FINAL

Sidmouth & East Beach Management Plan

Prepared for

East Devon District Council

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Document History

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Contents

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Executive Summary

This Beach Management Plan (BMP) covers the coastline of Sidmouth, Devon, from Jacob's Ladder Beach, in the west, to East Beach, in the east, as well as the western bank of the River Sid up to the weir. The open coast area covered by this BMP is the responsibility of East Devon District Council (EDDC), whilst the River Sid western wall is the responsibility of the Environment Agency. In addition, Plymouth Coastal Observatory (PCO) undertakes coastal monitoring of the area as part of the South West Strategic Regional Coastal Monitoring Programme (SWRCMP), whilst Devon County Council maintain the Alma Bridge and South West Water maintain on outfall that extends offshore from a point adjacent to the mouth of the River Sid.

The aim of this BMP, which has been developed utilising best practice contained in the *CIRIA Beach Management Manual* (CIRIA, 2010), is to inform, guide and assist the responsible authorities and organisations in managing the beach and associated hard coastal defences, and to ensure that the risk of coastal flooding and erosion to properties and other assets along the BMP frontage continues to be managed sustainably, whilst recognising and managing the environmental and amenity implications of doing so.

The key objective of this BMP is to manage the risk of coastal flooding and erosion to property and other assets along the Sidmouth frontage in the immediate future by ensuring that an adequate beach is maintained along the BMP frontage, supported by (and in support of) adequate maintenance of the existing hard defence/control structures and any future structures.

The BMP sets out the plan for monitoring and intervention to maintain the beach and associated hard coastal defences to ensure they continue to provide adequate coastal flood and erosion risk management to Sidmouth in the immediate future, whilst also identifying measures to support development and implementation of more sustainable longer-term solutions to the management of these issues. This monitoring and intervention plan has been developed in the context of providing a technically, economically, environmentally and socially sustainable management approach for the next 5 years (the BMP review period) in line with the long-term strategic coastal flood and erosion risk management approach developed alongside this BMP.

In summary, this preferred option for the long-term strategic coastal flood and erosion risk management approach along the BMP frontage (which is to be developed and implemented as soon as possible) is to seek to construct one or two new rock groynes along East Beach over a distance of up to 200m east of the River Sid, whilst modifying the length of the seaward end of the River Sid training wall and East Pier rock groyne to improve sediment transport between Sidmouth Town Beach and East Beach (and enable access for future beach management at East Beach). This is to be supported in the immediate future by repairs to the seaward end of the training wall (which is at imminent risk of failure) whilst the scheme details are developed, as well as by ongoing recycling of sediment along Sidmouth Town Beach and maintenance of the existing defences at Jacob's Ladder Beach and Connaught Gardens (around Chit Rocks).

This option was selected as it provides the best balance between technical viability, environmental acceptability and economic case. Importantly, discussions with East Devon District Council have indicated the level of funding contribution required (c.£3.3m) is at a level that is more realistic with partners/beneficiaries contributing and therefore provides a greater chance of project assurance in the shortest amount of time. It should be noted however, that if a greater level of funding contribution were to be available, then the preferred option would be for removal of existing rock groynes along the shoreline and construction of an additional number of offshore breakwaters.

As further work is still needed in the immediate future (within the next 6 months) to fully confirm the level of funding contribution that can be delivered to robustly evidence this in the business case when it is eventually submitted to the Environment Agency's National Project Assurance Service, it is possible that this change in preferred option could occur if, as a result of that further work, it is shown that a greater level of funding contribution can be confirmed as being deliverable. This funding work in the

immediate future can be progressed alongside initial work to develop the detailed appraisal of the currently defined preferred, with the scope able to be changed if the additional partnership funding is made available, and this is reflected in the forward plan presented in **Appendix D** for progressing the development of a project to secure the longer-term management of coastal flood and erosion risk along the BMP frontage whilst ensuring ongoing monitoring and maintenance occurs, as defined in the rest of this BMP, whilst that project is developed.

Glossary

Term	Definition
Accretion	Accumulation of sediment due to the natural action of waves, currents and wind.
ADCP	Acoustic Doppler Current Profiler.
AIMS	Asset Information Management System.
Alarm Level	A Trigger Level. The level before Crisis Level. This is usually a predetermined value where the monitored beach parameter falls to within range of the Crisis Level, but has not resulted in systematic failure of the function being monitored, e.g. recession of a beach crest eroding to within 10m of an asset, where it has been predetermined that an extreme storm event could result in recession of 5m. The Alarm Level in this example is therefore a 5m buffer. 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.
Amenity	The tangible or intangible elements of a location that contribute to a perceived positive character of the area for the enjoyment of those that use it.
Anthropogenic	General term used to describe the influence of man, e.g. the influence of sea defences or management actions on coastal processes.
APO	Annual probability of occurrence.
ATT	Admiralty Tide Table.
AWAC	Acoustic Wave and Current Profiler.
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.
BAP	Biodiversity Action Plan. A strategy for conserving and enhancing wild species and wildlife habitats in the UK.
Bathymetry / Bathymetric (survey)	The measurement of depths of water in oceans, seas and lakes. Also the information derived from such measurements.
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 Profile	Cross-section perpendicular to the shoreline. The profile can extend seawards from any selected point on the landward side or top of the beach into the nearshore.
Beach recharge (nourishment)	Artificial process of replenishing a beach with material from another source.
Beach recycling/re-profiling	The movement of sediment along a beach area, typically from areas of accretion to areas of erosion, and shaping the beach profile to have a desired crest height, width and slope.
BMP	Beach Management Plan. It provides a basis for the management of the beach and defence asset system for flood and coastal erosion risk management purposes, taking into account coastal processes and the other uses of the coastal environment.
Breaching	Failure of the beach head allowing flooding by tidal action.
CIRIA	Construction Industry Research and Information Association.
Climate Change	Long-term changes in climate. The term is generally used for changes resulting from human intervention in atmospheric processes through, for example, the release of greenhouse gases to the atmosphere from burning fossil fuels, the results of which may lead to increased rainfall and sea level rise.
Coastal Change	Physical change to the shoreline, i.e. erosion, coastal landslip, permanent inundation and coastal accretion.
Coastal Change Management Area (CCMA)	An area identified in Local Plans as likely to be affected by coastal change (physical change to the shoreline through erosion, coastal landslip, permanent inundation or coastal accretion).

Term	Definition
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 beach relative to mOD.
Crest width	The horizontal distance of the beach measured from the seaward edge of the promenade to the point where the beach slope angle drops down towards the sea.
Crisis Level	A Trigger Level. The level at which the function being monitored, such as the stability of the beach and/or any structures (seawall/promenade/groyne), could be compromised and emergency remedial action becomes necessary, e.g. as in the case described under Alarm Level above, the beach crest recedes to within 4m of an asset that requires protection, where it has been predetermined that an extreme event could result in 5m of recession.
Defra	Department for Environment, Food and Rural Affairs (formerly known as MAFF)
Devon County Council	Lead Local Flood Authority under the Flood and Water Management Act, 2010.
EA	Environment Agency. UK non-departmental government body responsible for delivering integrated environmental management including flood defence, water resources, water quality and pollution control.
EDDC	East Devon District Council. Coastal Operating Authority as defined under the Coast Protection Act 1949 with permissive powers to provide defence against coastal erosion.
Erosion	Wearing away of the land, usually by the action of natural forces.
Flood and Coastal Erosion Risk Management (FCERM)	FCERM addresses the scientific and engineering issues of rainfall, runoff, rivers and flood inundation, and coastal erosion, as well as the human and socio-economic issues of planning, development and management.
FCERM GiA	FCERM Grant in Aid. The mechanism by which central Government funding for coastal flood defence and erosion protection works is accessed by operating authorities to deliver schemes.
Flood Zone	A geographical area officially designated subject to potential flood damage. The Environment Agency uses Flood Zone 2 and Flood Zone 3.
Geomorphology/ morphology	The branch of physical geography/geology which deals with the form of the Earth, the general configuration of its surface, the distribution of the land, water, etc.
GIS	Geographical Information System
Groyne	Narrow, roughly shore-normal structure built to reduce longshore currents, and/or to trap and retain beach material. Most groynes are of timber or rock, and extend from a seawall, or the backshore, well onto the foreshore and rarely even further offshore.
Hard defence	General term applied to impermeable coastal defence structures of concrete, timber, steel, masonry, etc, which reflect a high proportion of incident wave energy.
Hold the Line	An SMP policy to maintain or change the level of protection provided by defences in their present location.
H_s	Significant wave height
Joint probability	The probability of two (or more) things occurring together.
Joint Probability Analysis (JPA)	Function specifying the joint distribution of two (or more) variables.
Joint return period	Average period of time between occurrences of a given joint probability event.
LiDAR	Light Detection and Ranging. This is an airborne mapping technique which uses a laser to measure the distance between the aircraft and the ground.
Listed Building	A building or other structure officially designated as being of special architectural, historical or cultural significance.
Locally generated (wind) waves	Locally generated short period and irregular waves created by the flow of air over water.
Longshore transport	Movement of material parallel to the shore, also referred to as longshore drift.

