estimated approximately 150,000 m^3 in total over the 5 year phase could be recycled from West Beach, the Open Beach, Coastguard Revetment and possibly the Ness. Where possible, the remaining 57,000 m^3 should be made up with material from Chichester Bar (30,000 m^3) and Gunner Point (27,000 m^3, pending landowner's permission). The aim is to build the beach up to design profile in Year 1 through extraction from Gunner Point in September 2017. Where it is not possible to extract material from Gunner Point or less material is available from Chichester Bar, recharge in the form of road import (6,000 m^3) and an offshore dredge (21,000 m^3) will be implemented.

Assessing the Required Volumes
Prior to each recycling and recharge operation the volume of material required on the nourished frontage must be calculated. A digital terrain model of the beach to be nourished will be compared to the beach design surface. The volume of fill required to bring the beach up to the design surface will be calculated and broken down into individual groynes bays. The volume of fill required will be sought from the potential sources. If there is insufficient suitable material to be extracted from recycling areas, then additional imported material will be used to top up the volume.

The volume of material available for extraction will be assessed by comparing the latest survey data to the previous post-operation survey or baseline survey, whichever is the most recent. This will be used to identify areas of accretion and calculate the likely volumes of material available for extraction. The suitability of material will be assessed visually just prior to the start of any recycling operation. Due to the dynamic nature of the beach there must be some flexibility in allocating extraction targets. Engineering judgement will be used on site to avoid over extraction from the beach face.

Programme of Works
The following lists the proposed timings of works:

Beach recycling
Over the five year period of the BMP, beach recycling from West Beach, the Open Beach, Coastguard Revetment and possibly the Ness is anticipated to take place annually every March, over a 4 week period.

Chichester Bar
Havant Borough Council object in principle to any dredging close to the Hayling coast but will

utilise the material from the Chichester Harbour maintenance dredge rather than lose it from the littoral system. Any dredging of the bar would typically be on a passing basis, but where possible timed to avoid school summer holidays. This has taken place in the month of September in the past.

Gunner Point

Given the potential for Gunner Point being a high tide roost site between October to mid-March and the requirement for drift line vegetated shingle establishment between mid-March and August (see Section 4.4), September is the preferable month where extraction from Gunner Point can take place at all states of the tide. At other times works can take place from October to March providing no works take place 1.5 hours before and 1 hr after high tide and no works take place during extreme cold periods (i.e. frozen ground conditions for more than 1 week).

Recharge

Where road import via road or a dredging campaign is necessary, this will take place in September.

Annual reporting

Annual reporting is scheduled for July as to prepare the information necessary for any September campaign. The monitoring information in the report will be presented to the landowners at Gunner Point to agree the quantity of material to be extracted.

Emergency works

Emergency beach management works may take place at other times during the year in response to low beach levels, and these works would be carried out with due regard to the trigger levels identified in Section 3.3.

5.1.2 Structures

This BMP only deals with the requirements to manage the beach as part of the overall defence system. Whilst interaction with these structures is discussed and considered within this BMP, the requirements for ongoing maintenance of the structures is set out in a separate maintenance plan prepared by the Eastern Solent Coastal Partnership for the structural elements along the BMP area, including the timber and rock groynes.

Routine maintenance is currently undertaken along the BMP frontage by the ESCP. In summary, this ongoing maintenance comprises:

- Maintenance of beach control structures (timber groynes and revetments) in BMP U2, U3, U4 and U5 should continue as at present to replace planks and remove sharps (for health and safety reasons). The existing beach control structures appear to be performing adequately along most of the nourished frontage. **If the beach design profile cannot be maintained to a sufficient standard during the course**

of the current BMP at the erosion hotspots identified in Section 2.6 then a more detailed analysis of the control structures in these areas will be warranted.

- Clearing of shingle from the promenade in BMP U3 as required.
- Maintenance and operation of flood boards in BMP U3.
- **Removal of the remaining structure at West Beach should be investigated and take place when the revetment is no longer serviceable and before there is a health and safety issue with the structure.**
- **The performance of the remaining groynes at West Beach should be investigated and where deemed redundant, should be removed where causing a health and safety risk. Further studies are required to investigate whether these should be removed or repaired.**
- **It is recommended a feasibility study be undertaken to appraise options for an Eastoke Drainage Scheme. This scheme would look to improve drainage of overtopped seawater from the Eastoke promenade back into the sea during storm events. This could include for example new porous control structures, such as a rock revetment/rock groynes at key erosion hotspots along the frontage, to improve drainage and reduce beach losses.**
- **Removal of the Coastguard revetment should be investigated. If there is deemed to be no increase in flood or erosion risk, the revetment should be removed.**

This existing maintenance regime of structures is to continue in the future. **Any maintenance activities should be recorded in the Structure Maintenance Log**. No additional maintenance activities are proposed.

5.1.3 Public Access, Amenity and Safety

Beach management activities should avoid the peak holiday season, weekends and public holidays where possible. Condition 4 of the recycling Planning Consent (Appendix C) prohibits all but emergency works on weekends and recognised public holidays. This will minimise the impact of works on beach users and will reduce the minor risk to public safety that such work would pose. In order to ensure the safety of the public whilst works are being carried out, restrictions on public access to the areas of the beach being worked on should be implemented, with alternative routes provided if possible.

Experience has shown that closing the beach entirely is likely to be impractical, and **it is suggested that adequate on site supervision and signage are employed to direct public access to safe sections of the promenade and beach during works**. Health and safety risks should be assessed through a site specific risk assessment. It may be necessary to close the access at highest pedestrian traffic areas (e.g. Eastoke Corner car park), due to the relatively narrow crest and difficulty for dump truck drivers to identify all access points along this stretch.

Information boards should be displayed whilst the works are being carried out to

explain what is being done and why. This will also serve to improve public education. Appendix B contains the Communications Plan which identifies how to communicate with the public and local businesses when undertaking the beach maintenance works. The Communications Plan also contains examples of information posters for future works. This section is not exhaustive and any works should comply with the relevant up-to-date Havant Borough Council/ESCP procedures.

5.2 Emergency Works

It is emphasised that the application of trigger level values should not be absolute, and consideration should also be given to sea conditions at the time of the assessment. Good engineering judgement will play a large role in the decision to trigger emergency works.

If a design profile Crisis Level (refer to Section 3.3) is identified as being reached on the nourished frontage, the immediate action would be to carry out an emergency recycling operation to top up the affected area. The potential sources identified in Section 5.1.1 will be assessed to establish if there is an adequate supply of recycling material. In 2014, Gunner Point was used as an emergency source of material when 25,400 m^3 was recycled back to Eastoke.

If there is an inadequate volume of material available for recycling then a decision will be made on a case by case basis for importing recharge material via road to re-establish the required standard of protection. The crisis works will be carried out in addition to the ongoing annual beach recycling works.

If there is an inadequate volume of material available for recycling then a decision will be made on a case by case basis for importing recharge material via road to re-establish the required standard of protection. The crisis works will be carried out in addition to the ongoing annual beach recycling works. The programme of works is flexible to accommodate the response of the beach to storm events.

The beach levels at Eastoke Point will be monitored as the crest behind the rock can narrow towards the nature reserve. Future adjustments may be required to maintain the width.

5.3 Implementation

5.3.1 Plant Requirements

Beach recycling will typically be carried out using a tracked bulldozer and a hydraulic excavator, with dump trucks to transport material along the frontage. Reprofiling of the beach crest to reduce cliffing will typically be carried out using a tracked bulldozer. Clearance of the promenade following storm events requires a smaller hydraulic excavator, allowing the operator to dig close to the concrete splash wall to the rear of the promenade. This land-based plant is usually required over the winter months for reprofiling cliffing and promenade clearance, and in March for the annual recycling operation. Any tracked plant driving on the

promenade should be fitted with rubber tracks to avoid scratching the promenade surface.

Beach recharge via road will use the same plant as the annual beach recycling operation. If the need arises to run a marine-based operation, the material is 'rainbowed' onto the mid- to lower-beach and allowed to disperse naturally under wave action where large volumes are landed (exceeding the capacity of the groyne bays) the excess will be regraded to other areas.