Term	Definition
mCD	metres Chart Datum. Approximately the lowest astronomical tidal level, excluding the influence of the weather.
mOD	metres Ordnance Datum. A universal zero point used in the UK, equal to the mean sea level at Newlyn in Cornwall.
Managed Realignment	An SMP policy, allowing the shoreline to move backwards or forwards, with management to control or limit movement. This includes reducing erosion or building new defences on the landward side of the original defences.
Mean Sea Level (MSL)	Average height of the sea surface over a 19-year period.
Mean High Water (MHW)	The average of all high waters observed over a sufficiently long period.
Mean High Water Springs (MHWS)	The average height of the high waters of spring tides.
Mean Low Water (MLW)	The average of all low waters observed over a sufficiently long period.
Mean Low Water Springs (MLWS)	The average height of the low waters of spring tides.
Met Office	UK Meteorological Office.
Monitoring	Systematic recording over time
MMO	Marine Management Organisation. An executive non-departmental public body established and given powers under the Marine and Coastal Access Act 2009. Responsible for managing activities in the marine environment including marine licensing and marine planning.
Natural England	A non-departmental public body of the UK government responsible for ensuring that England's natural environment, including its land, flora and fauna, freshwater and marine environments, geology and soils, are protected and improved. It also has a responsibility to help people enjoy, understand and access the natural environment.
Nearshore	The zone that extends from the swash zone to the position marking the start of the offshore zone, typically to water depths of about 20m.
NFCDD	National Flood and Coastal Defence Database.
No Active Intervention	An SMP policy that assumes that existing defences are no longer maintained and will fail over time or undefended frontages will be allowed to evolve naturally.
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.
Partnership Funding	A mechanism that provides funding in full or in part (alongside a proportion of total funding need from FCERM GiA) for coastal flood defence and erosion protection from multiple sources (including those that benefit directly from such measures).
PCO	Plymouth Coastal Observatory. Based at the University of Plymouth, responsible for the South-West Strategic Regional Coastal Monitoring Programme (SWRCMP).
Policy Unit	A Policy Unit relates to the policy area defined by the Shoreline Management Plan (SMP).
Return Period	A statistical measurement denoting the average probability of occurrence of a given event over time.
Rock Armour	Wide-graded quarry stone normally bulk-placed as a protective layer to prevent erosion of the seabed and or other slopes by current and/or wave action.
Rock Revetment	A sloping surface of rock or stone used to protect a shoreline against erosion.

Term	Definition
SAC	Special Area of Conservation: this designation aims to protect habitats or species of European importance and can include Marine Areas. SACs are designated under the EC Habitats Directive (92/43/EEC) and will form part of the Natura 2000 site network. All SACs sites are also protected as Site of Special Scientific Interest, except those in the marine environment below the Mean Low Water (MLW).
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	Removal of underwater material by waves or currents, especially at the toe of a shore protection structure.
Sea level change	The rise and fall of sea levels throughout time in response to global climate and local tectonic changes.
Seawall	Massive structure built along the shore to prevent erosion and damage by wave action.
Sediment transport	The movement of a mass of sedimentary material by the forces of currents and waves.
Significant wave height	The average height of the highest of one third of the waves in a given sea state.
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.
Spit	A long, narrow accumulation of sand or shingle, generally lying in-line with the coast, with one end attached to the land the other projecting into the sea or across the mouth of an estuary.
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.
Standard of Protection (SoP)	The level of return period 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.
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	The area onshore of the surf zone where the breaking waves are projected up the foreshore.
Swell waves	Remotely wind-generated waves (i.e. Waves that are generated away from the site). Swell characteristically exhibits a more regular and longer period and has longer crests than locally generated waves.
SWL	Still water level. The level that the sea surface would assume in the absence of wind and waves.
SWRCMP	South-West Strategic Regional Coastal Monitoring Programme. Based at the University of Plymouth with Teignbridge District Council as lead authority (see also PCO).
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.
Tombolo (Tombolas)	Coastal formation of beach material developed by refraction, diffraction and longshore drift to form a "neck" connecting a coast to an offshore island or breakwater.
Trigger level	This is usually a predetermined value where the monitored beach parameter falls to within range that results in management action being required (see also Action Level and Crisis Level).

Term	Definition
UKCP09	UK Climate Projections 2009. Research giving predictions of how future climate change may affect the UK.
UKHO	United Kingdom Hydrographic Office.
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.
Wave refraction	Process by which the direction of approach of a wave changes as it moves into shallow water.
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.
WFD	Water Framework Directive. A European Directive that aims to establish a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater.
World Heritage Site	A place of 'outstanding universal value' selected by UNESCO.

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1 Introduction

1.1 Background

This Beach Management Plan (BMP) has been prepared for East Devon District Council (EDDC) and covers the coastline from Jacob's Ladder Beach, in the west, to East Beach, in the east, as well as the western bank of the River Sid up to the weir (**Figure 1-1**).

The Sidmouth frontage is at risk of both coastal flooding and erosion. To reduce these risks, various coastal defences have been constructed along the frontage over the years; with the current coastal defences being comprised of seawalls, rock revetment, rock groynes, offshore rock breakwaters, concrete jetties/piers, and beach recharge.

These coastal defences protect a large number of assets along the BMP extent, including up to 108 residential and 80 commercial properties at risk of flooding in the low-lying Sidmouth town centre area over the next 100 years; the discounted Present Value (PV) of these property flood risks is estimated to be £85,383k (see also **Appendix A**). Critical infrastructure such as the Sidmouth sewage pumping station (located near to the Alma Bridge behind the River Sid western wall), sewage and drainage pipes, electricity sub-stations, Sidmouth Lifeboat station and various amenity facilities including hotels (and other accommodation types), restaurants, car parks and various entertainment facilities are also at risk in this area; which also forms part of the South West Coast Path – the path running along the promenade from west to east along the BMP area, and across Alma Bridge to atop East Cliff and beyond. The discounted PV of this amenity aspect of the frontage is estimated to be £31,431k over 100 years (see also **Appendix A**).

At the East Beach end of the BMP frontage, there are no coastal defences present. In this area there is a long history of erosion of the cliffs, with erosion rates varying over time depending upon the level of the beach in front of the cliffs; which is itself determined by the direction of waves that determines net drift direction; the timing, intensity and frequency of storms; and the amount of rainfall (refer also to **Appendix B**). If left to continue in this manner, it is predicted that up to 5 residential cliff top properties are at risk of coastal erosion over the next 100 years along the East Beach frontage; with a discounted PV estimated to be £9k (see also **Appendix A**).

In addition, as East Cliff continues to erode over the next 100 years, the Alma Bridge will become unsustainable in its current position in the near future, whilst the western wall of the River Sid, that provides fluvial flood defence at the present time, will become increasingly exposed to full coastal conditions (particularly during south-easterly storm events). Such exposure, which will start to occur if East Cliff receded by about a further 10-15m from its 2015 position over a 30-50m length of open coast extending eastwards form Alma Bridge, will increase the likelihood of defence failure and thus incurrence of flood damages discussed above over time; this would also impact the critical infrastructure located behind the western wall of the River Sid that serves the wider area, notably the Sewage Pumping Station operated by South West Water. This serves to demonstrate that whilst measures along the Sidmouth Town frontage to reduce flood risk from wave overtopping are appropriate (i.e. reduce economic damages), this benefit would be for nought if the risk posed by outflanking from the east is not also addressed at the same time (see also **Appendix A**).

To address these issues, a preferred option for long-term coastal flood and erosion risk management for Sidmouth that has been developed alongside this BMP. This is documented in full in the Options Appraisal Report (see **Appendix C**) and summarised in **Section 1.1.1** for ease of reference.

1.1.1 Preferred option

The preferred option for long-term coastal flood and erosion risk management for Sidmouth is to be developed and implemented as soon as possible, and is to seek to construct one or two new rock groynes along East Beach over a distance of up to 200m east of the River Sid, whilst modifying the length of the seaward end of the River Sid training wall and East Pier rock groyne to improve sediment transport between Sidmouth Town Beach and East Beach (and enable access for future beach

management at East Beach). This is to be supported in the immediate future by repairs to the seaward end of the training wall (which is at imminent risk of failure) whilst the scheme details are developed, as well as by ongoing recycling of sediment along Sidmouth Town Beach and maintenance of the existing defences at Jacob's Ladder Beach and Connaught Gardens (around Chit Rocks).