5.3.2 Beach Reprofiling

Beach reprofiling is only undertaken to remove severe cliffing along the nourished frontage, and is usually carried out as standalone emergency works. It is not to be used to push up material from the lower beach to supplement the crest. Any shortfall in material will be made up by the beach recycling element of the works. Costs for beach reprofiling can be built in to the contract for beach management as day rates. Therefore the cost of reprofiling could be known before any emergency works are carried out.

5.3.3 Access

Plant access to the beach in BMP U3 is via Eastoke Corner car park and along the beach crest to the Havant Borough Council Southwood Road Compound. The currently agreed delivery route to the Compound is in Appendix I. Plant can then access the entire Hayling frontage along the crest of the beach. At the Inn-on-the-Beach (BMP U5) the removal of timber parking bollards is required to access behind the structure and further west towards Gunner Point. Material imported via road will be stockpiled at the western end of the Eastoke Corner car park prior to placement, and again access to this stockpile area requires the temporary removal of timber parking bollards.

5.3.4 Permissions / Consents

There is a requirement to notify Hampshire County Council a minimum of one month prior to the commencement of any annual beach recycling and recharge operations (Appendix C).

A Chichester Harbour Conservancy 1971 Section 45 Works Licence has been approved for the recycling operations with various conditions attached (Appendix C). Condition IX of the Works Licence requires at least 48 hours notice of the date and time of commencement of works to the Harbour Master.

There are 11 conditions attached to the current Beach Recycling Planning Consent (Appendix C) that must be complied with when carrying out operations.

5.3.5 Notifying Others

In line with the Communications Plan (see Appendix F), **it is recommended that explicit notification of beach works also be provided to the following organisations**:

- Natural England (in relation to nature conservation and coastal access interests).

- Hampshire County Council (as landowner)
- Beachlands Funfair (as landowner)
- Inn-on-the-Beach (as landowner)
- Hayling Golf Course (as landowner)
- Hayling Island Sailing Club (as landowner)

Contact details for each are contained in the Project Contact List.

5.3.6 Environmental constraints and Opportunities

We have planning consent for the ongoing BMP works until 2019. One of the main conditions of this existing consent, is that planned maintenance operations should avoid the period from 1st October to 28th February, unless necessary as an emergency response, as per Condition 3 of the Planning Consent (Appendix C). This was to avoid disturbance to overwintering birds on the open coast, as a blanket restriction. The Planning Consent also specified that vegetated shingle must be demarcated with cones to avoid damage by heavy plant on the haul road.

With experience gained through the delivery of the existing BMP over the last 5 years, incorporation of knowledge from local ornithologists, and the need to extend the BMP coastal frontage to the full extent of Hayling Island's open coastline, a new Planning Permission is being sought. To recharge via marine licenced dredge sites, and by road, a separate Marine Licence is also required. These will supersede the existing licences once granted. Until that time, operations will continue under the existing Planning Permission and consents.

Our revised Planning and Marine Licence applications are presenting an enhanced set of impacts and mitigation measures. These build from our experience of undertaking beach management activities historically; detailed discussions with Natural England (utilising their Discretionary Advice Service); and advised by our environmental scoping opinion. Because the revised BMP extends further into the sensitive harbour environments, and because we are proposing new extraction points on the open coast within more sensitive areas, the impact / mitigation list has been enhanced. This list is included in Section 4.4.4. Based on the proposed mitigation, Natural England have written to confirm that they believe this full BMP proposal will lead to an environmentally acceptable solution (see Appendix E).

5.3.7 Recording Activities

All beach management activities should be logged for inclusion in the Annual Beach Management Report (Section 6.2), and a template for recording the appropriate data is available. Areas of extraction and deposition should be logged throughout any operation to allow for future consideration in any sediment budget analysis.

5.4 Management Programme

5.4.1 Management and Supervision

All works carried out as part of the BMP will be managed and supervised by appropriate

officers working on behalf of the ESCP. The ESCP has long standing experience of managing and supervising the ongoing beach management operations on Hayling Island.