This option was selected as it provides the best balance between technical viability, environmental acceptability and economic case. Importantly, discussions with East Devon District Council have indicated the level of funding contribution required (c.£3.3m) is at a level that is more realistic with partners/beneficiaries contributing and therefore provides a greater chance of project assurance in the shortest amount of time. It should be noted however, that if a greater level of funding contribution were to be available, then the preferred option would be for removal of existing rock groynes along the shoreline and construction of an additional number of offshore breakwaters.

As further work is still needed in the immediate future (within the next 6 months) to fully confirm the level of funding contribution that can be delivered to robustly evidence this in the business case when it is eventually submitted to the Environment Agency's National Project Assurance Service, it is possible that this change in preferred option could occur if, as a result of that further work, it is shown that a greater level of funding contribution can be confirmed as being deliverable. This funding work in the immediate future can be progressed alongside initial work to develop the detailed appraisal of the currently defined preferred, with the scope able to be changed if the additional partnership funding is made available, and this is reflected in the forward plan presented in **Appendix D** for progressing the development of a project to secure the longer-term management of coastal flood and erosion risk along the BMP frontage whilst ensuring ongoing monitoring and maintenance occurs; as defined in the rest of this BMP; whilst that project is developed.

The preferred option has also been subject to a Habitats Regulations Assessment (HRA) Stage 1 (screening) assessment in line with the requirements of the Conservation of Habitats and Species Regulations (2010). This assessment, provided in **Appendix E**, concluded that the preferred option for future management of coastal flood and erosion risk is likely to have a significant effect on features of designation and so a HRA Stage 2 assessment (an Appropriate Assessment) is required. This will need to be undertaken as part of detailed investigations to develop the preferred option in order to provide the level of detail required to completed the Appropriate Assessment, in line with the requirements for this as set out in **Appendix E**.

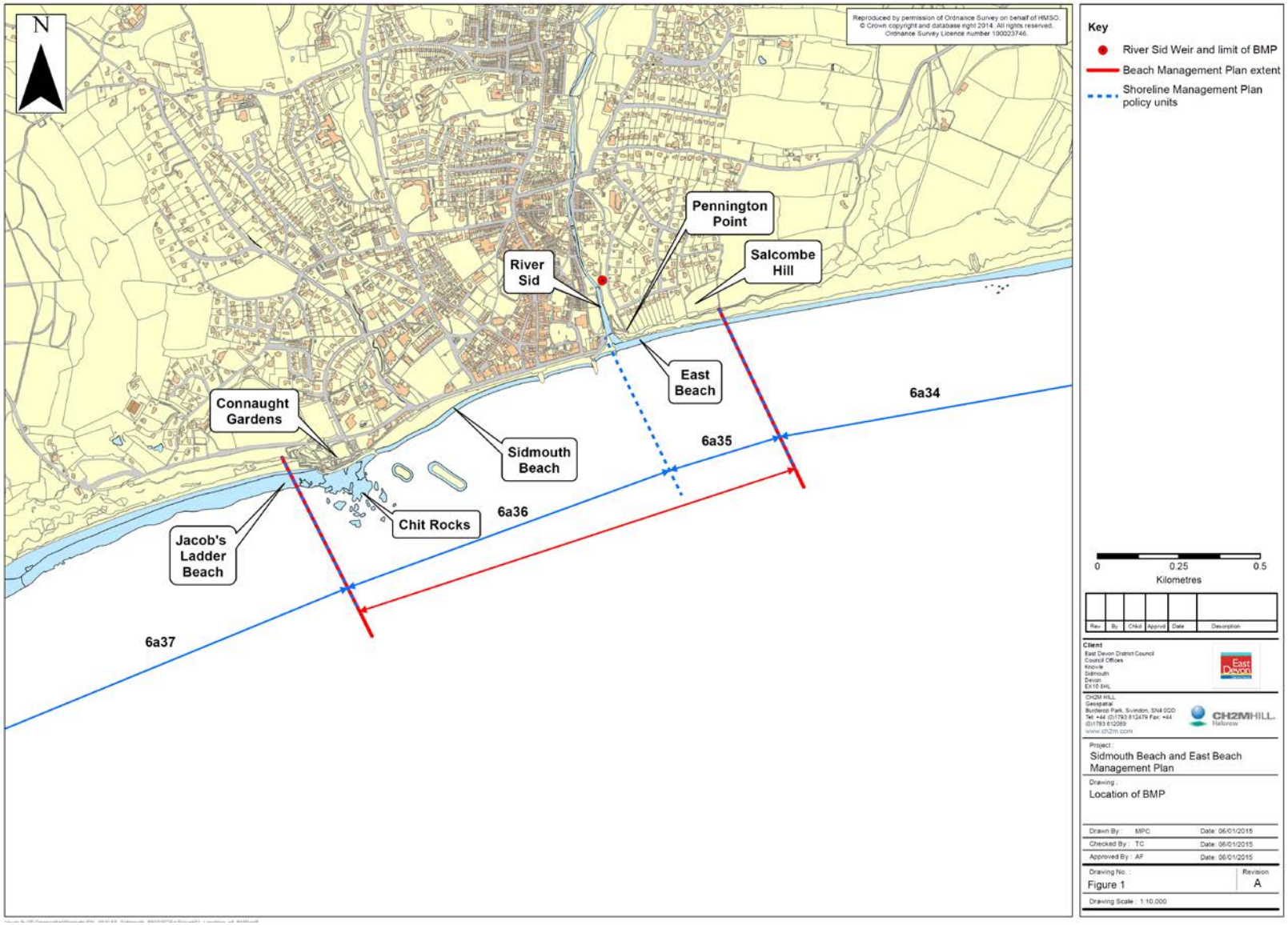


FIGURE 1-1
Sidmouth BMP extent

1.2 Objectives

The open coast area covered by this BMP is the responsibility of East Devon District Council (EDDC), whilst the River Sid western wall is the responsibility of the Environment Agency. In addition, Plymouth Coastal Observatory (PCO) undertakes coastal monitoring of the area as part of the South West Regional Coastal Monitoring Programme (SWRCMP), whilst Devon County Council maintain the Alma Bridge and South West Water maintain on outfall that extends offshore from a point adjacent to the mouth of the River Sid.

The purpose of this BMP, which has been developed utilising best practice contained in the *CIRIA Beach Management Manual, 2nd Edition* (CIRIA, 2010), is to inform, guide and assist the responsible authorities and organisations in managing the beach, cliffs and hard coastal defences along the BMP area, and to ensure that the risk of coastal flooding and erosion to properties and other assets along the Sidmouth frontage continues to be managed sustainably, whilst recognising and managing the environmental and amenity implications of doing so.

The key objective of this BMP is to manage the risk of coastal flooding and erosion to property and other assets along the Sidmouth frontage in the immediate future by ensuring that an adequate beach is maintained along the BMP frontage, supported by (and in support of) adequate maintenance of the existing hard defence/control structures and any future structures.

The BMP sets out the plan for monitoring and intervention to maintain the beach and associated hard coastal defences to ensure they continue to provide adequate coastal flood and erosion risk management to Sidmouth in the immediate future, whilst also identifying measures to develop and implement more sustainable longer-term solutions to the management of these issues and the risk posed by potential outflanking of Sidmouth Town by ongoing erosion of the cliffs at East Beach.

This monitoring and intervention plan has been developed in the context of providing a technically, economically, environmentally and socially sustainable management approach for the next 5 years (the BMP review period) in line with the long-term preferred option to coastal flood and erosion risk management developed alongside this BMP, as described in **Section 1.1**, which in turn aligns to the Shoreline Management Plan policies for this frontage that are set for a 100 year planning horizon (refer to **Section 1.7.1**). The BMP includes recommendations for further studies and investigations to refine the preferred long-term option and lead to its implementation within the next 5 years.

Recommendations are contained throughout the BMP, and are identified with **bold underlined text**. These are also summarised in an Action Plan presented in **Section 6**. **These are to be reviewed in 5 years' time.**

1.3 Location

1.3.1 Environmental setting

The BMP area contains the following environmental and conservation designations:

- Sidmouth to West Bay Special Area of Conservation (SAC).
- Lyme Bay to Torbay SAC.
- Sidmouth to Beer Coast Site of Special Scientific Interest (SSSI) (most units are at favourable status. Updated 15/08/2012).
- Ladram Bay to Sidmouth SSSI (all units are at favourable status. Updated 09/03/2012).
- Dorset and East Devon Coast United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage Site (the 'Jurassic Coast').

These are important in the consideration of options for beach management, with many having legislative requirements to ensure they are not adversely impacted by human actions.

In addition, the area is designated for its landscape setting and character with both the eastern and western ends of the BMP extent being within the East Devon AONB. The town of Sidmouth itself also

includes several conservation areas as well as many listed buildings, a registered park and garden, and numerous non-designated archaeological sites.