5.4.2 Transportation of Materials

The transportation of materials on and off Hayling Island to the BMP study area will be carried out in line with the appropriate conditions set out in the relevant HBC planning permission. For the ongoing beach recycling works this includes restrictions on the hours between which heavy plant can be delivered to the site compound, and the route to be used to access the compound (Appendix I). Where no conditions are stipulated due regard will be paid to reducing the impact that any delivery to the site will have on the residents of Hayling Island. In the case of marine-based recharge the delivery of nourishment material via 'rainbowing' will necessitate 24 hour working and local residents will be warned of any potential disruption well in advance of the operation (Appendix F).

5.4.3 Relevant Information

The following provides a list of all sources of information that have been referenced in this section of the Beach Management Plan.

Ref 5.1 **Beach Recycling Planning Permission 09/53949/008**, Havant Borough Council as Local Planning Authority (2009).

6. REPORTING AGAINST OBJECTIVES

6.1 Reporting Programme

The recommended reporting programme incorporates the annual reporting of the various logs and data collected as part of the monitoring programme (Section 4.4) and maintenance regime (Section 5). The schedule below (Table 6.1) identifies all of the individual logs and reports required by the Beach Management Plan (BMP). Where the logs and reports are dependent on events to trigger them (i.e. storm conditions, structural maintenance or recycling operations), the timings shown are indicative. **There are three reports required by the BMP; an Annual Vegetated Shingle Report, Annual Beach Monitoring Report & Annual Beach Management Report. These reports will inform the ongoing Beach Management Activities, providing recommendations if change is required.**

Table 6.1 Indicative BMP reporting schedule, assuming March and September recycling and recharge operations

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Structure Maintenance Log		•					•					
Storm/Flooding Event Log	Report as required throughout year											
Beach Recycling Log				•						•		
Beach Recharge Log				•						•		
Beach Visual Inspection Log	•	•	•	•	•	•	•	•	•	•	•	•
Annual Vegetated Shingle Report							•					
Annual Beach Monitoring Report							•					
Annual Beach Management Report							•					

6.2 Annual Beach Management Report

The Annual Beach Management Report will be produced by the second week of July to record and summarise the Beach Management activities, and their impact, if any, on the wider South Hayling frontage. The Beach Management Activities will be placed in context by reporting of the wave climate and water levels, including any storm events, and will draw on a variety of data sources.

The report will contain the following chapters:

a) Beach management activities
b) Wave climate and water levels
c) Performance of nourished beach
d) Overall condition of South Hayling frontage
e) Changes in operational practice
f) Summary
g) Recommendations
h) Appendices

Beach management activities

This section will contain a summary of the Beach Management Activities carried out over the preceding year. This will include a summary of any beach recharge or recycling operations as well as any maintenance carried out on the control structures.

Wave climate and water levels

This section will contain a summary of the local wave climate and water levels over the preceding year. Any significant events should be identified and discussed in more detail.

Performance of nourished beach

The performance of the nourished beach should be assessed in this section of the report. The results of the ongoing monitoring should be compared to the design beach parameters (Section 3) to establish the standard of protection afforded by the beach throughout the year. Any trends apparent in the performance of the nourished beach should also be included in this section of the report and related to the ongoing Beach Management Activities. This will utilise the pre- and post- works surveys as well as the Regional Monitoring survey data from which the Design Profile graph (Figure 2.16) will be updated.

Overall condition of South Hayling frontage

This section will contain a summary of the overall condition of the South Hayling frontage, drawn largely from the findings of the Annual Beach Monitoring Report (Section 6.2). It will also relate any changes to the ongoing Beach Management Activities.

Changes in operational practices

This section will identify any changes in operational practices over the previous year. The basis for such decisions should be summarised and any background evidence included in an appendix to the report. For example, in the past, recycling operations have alternated between extracting material close up to the eastern wall of the Inn-on-the-Beach and leaving material piled against the structure. This change was driven by a change in ownership of the property and the owner's priorities. One owner wanted to retain material against the structure to prevent damage during stormier wave conditions; another wanted to prevent people being able to climb straight onto the front patio of the property directly from the beach. By recording such changes in the report the next beach management operation can be modified accordingly. Any changes in landownership should also be included in this section of the report.