Section 2.7 and **Appendix F** provides much more detail on these and other environmental features within and around the BMP area.

1.3.2 History of flooding and erosion

The Sidmouth BMP frontage has a long history of coastal flooding and erosion, particularly when beach levels are low.

Literature reviewed as part of the *Devon Tidal Flood Warning Report* (Halcrow, 2009) in particular shows that Sidmouth was affected by the "great gale" that affected large parts of the south coast of England in November 1824; with both coastal erosion and flooding of properties reported at Sidmouth. Between 1981 and 2008, there have been approximately 6 events whereby wave overtopping of the open coast defences at Sidmouth (i.e. along the BMP extent) has occurred, although the impacts appear to have been largely confined more to spray impacts rather than extensive flooding, and pebbles being thrown onto the promenade. The most recent events that caused significant wave overtopping of the Sidmouth coastal defences occurred in February 2014, but again vary few (if any) properties were flooded, with flooding largely confined to the eastern end of the seafront in the Port Royal area.

In addition to wave overtopping impacts and associated flooding, coastal erosion has been a regular occurrence over the years. Along the Sidmouth town frontage this has resulted in the seawall failing at various times; most recently in 1989/90 which precipitated the construction of the current coastal defence scheme. Along the East Beach part of the frontage, the cliffs have also experienced ongoing erosion (see **Appendix B**) as there are no defences here, and this erosion is now posing a risk of outflanking to the eastern side of Sidmouth along the western wall of the River Sid.

1.3.3 Defence history

Coastal defences along the Sidmouth BMP frontage has had numerous phases of construction throughout the past two centuries. Full details are summarised in Section 2 of **Appendix G**, and can be summarised as follows:

- 1825-1826: Timber groynes and breastwork built.
- 1835: First seawall built.
- 1875: Dunning's Pier built.
- 1917-1919: Seawall repaired and extended.
- 1918: River Sid training wall replaced with structure that acted as terminal groyne.
- 1926: Dunning's Pier replaced with East Pier.
- 1957: Seawall and promenade built to protect Connaught Gardens.
- 1991: Sidmouth Coast Protection Scheme Phase 1 encased old seawall, build low level rock apron and removed timber groynes.
- 1993: Rock revetment placed along frontage as emergency works.
- 1994: Rock revetment placed in front of 1957 Connaught Gardens seawall.
- 1995: Sidmouth Coast Protection Scheme Phase 2 built. This included 2 offshore breakwaters, 2 rock groynes (York and East), and Beach recharge (buried rock revetment built in 1993).
- 1999: Clifton Walkway built.
- 2000: Sidmouth Coast Protection Scheme Phase 3 completed. This included construction of the Bedford groyne and some beach sediment recycling along the frontage.
- 2015: Beach recycling operation to re-distribute beach sediment along the Sidmouth Town frontage.

Figure 1-2 highlights the current coastal defences and, with reference to the above list, the scheme extents that constructed them. **Section 3.1** provides further details about these current coastal defences.

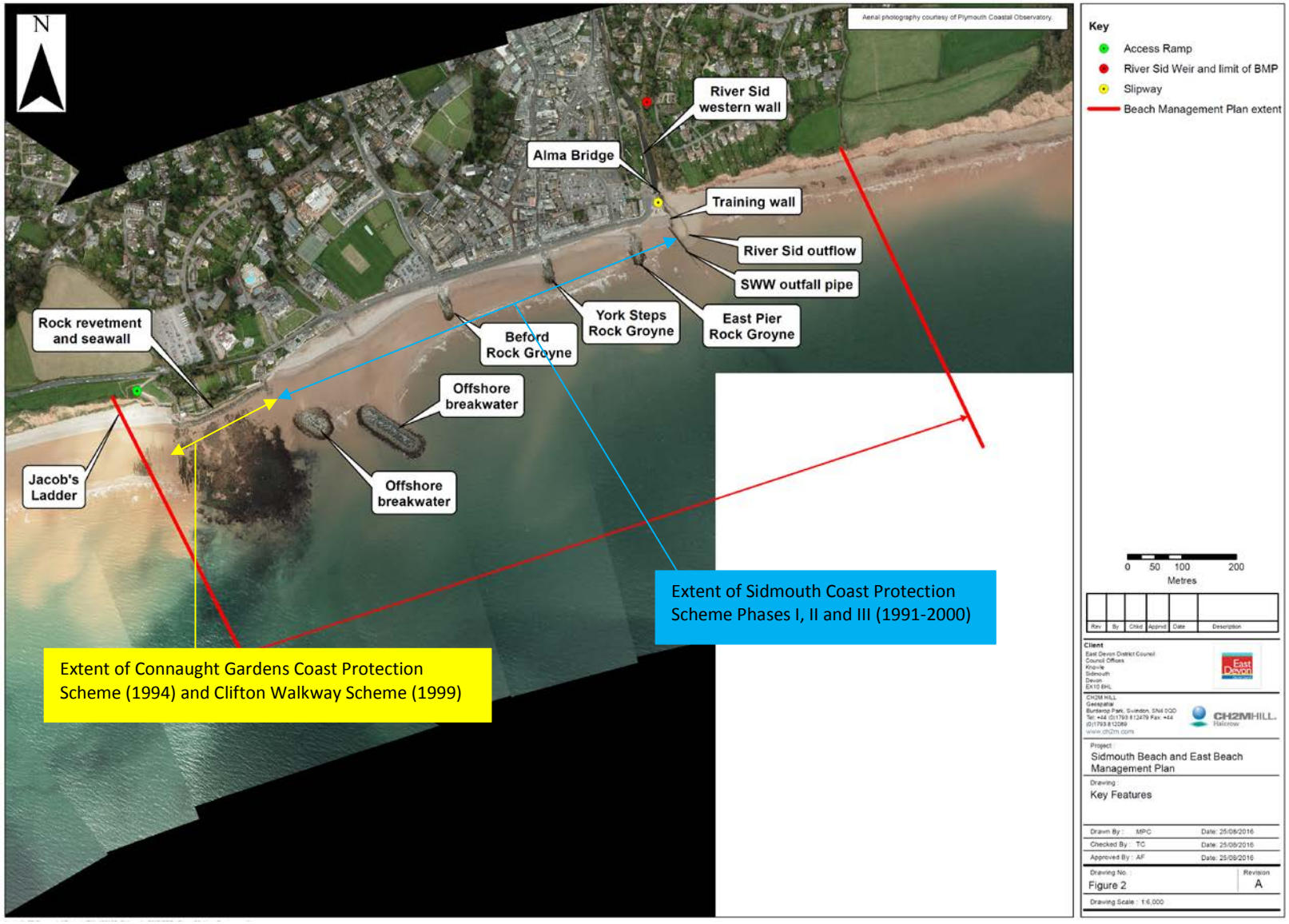


FIGURE 1-2

Key features and extent of recent schemes that have led to the current coastal defences along the BMP extent

1.3.4 Current defence condition

As part of developing this BMP, a coastal defence visual condition assessment was undertaken in accordance with the Environment Agency's *Condition Assessment Manual* (Environment Agency, 2012b). This is described in detail in Section 3 of **Appendix G**, but in summary concluded that the hard defences along the Sidmouth frontage are in good to fair condition with a typical residual life (with ongoing maintenance) of at least 50 years or more.

The main area of concern identified was with the River Sid Training Wall downstream (seawards) of the Alma Bridge. This is assessed as being in a poor condition with a residual life of 10 to 15 years at best. **Appendix G** provides further details.

1.3.5 Amenity value

The East Devon coast is a popular tourist destination and as such the local economy is heavily dependent on this source of revenue. There are numerous accommodation facilities in Sidmouth for tourists including approximately 30 hotels, 50 guest houses and 50 self-catering establishments and camping resources. The beach has an amenity value which is likely enhanced at low tide by the sandy tombolas formed between the shingle and the offshore breakwaters. It is popular for a range of activities including dog walking, storm watching, swimming, surfing, kayaking, paddle boarding, fishing/angling, beachcombing, bird watching and fossil hunting. The Sidmouth Sailing Club also uses the beach to launch their boats. The frontage is also used for gig racing and community events such as Folk Week, Sidmouth Sea Fest and Sidmouth Carnival.

The South West Coastal Path is present through the entire Study Area. It follows the promenade and crosses the River Sid at Alma Bridge to the east of the Study Area. It has been reported that the route crossing Alma Bridge provides an important link between residence east of the River Sid and the main town. In addition, walkers from Weston to the east of Sidmouth regularly walk to Sidmouth and access Alma Bridge via steps from East Beach – this being the only access point along the shoreline between Sidmouth and Weston.

Sidmouth seafront is also part of the National Cycle Route number 2.

There is a small rocky area just off shore that provides limited SCUBA diving opportunities in that it is suitable for training.

1.3.6 Land ownership

The BMP area is in a variety of public (East Devon District Council, Devon County Council and Environment Agency) and private (South West Water, National Trust and private individuals) ownership.

In terms of responsibility for managing coastal flood and erosion risk, it is East Devon District Council's responsibility to manage the majority of the BMP frontage with the exception of the River Sid western wall upstream of the Alma Bridge, which is the responsibility of the Environment Agency (East Devon District Council are responsible for the section seawards of the Alma Bridge).

Devon County Council are responsible for Alma Bridge and the public highways, including the road that runs along Sidmouth seafront.

South West Water operate the outfall and pumping station at the mouth of the River Sid.

The National Trust are the landowner for the immediate cliff top area (seawards of individual property ownership) and beach (above Mean High Water) along the section of BMP frontage immediately to the east of the River Sid, with this ownership expanding landwards beyond the eastern limit of the BMP area. It is uncertain how much of this cliff top land owned by National Trust remains. Where land has been eroded, the land that was National Trust reverts to Crown Estate ownership.

In addition, the Crown Estate owns the seabed below Mean High Water.

1.3.7 Highways, services and utilities

The Esplanade runs along the beach providing access for local residents and visitors. The Sidmouth Lifeboat Station operates from the eastern end of the Esplanade near the mouth of the River Sid. A

tractor is used to transport the lifeboat to the beach in lee of the two western offshore breakwaters, where it is launched.

The main roads into Sidmouth are the B3176 and the A375 which both reach the Esplanade. Alma Bridge provides pedestrian access for local residents of Cliff Road and Beatlands Road as well as for people using the South West Coast Path. There is a sewage treatment work on the western bank of the River Sid and an outfall pipe discharging offshore of the mouth of the river.

There are four car parks within Sidmouth, the largest of which is at Manor Road just north of Connaught Gardens and offers just under 300 car parking spaces. The three other car parks are in the east of the town near the Ham and together provide an additional 341 spaces.

1.4 Issues

1.4.1 Coastal flood and erosion risk management

The beach and hard defences along the BMP frontage protect against the risk of coastal flooding and erosion (see **Figure 1-3**).

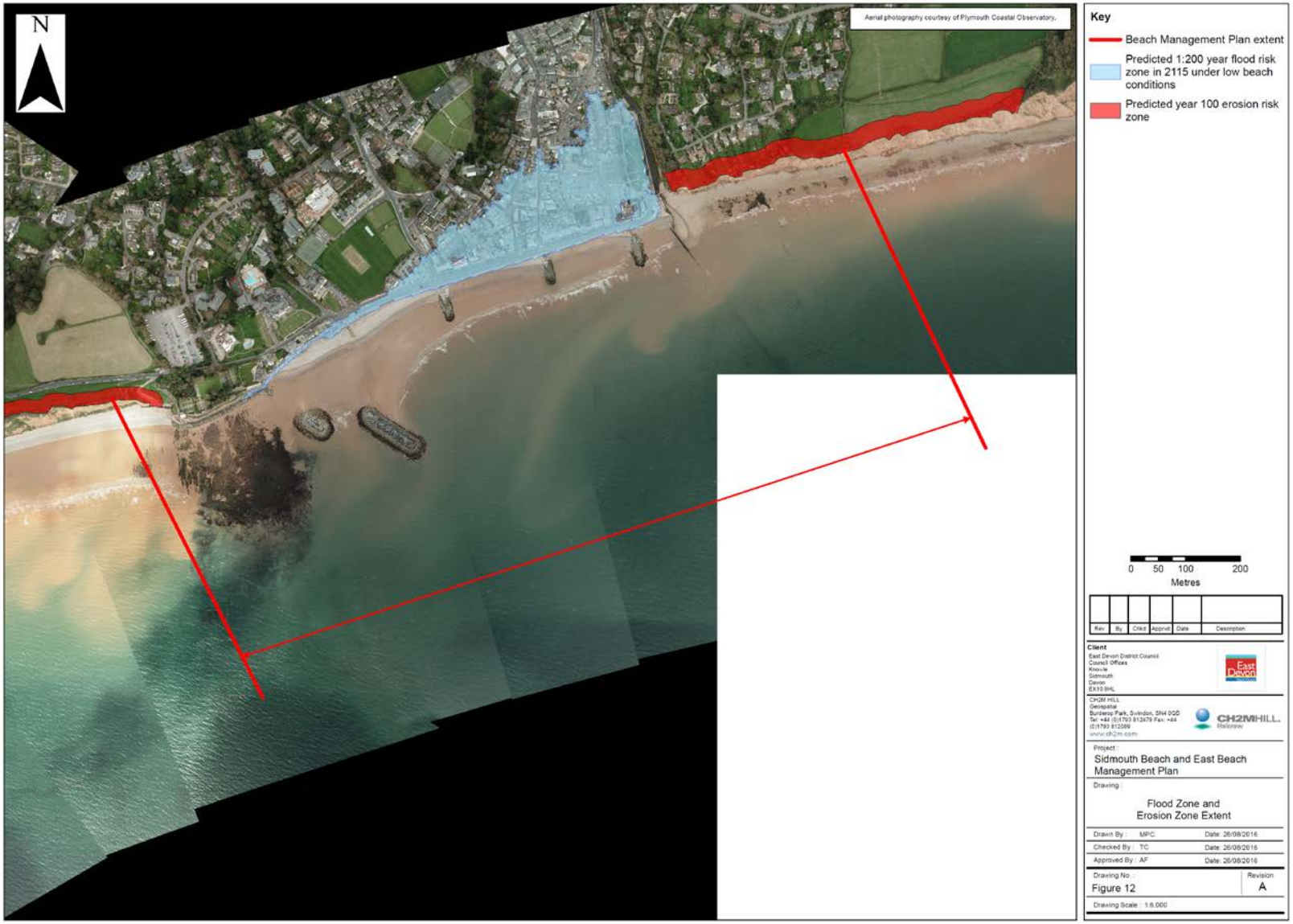


FIGURE 1-3
Flood and erosion risk along the BMP frontage

The current coastal defence system along the BMP frontage (i.e. beach, groynes, revetments and seawalls in combination) have been constructed over a period of years since the 1990's (refer to **Section 1.3.3**). Analysis completed as part of this BMP indicates that the defences are in good to fair condition with many years of service left in them provided they are appropriately maintained (refer to **Section 1.3.4**); which is to be guided by ongoing monitoring as defined in **Section 4** of this BMP. However, there are two key challenges to be addressed to minimise the risk of coastal flooding and erosion:

1. Ensuring beach levels along the Sidmouth Town frontage are maintained to a sufficient level so as to minimise the amount of wave overtopping experienced during storm events; and
2. Managing the risk posed to Sidmouth Town frontage posed by ongoing recession of the cliffs along East Beach.

The preferred option for addressing these challenges has been developed alongside this BMP, and is described in **Section 1.1**. The measures to implement the preferred option will also be supported by the Local Plan commitment to designate a Coastal Change Management Area (CCMA) at Sidmouth to manage the impacts of future coastal change, something that will be particularly necessary for assets located atop East Cliff, where measures will only reduce rate of erosion not prevent it all together (refer also to **Section 1.7.2**).

1.4.2 Environmental considerations

The following environmental considerations for beach management activities at Sidmouth have been identified:

- Access and noise/visual disturbance to recreational users in the vicinity of BMP activities, as the beach is used extensively for amenity purposes – all works will need to be programmed to minimise the impact on amenity users by avoiding the peak holiday season, where possible. Also, there is a need to ensure safe public access of any possible recycling/re-profiling works.
- Access and noise/visual disturbance to residents/local businesses.
- Access for the Sidmouth Lifeboat.
- Impact of beach management activities on internationally and nationally designated sites – need to avoid disturbance to notable and protected habitats and species. Potential requirement for Habitats Regulations Assessment to assess impacts of beach management activities on the integrity of the international conservation sites. Early consultation with Natural England during the development of the BMP will be required (see **Appendix E**).
- Impact of the beach management activities the on the AONB and World Heritage Site Outstanding Universal Value and setting.
- Access for vehicles and personnel during any construction on to the beach may limit works.

1.4.3 Public safety and amenity considerations

In addition to the environmental related considerations identified in **Section 1.4.2**, the following public health and safety concerns were encountered during the visual condition assessment of the frontage (refer also to **Appendix G**). These are summarised as follows:

- Along the Jacob's Ladder Beach to Clifton Walkway section of the BMP frontage:
    a. The hand railing in a number of locations is corroded, with full thickness loss in some places. Replacement is advised for safety reasons.
    b. A life ring was found to be partially buried due to it being situated on the beach. It is suggested that the life ring be moved so as it can be easily accessed and used if required.

- Along the River Sid Training Wall, hand railing could be extended further than its present extent, given the considerable height above the beach exists (particularly when there are periods of low beach levels along East Beach).