Summary

This section will contain a summary of the preceding sections of the report, including reference to the performance of the Beach Management Plan over the entire BMP period.

Recommendations

This section will contain any recommendations resulting from the ongoing monitoring of the beach management plan operations.

Appendices

This section will include the following items:

a) Structure Maintenance Log
b) Storm / Flood Event Log
c) Beach Maintenance Log
d) Beach Maintenance Plot
e) Beach Visual Inspection Log
f) Annual Beach Monitoring Report (see Section 6.3)
g) Annual Vegetated Shingle/Bird Monitoring Report (see Section 6.4)

These appendices may or may not be consistent throughout the life of the BMP, depending on storm events and timings of structure inspections.

6.3 Annual Beach Monitoring report

The Annual Beach Monitoring Report will be an appendix to the Annual Beach Management report above (Section 6.2) and will be compiled in conjunction, providing an analysis of the preceding year's monitoring programme (Section 4). The report will be completed by the

second week of July each year. This will also allow time for the report to be provided to the Hayling Island Golf Club in the third week of July prior to any extraction being carried out from Gunner Point in September. If the results of South-east Regional Coastal Monitoring Programme annual report are available, they can be incorporated into this report, although the Annual Beach Monitoring Report is intended to be a more detailed analysis of sediment transport around the BMP frontage.

The report will include the following:

a) Beach plan-form analysis: using pre- and post- works survey data
b) Beach profile analysis: using Regional Monitoring profile data collection
c) Beach volume and cross-sectional area (CSA) change analysis
d) Beach sediment tracer analysis: to be included when tracers have been deployed – potentially in years 2 and 4 of the BMP
e) Sediment Budget Analysis
f) Wind, wave and water level assessment
g) Sediment sampling results: to be included when sediment sampling is carried out throughout the life of the BMP

Within the beach volume and cross-sectional area (CSA) change analysis section will be a summary of volume change at Gunner Point.

6.4 Annual Vegetated Shingle / Bird Monitoring Report

The Annual Vegetated Shingle/Bird Monitoring Report will be an appendix to the Annual Beach Management report above (Section 6.2) and will be compiled in conjunction. An annual report will be produced to detail the results of the annual vegetated shingle surveys and ongoing bird monitoring. This will help guide on-going works, and refine the mitigation that has been proposed, where this could benefit the environment and interest features. This report is to be presented to the Local Planning Authority, currently required by Condition 10 of the existing planning permission (Ref 6.2). Ideally, a survey of the vegetated shingle / annual vegetation of drift line habitats should be carried out in late July or August, however, this does not allow enough time to obtain permission from Hayling Golf Club on volumes to be extracted from Gunner Point for the September campaign. Therefore, a vegetated shingle survey will be undertaken in early July to assist in obtaining permission from the golf club. A further walkover survey will be undertaken in August, from which the July survey and volumes of extraction from Gunner Point will be amended accordingly. A preliminary report will be ready for the second week in July and amended accordingly following the August survey (See Section 4.4 for more information on environmental monitoring and mitigation).

6.5 Relevant Information

The following provides a list of all sources of information that have been referenced in this section of the Beach Management Plan.

Ref 6.1 **Guidance for producing an Annual Assessment monitoring the effects of recycling operations on vegetated shingle habitats and Sinah Common SSSI**, HBC Technical Report (2007).

Ref 6.2 **Beach Recycling Planning Permission 09/53949/008**, Havant Borough Council as Local Planning Authority (2009).

7. ACTION PLAN

This section provides a summary of the recommendations made throughout the rest of the BMP in the form of an action plan. The action plan is presented in Table 7.1 and identifies actions by type as being either for 'Monitoring', 'Maintenance', 'Emergency Planning', 'Reporting', 'Research' or 'Analysis'.