These were considered as part of developing the monitoring and maintenance regime presented in **Sections 4 and 5** of this BMP.

1.4.4 Uncertainties about coastal processes

A detailed review of coastal processes was undertaken as part developing this BMP. This is presented in full in **Appendix B**, with key information for beach management decisions summarised in **Sections 2.1 to 2.6**. This generally provides a reasonable understanding of the coastal dynamics along the BMP frontage. However, there remain a number of key uncertainties and limitations to our understanding of the behaviour of the coastline at Sidmouth, and which will ultimately determine the future behaviour and therefore management of the beach. These are discussed below:

- The current monitoring of beach levels does not provide a good basis by which to assess volume changes, due to the distribution of profiles and the response of the beach, which is not very well replicated by interpolation of adjacent profile lines.
- Work completed by PCO for EDDC shows the design volume to MLWS (-2mOD) to be 182,062m^3, however, this is based on a relatively crude volume calculation, which does not account for the recorded difference in placed beaches compared to the design beaches. This means it is very difficult to assess the long term success of the coastal defence scheme constructed in the 1990s.
- The sediment pathway between the nearshore and offshore remains uncertain, particularly how much and where sediment may be being stored in the nearshore/offshore zone. More detailed and regular bathymetry surveys supported by sediment sampling would help to clarify this matter.
- Based on previous analysis, assumptions have been made regarding the transport of shingle across the River Sid, which are assumed to be small, in terms of shingle. A better understanding of this potential linkage would add confidence to the arguments presented in **Appendix B**.
- The nature of sediment transported between East Beach and Beer Head and potential interruption of sediment supply by periodic landslides. It would be useful to have beach monitoring data along this whole length of coast to improve understanding of the links between beach behaviour and response at East Beach and beaches further east.

Monitoring of data to help improve understanding and overcome some of the uncertainties in present understanding is included in **Section 4** of this BMP.

1.5 Responsibilities for management

Responsibility for the management and operation of activities along the BMP frontage varies depending upon the activity and ownership. **Table 1-1** summarise the roles and responsibilities.

TABLE 1-1

Assigned responsibilities for coastal flood and erosion risk management activities at Sidmouth.

Management Activity	**Assigned Responsibility *(note, responsibility varies along the frontage for some management activities)***
Monitoring of beach and other coastal processes	South West Coastal Monitoring Group
Initiation of post-storm surveys	East Devon District Council
Operations to maintain beach profile	East Devon District Council
Cleaning/clearance of promenades/backing roads, etc of beach debris for amenity.	East Devon District Council
Cleaning/clearance of beach in response to pollution incidents.	East Devon District Council or Devon County Council *(depending on nature of hazard)*
All structural inspection and maintenance of promenade, seawall, rock groynes, offshore rock breakwaters and River Sid Training Wall that form part of the coastal defences	East Devon District Council
All structural inspection and maintenance of River Sid Western Wall	Environment Agency
All inspection and maintenance of access steps and ramps to beach from seawalls/promenades that form part of the formal coastal defences	East Devon District Council
All maintenance of footpath and cycleways including signs for designated public footpaths and rights of way. Includes Alma Bridge.	Devon County Council / Private Landowners
Litter clearance	East Devon District Council / Private Landowners
Maintenance of seats, litter bins, etc.	East Devon District Council / Private Landowners
Provision of signage	East Devon District Council / Devon County Council / Private Landowners
Flood warning	Environment Agency
Flood incident response actions	Environment Agency and Devon County Council
Emergency planning	East Devon District Council, Environment Agency and Devon County Council

Actual ownership of the assigned responsibility for each management operation identified in **Table 1-1** is in some cases held by different departments within the identified organisation. Therefore, in order to support **Table 1-1** and to provide clarity on who should be contacted for each item, **Appendix H** provides more specific contact details for those responsible for each management operation.

1.6 Licences, approval and consents

In order to undertake any future beach recycling, beach recharge or other capital scheme along the BMP frontage as described in **Section 5**, a range of licences, approvals and consents will be required, including:

- Marine Licence under the Marine and Coastal Access Act 2011 (see **Section 1.6.1**).
- SSSI consent from Natural England (see **Section 1.6.1**).
- Planning Application under the Town and Country Planning Act 1990 (see **Section 1.6.2**).

The following sections summarise the required consents and the processes to obtaining them.

Discussions should be held with the relevant consenting organisations in a timely manner to ensure that all requirements of licence/consent applications are confirmed and addressed in order to minimise the risk of delays in being able to implement works. These discussions should also assess the applicability of progressing a licence application through the streamlined process defined in the Coastal Concordant for England published in November 2013 (Defra, 2013).

1.6.1 Marine Licence

At present along the frontage no Marine Licence is held to facilitate the beach management works envisaged to be implemented within the next few years to fulfil the preferred option identified as part of developing this BMP (refer to **Section 1.1** and/or **Appendix D**). As such, as part of any future scheme development to implement beach recycling or any other works along the BMP frontage, the Marine Management Organisation (MMO) will need to be engaged to seek a Marine Licence or Licences to facilitate both the capital works and/or any ongoing maintenance activities.

As part of the process of obtaining a Marine Licence or Licences for undertaking beach recharge or other capital works, consideration of the Marine Work (Environmental Impact Assessment) Regulations 2007 will also be needed to determine whether an environmental impact assessment is required. The MMO would most likely act as the Competent Authority in this regards.

A Water Framework Directive Assessment may also be required to support the Marine Licence application. The scope of any such assessment would require consultation with the Environment Agency.

As there are also areas in the immediate vicinity of the study area that are designated under The Conservation of Habitats and Species Regulations 2010, a Habitats Regulations Assessment will also need to be undertaken as part of a Marine Licence application. The Competent Authority for this would be the MMO. See also **Appendix E**.

With regards to undertaking beach recycling works, it should be noted that the MMO guidance has previously advised that beach recycling activities within the same sediment cell are exempt from the need for a marine licence. However, there is still a need to notify the MMO of a licence exempt activity notified via the MMO website (see https://www.gov.uk/guidance/make-a-marine-licence-application). Should the MMO not agree with the exemption they will notify the applicant (usually within a week). **It is strongly recommended that a Scoping Opinion be sought from the MMO in the immediate future to clarify this and determine whether or not a Marine Licence is required for ongoing beach recycling covering a period of 10 years or so (in advance of any new scheme being implemented) and, if needed and given the time-scale involved in obtaining a Marine Licence (typically 14 weeks), obtain a Marine Licence from the MMO in good time to enable beach management works to be implemented when it becomes required**, rather than having this 14 week delay at a time when such a delay may increase risk of failure of the seawall, etc. Any Marine Licence should be kept up-to-date so there is no lapse. It may be pertinent to seek a Marine Licence in the immediate future that would facilitate undertaking emergency works prior to the any planned works that are to be developed in further detail in the near future.

If beach recycling works are to occur along the East Beach part of the BMP area without a Marine Licence and/or planning permission in place, **consent will be needed from Natural England each time works are carried out in the SSSI area**.

1.6.2 Planning Application

Any capital scheme will also require some form of planning consent from EDDC. It is recommended that the local planning officer be consulted at the time when a capital scheme is being developed to determine the most appropriate route for planning consent.

Above the MHWS the planning authority would act as the Competent Authority and planning permission would be sought. An application under these circumstances would also require consideration under the Town and County Planning (Environmental Impact Assessment) regulations 2011. In this regard, EDDC would likely act as the Competent Authority.

1.7 Linkages to other relevant documents

1.7.1 Shoreline Management Plan policy

The current Shoreline Management Plan (SMP) covering the BMP frontage was adopted in June 2011 (Halcrow, 2011). The SMP policy recommended for this section of coast is defined by policy units 6a35 and 6a36, is stated in the SMP2 as being:

> *"The town is currently defended by a range of defence measures including seawalls, rock groynes and offshore rock breakwaters, supported by ongoing beach management activities. The seawall along this section protects low-lying land from flooding, whilst the shoreline structures, offshore breakwaters and beach management serve to retain beach material in front of the seawall. Defences along the River Sid also provide flood protection to the town of Sidmouth.*
>
> *There are no defences along the coastal frontage of this stretch across the mouth of the River Sid and the easternmost part of Sidmouth. The defences along the Sidmouth frontage have, in part at least, contributed to low beach levels along this section and part of the adjacent coast to the east. This has led to an accelerated rate of cliff recession locally such that there is an increasing risk that the fluvial defences along the River Sid could become exposed to attack from the sea, which they are not currently designed to withstand, and so increase the risk of flooding to Sidmouth.*
>
> *The long term Plan for the section across the mouth of the River Sid is therefore to intervene to the extent that protection to the fluvial defences is provided, whilst providing a transitional zone between the area of 'Hold the Line' to the west and 'No Active Intervention' to the east.*
>
> *This would allow the cliffs to continue to erode, but at a slower rate. As this would not prevent cliff erosion but merely reduce the rate at which is occurs, cliff top properties to the immediate east of the River Sid would be protected for a period of time (expected to be most of the 100 year life of the Plan), but these assets would ultimately be at risk and measures will need to be put in place to manage this. In the very long term (beyond the 100 year life of the Plan), it is expected that more significant intervention to prevent further cliff recession will be required (and be economically justified) to achieve the long term vision to continue to protect the town of Sidmouth. However, if cliff erosion occurs at a faster rate than presently predicted there may be a need for this to be brought forward."*

Table 1-2 summarises the SMP policies that apply to the BMP area.