It is intended that this Action Plan be used to guide future investment in this area which will ultimately enable more appropriate, effective and efficient maintenance practices to be established and implemented along the BMP area.

Table 7.1 Action Plan

Action Type	Action Description	When by?	Related BMP Section(s)
Research	It is important that bi-modal extremes are developed and tested on the existing design profile, using a model such as SHINGLE-B.	2022 at the latest	1.4.4 and 4.5.1
Maintenance	Renew Chichester Harbour Conservancy 1971 Section 45 Works Licence prior to expiry on the 26th January 2019	Late 2018	1.4.5
Maintenance and Reporting	Where maintenance issues are identified on privately owned and maintained land, the appropriate owner / maintainer shall be notified of the defect and any obligation to make good.	Ongoing	1.5.2

Action Type	Action Description	When by?	Related BMP Section(s)
Maintenance	Future recycling extraction should target areas of growth on the open frontage. An initial campaign to extract material from Gunner Point (BMP U7) is recommended, with extraction thereafter (if material is required) once material has accreted again.	Ongoing	2.5.2
Research	Sediment budget analysis, incorporating the nearshore zone and Chichester Harbour and Langstone Harbour ebb delta systems is necessary to understand the onshore/offshore relationship between the two. This is particularly required in Chichester Harbour given the material is recycled back to Eastoke from the maintenance dredge of the bar.	Before the next BMP	2.5.2 (c)
Maintenance	Arisings from maintenance dredging of the Chichester entrance channel should be a preferred source of material for the next phase of the BMP. This is an excellent beneficial re-use of material; material that has arisen from this sediment cell.	Ongoing	2.5.2 (d)
Analysis	Ongoing monitoring should be designed to detect the early signs of a decline in the West Pole	Ongoing	2.5.2 (f)
Maintenance	Liaison with MDL Marinas should continue if requested and the possibility of incorporating some sand extraction into the recycling operations considered if requested.	Ongoing	2.6
Maintenance and Reporting	Liaison with HISC should be ongoing and the possibility of incorporating some sand extraction into the recycling operations considered if requested.	Ongoing	2.6

Action Type	Action Description	When by?	Related BMP Section(s)
Maintenance	Clearance of the shingle ridge in front of the RNLI station should be considered prior to each recycling operation, if the material is of the right grade.	Ongoing	2.6
Maintenance	Movements of small quantities of material around Ferry Road car park should be considered pending the renewed planning application	Ongoing	2.6
Research	If the design profile cannot be maintained through annual recycling alone at Eastoke Corner then further investigations should be carried into adjusting control structures.	Ongoing	2.6 and 5.1.2
Research	If the design profile cannot be maintained through annual recycling alone at Creek Road Car Park then further investigations should be carried into adjusting control structures.	Ongoing	2.6 and 5.1.2
Monitoring	Monitor the beach levels at Eastoke Point and if necessary, bring in additional material to be brought in over and above the recommend volume for the BMP period.	Ongoing	3.1.1 and 3.2
Research	There is a requirement to update the 'Joint Probability of extreme wave and water levels' to account for bi-modal waves over the next couple of years. This will allow bi-modal extremes to be tested on the current design profile using a new model called SHINGLE-B to establish whether a change is required to ensure the design profile can withstand 1 in 200 year bi-modal wave events.	2022	3.2.4

Action Type	Action Description	When by?	Related BMP Section(s)
Monitoring	Beach monitoring data should be continually collected to inform the revision of the BMP in five years time by providing a greater level of quantitative field data to aid improved understanding of the coastal processes.	Ongoing	4.1
Monitoring and Reporting	Beach profiles should be collected after all significant storm events to inform the ongoing beach management response.	Ongoing	4.2.2
Monitoring	Bathymetric surveys should be collected every 2 years. If SERCMP funding fails to cover this cost, then additional funding will be required to continue collecting data for the highly dynamic ebb-deltas.	2018 and 2020	4.2.4
Monitoring	Visual inspections are to continue along the Eastoke southern frontage, inspecting beach levels and identifying any major structural defects, in line with the ESCP Asset Inspection Programme. In addition, a more detailed defect reporting process should be undertaken as required where the visual inspections highlight specific defects or structures of poor condition.	Ongoing	4.2.5, 4.3.1, 4.3.2 and Appendix H
Monitoring	The regular deployment and tracking of beach sediment tracers should continue along the Eastoke Nourished frontage, as well as further deployments and surveys around the entire South Hayling BMP frontage.	Ongoing	4.2.7
Monitoring	A comprehensive set of sediment samples should be collected in the Year 2 (2018/19) and year 4 (2020/21) of the BMP.	2018/19 and 2020/21	4.2.8

Action Type	Action Description	When by?	Related BMP Section(s)
Monitoring	Vegetated shingle surveys will be carried out in July each year, with a walkover in August, prior to the September campaign. An ecological walkover for the ground nesting birds during the nesting season will also take place.	Ongoing	4.4
Monitoring	Any environmental requirements stipulated as part of the planning and consents necessary to carry out the proposed works will be incorporated into the ongoing BMP monitoring programme.	Ongoing	4.4.4
Monitoring	A wave model should be developed a part of a new strategy study for the East Solent with adequate detail around the nourished frontage to improve the understanding of sediment transport around the drift divide under various wave conditions.	2022	4.5.1
Monitoring	The temporary deployment of suitable wave monitoring equipment, e.g. AWAC, at different points along the nourished frontage could be considered by the ESCP.	2022	4.5.1
Monitoring	Relate the proposed wave model, and any measured calibration data, to run-up measurements collected as part of beach profile surveys.	2022	4.5.1
Monitoring	Details of storm conditions should be recorded (waves and water levels)	Ongoing	4.5.2
Reporting	A feasibility study into drainage improvements at Eastoke will be undertaken	2022	5.1.2 and 2.5.2 (e)

Action Type	Action Description	When by?	Related BMP Section(s)
Monitoring and Maintenance	Removal of the remaining structure at West Beach should be investigated and take place when the revetment is no longer serviceable and before there is a health and safety issue with the structure.	Ongoing	5.1.2
Monitoring and Maintenance	The performance of the remaining groynes at West Beach should be investigated and where deemed redundant, should be removed where causing a health and safety risk. Further studies are required to investigate whether these should be removed or repaired.	Ongoing	5.1.2
Research and Maintenance	Removal of the Coastguard revetment should be investigated. If there is deemed to be no increase in flood or erosion risk, the revetment should be removed where causing a health and safety risk..	Ongoing	5.1.2
Maintenance	When undertaking works along the beach, measures to ensure safe public access to the beach should be utilised. This should include the use of banksmen where appropriate, spare personnel and signage to direct the public to safe access locations and temporary diversions. This should be supported by information boards displayed during works to explain what is being done and why.	Ongoing	5.1.3
Monitoring and Maintenance	It is suggested that adequate on site supervision and signage are employed to direct public access to safe sections of the promenade and beach during works.	Ongoing	5.3.5

Action Type	Action Description	When by?	Related BMP Section(s)
Maintenance and Reporting	Provide explicit notification of beach works to landowners, residents, beach hut owners, HCC, Natural England, Inn on the Beach, Hayling Golf Club and, Hayling Island Sailing Club. Beachlands Funfair owners should also be notified prior to recycling operations commencing and any request relating to the works considered.	Ongoing	Appendix F
Reporting	Three reports are required by the BMP; an Annual Vegetated Shingle Report, Annual Beach Monitoring Report and Annual Beach Management Report. The Vegetated Shingle Report and Beach Monitoring Report will form appendices to the Annual beach Management Report to inform the ongoing BMA, providing recommendations if change is required.	Ongoing	6.1
Maintenance	Any maintenance activities should be recorded in the Structure Maintenance Log	Ongoing	6.2 and 5.1.1
Monitoring and Reporting	Continuously assess the project finances, expenditures and efficiencies. Report and resolve any problems at the earliest stage possible (e.g. applying for contingency).	Ongoing	
Monitoring / maintenance	Undertake a review of this BMP	2021	