Table 1-2

SMP Policies adopted June 2011 (from Halcrow, 2011) along the BMP area

Policy Unit	Short Term (to 2025)	Medium Term (to 2055)	Long-term (to 2105)
6a34 - Beer Head to Salcombe Hill	Allow natural coastal evolution to continue through No Active Intervention.	Allow natural coastal evolution to continue through No Active Intervention.	Allow natural coastal evolution to continue through No Active Intervention.
6a35 - River Sid and Sidmouth (East)	Undertake Managed Realignment through beach management.	Undertake Managed Realignment through beach management.	Undertake Managed Realignment through beach management.
6a36 - Sidmouth	Continue to maintain existing defences under a Hold the Line policy.	Continue to maintain existing defences under a Hold the Line policy.	Continue to maintain existing defences under a Hold the Line policy.
6a37 – Chit Rocks to Big Picket Rock	Allow natural coastal evolution to continue through No Active Intervention.	Allow natural coastal evolution to continue through No Active Intervention.	Allow natural coastal evolution to continue through No Active Intervention.

1.7.2 The East Devon New Local Plan 2013-2031

The current East Devon Local Plan was adopted on 28th January 2016. The Plan sets out the aim of the plan to guide where development in East Devon will occur and how the great natural asset will be conserved and enhanced. Pertinent strategies and policies are identified below:

- Strategy 5 – Environment
- Strategy 22 – Development at Sidmouth
- Strategy 44 – Undeveloped coast and coastal Preservation Areas
- Strategy 45 – Coastal erosion
- Strategy 46 – Landscape conservation and enhancement and AoNB
- Strategy 47 – Nature conservation and geology
- Policy EN4 – Protection of Local Nature Reserves, County Wildlife Sites and County Geological Sites
- Policy EN5 – Wildlife habitats and features
- Policy EN6 – Nationally and locally important archaeological sites
- Policy EN7 – Proposal affecting site which may potentially be of archaeological importance
- Policy EN10 – Preservation and enhancement of conservation areas
- Policy EN15 – Environmental impacts, nuisance and detriment to health
- Policy EN18 – Maintenance of water quality and quantity
- Policy EN21 – River and coastal flooding
- Policy EN23 – Coastal erosion and surface water run-off
- Policy EN24 – Coastal Defence Schemes
- Policy EN25 – Development affected by coastal change
- Policy TC4 – Footpaths, Bridleways and cycleways.

Included within the Plan is a commitment to designate a Coastal Change Management Area (CCMA) at Sidmouth to manage the impact of future coastal change, though no timescale for CCMA designation is stated. **Monitoring data defined by this BMP in Section 4 should be used to inform CCMA development within the next few years**.

1.7.3 UNESCO Dorset and East Devon World Heritage Site Management Plan, 2014-2019

The UNESCO Dorset and East Devon Coast World Heritage Site Management Plan defines a number of aims and objectives for the long-term sustainable management of the site. The aim is 'to protect the Site's Outstanding Universal Value (OUV) and setting.'

In line with this aim, the management plan sets out a range of policies covering all aspects of coastal management. The following policies are still of particular relevance to the development of future management options for the BMP area:

- Policy 1.1: Protect the OUV of the Site through prevention of developments that might impede natural processes, or obscure the exposed geology, as set out in the GCR / SSSI details, now and in the future.
- Policy 1.2: Where developments affecting the Site or setting do take place, avoid or at least mitigate negative impact on the natural processes of erosion and exposed geology.
- Policy 1.5: Ensure that the 'South Devon and Dorset', and 'Two Bays' Shoreline Management Plans continue to take full account of the OUV of the Site and the specific geological and geomorphological features in the GCR sites when defining actions for coastal defences.

1.7.4 East Devon Catchment Flood Management Plan (CFMP)

The CFMP acknowledges sources of flooding from rivers in the East Devon Catchment. It describes significant tidal flooding in Sidmouth with risks to people, property and infrastructure. The plan highlights preferred risk management policies for East Devon with a recommended '*sustain the current scale of flood risk'* for Sidmouth.

1.7.5 East Devon Area of Outstanding Natural Beauty (AONB) Management Strategy 2014-2019

The East Devon AONB management strategy contains a number of objectives and policies deriving from three main themes 1. Landscape 2. Sustainability 3. Communication and Management and 12 sub-themes. Objectives and policies relevant to the Exmouth BMP are detailed below with sub-themes presented in bold:

- **Coast** – Objective: The conservation and enhancement of the high quality and international significant coastline. Policy: (C 1) Conserve and enhance the tranquil, unspoiled and undeveloped character of the coastline and estuaries and encourage improvements to coastal sites damaged by past poor quality development or intensive recreational pressure.
- **Planning and Development** – Objective Planning development and policy protects the special landscape character and tranquillity of the AONB and will enable appropriate forms of social and economic development that are compatible with the landscape, so conserving and enhancing the environment. (P 3) Encourage the development of guidelines and design guides to support high quality sustainable development which complements and respects the AONB landscape and historic character.

1.7.6 Sidmouth to West Bay SAC Site Improvement Plan, 2014

Site Improvement Plans (SIPs) have been developed by Natural England for each Natura 2000 site in England as part of the Improvement Programme for England's Natura 2000 sites (IPENS). Natura 2000 sites is the combined term for sites designated as Special Areas of Conservation (SAC) and Special Protected Areas (SPA).

The SIP covering the Sidmouth to West Bay SAC was published in 2014 (Natural England, 2014) and provides a high level overview of the issues (both current and predicted) affecting the condition of the Natura 2000 features on the site(s) and outlines the priority measures required to improve the condition of the features.

It does not cover issues where remedial actions are already in place or ongoing management activities which are required for maintenance. This includes actions regarding inappropriate coastal management with relation to vegetated sea cliffs habitat.

1.7.7 South Inshore and South Offshore Marine Plans

The BMP area lies within the South Inshore Marine Plan area. This Marine Plan is currently being developed by the Marine Management Organisation (MMO) in parallel to the South Offshore Marine Area. Once published and adopted, the Marine Plan will be a statutory planning document used to guide licence and consent decisions within the marine environment up to the MHW mark including beach management activities (refer also to **Section 1.6.1**).

The final South Inshore and South Offshore Marine Plans are expected to be adopted in 2016, with a six-year review period.

1.7.8 South West River Basin Management Plan, 2009

The South West River Basin Management Plan (Environment Agency, 2009) was prepared under the Water Framework Directive (WFD) as a product of the first of a series of six-year planning cycles. It contains actions to improve the ecological status of water bodies in river basin catchments, including coastal waters out to 1 nautical mile. The BMP area lies within one such WFD Coastal Water Body and so activities need to comply with the requirements of this plan.

2 Supporting Information

This section of the BMP provides a summary of the physical setting of the BMP area. The aim of this summary is to provide an overview of the coastal processes affecting the Sidmouth frontage and the impacts of human intervention upon them, as well as details of the environmental features of the site that must be considered when undertaking beach management in this area. This includes the following information:

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

This summary is largely based upon detailed assessment undertaken as part of developing the BMP, which is provided in **Appendix B**.

2.1 Wave climate

2.1.1 Typical waves

The coastline between the Jacob's Ladder Beach and East Beach is orientated in a north-east to south-west direction. Various wave data sets are available relevant to this frontage (see **Figure 2-1** and **Table 2-1**); these all indicate that waves predominately approach this coastline from the south-west and south-east (refer to **Appendix B**).

The Met Office hindcast wave data for location '407' (**Figure 2-2**) is closest to the BMP area and provides the longest record of data. This data set indicates that a predominant south-westerly wave regime along this coastline, but that south-easterly storm conditions occur throughout the year for days at a time.

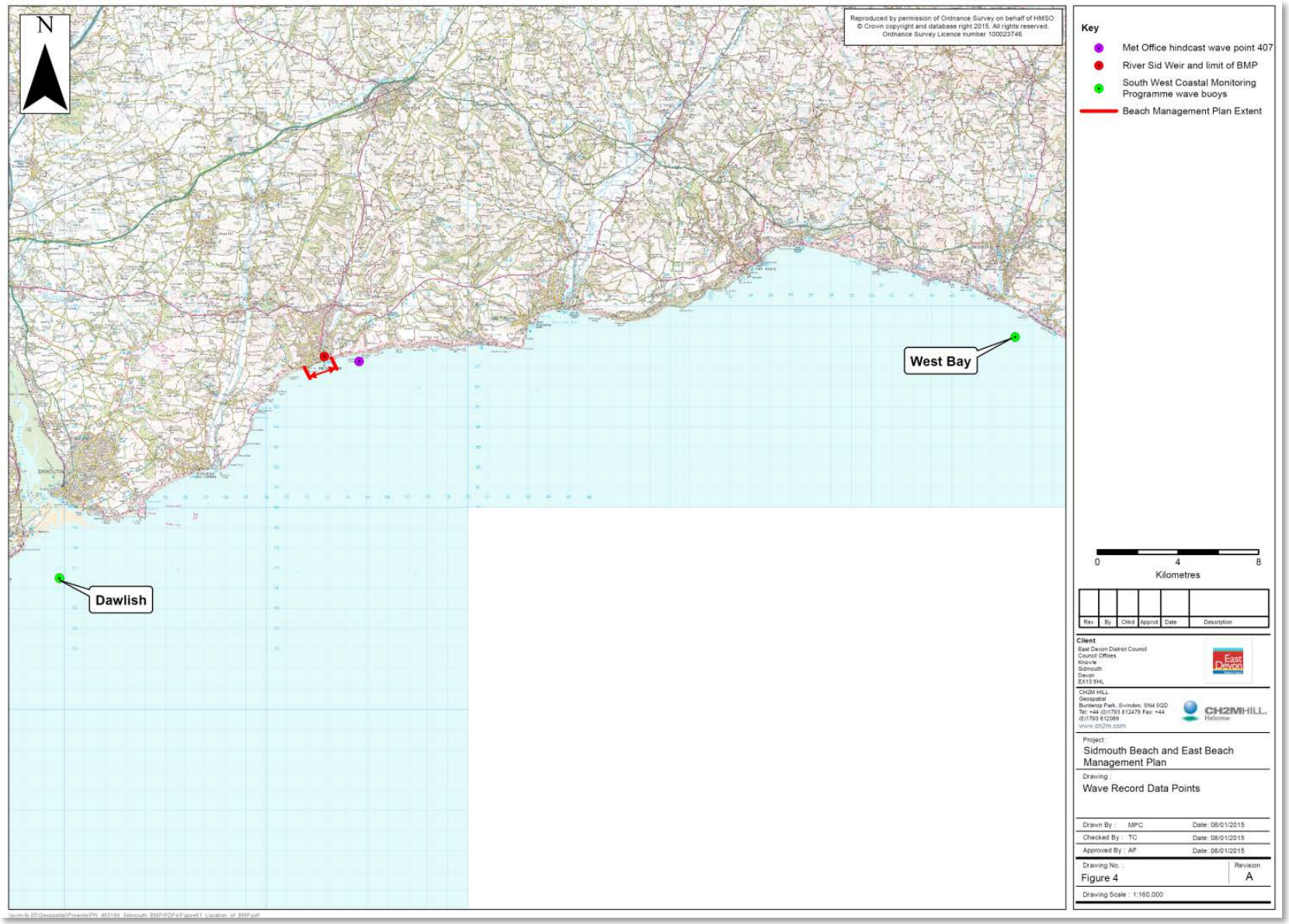


FIGURE 2-1
Map showing the locations of the wave data collection points.

TABLE 2-1
Wave data sets relevant to the Sidmouth BMP area.

Name	Location	Record length	Details
Location 407, Sidmouth	Sidmouth	Hindcast data for 33 year period between Jan 1980 and Dec 2013	Met Office hindcast wave data which used the WaveWatch III hindcast model.
Dawlish Directional Waverider Buoy	9 miles south-west of Sidmouth	Measured data: 2 years - Dec 2010 to Dec 2012	Operated as part of the SWRCMP
Seaton nearshore wave data point	East of Beer Head	Modelled data: 1991 - 2000	Transformed inshore wave data from Futurecoast (Halcrow, 2002). Derived from offshore Met Office Wave Model 1991 - 2000
West Bay Directional Waverider Buoy	East of Sidmouth, near Bridport	7 year period Nov 2006 to June 2013.	Operated as part of the SWRCMP

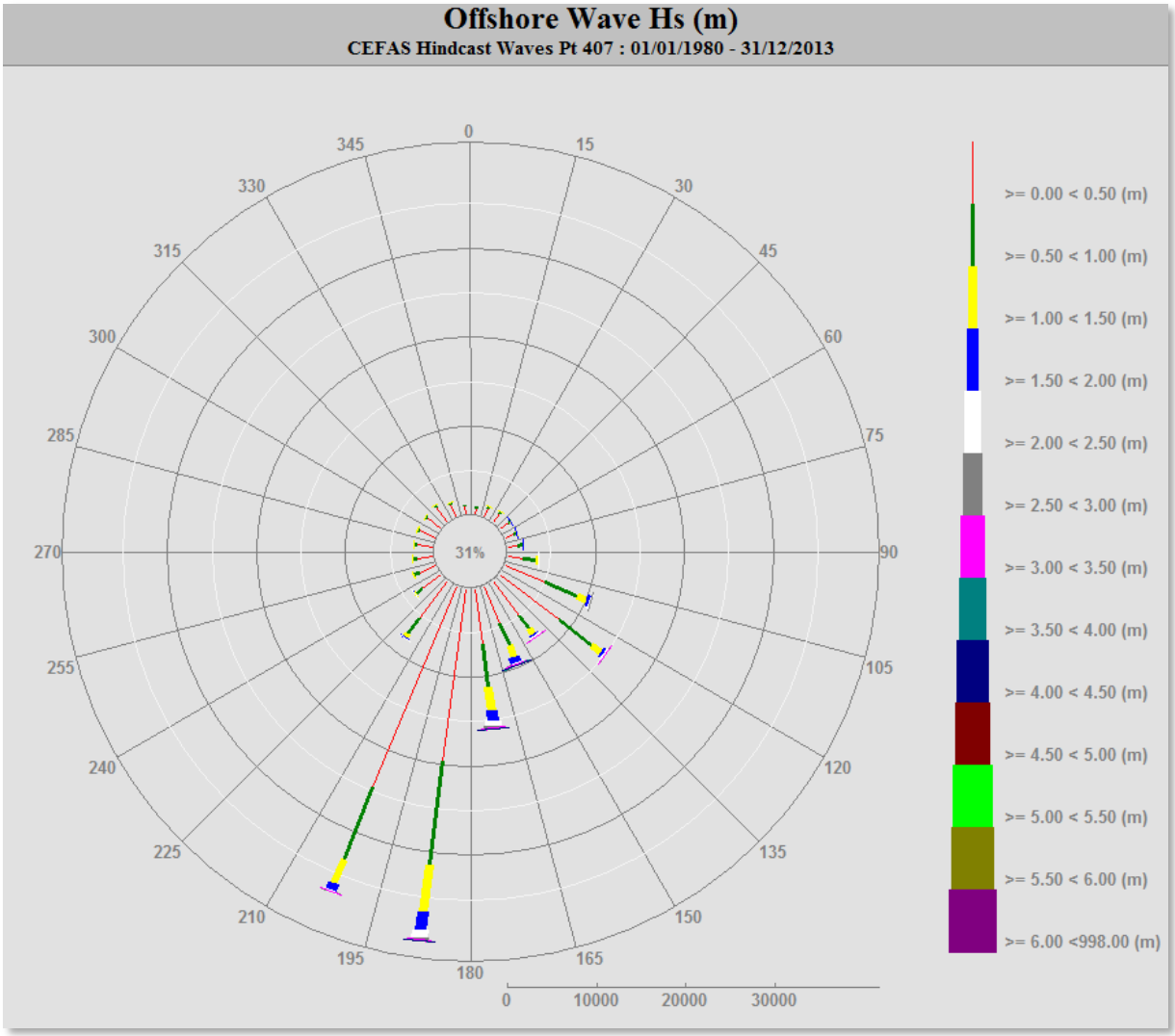


FIGURE 2-2
Met Office WaveWatch III hindcast wave record for location '407' between 1/1/1980 and 31/12/2013.

2.1.2 Extreme waves

The Environment Agency's R&D project *Coastal Flood Boundary Conditions for UK Mainland and Islands* (Environment Agency, 2011a) provides the most recent assessment of extreme swell waves. This extreme swell wave data (see **Table 2-2a**) indicates that of the three predominant onshore wave directions; southeast, south and southwest; the largest waves, with the longest period, tend to come from the south, with an average wave height of 3.7m and period of 12s for a 1 in 1 year condition, and wave height of 5.25m and period of 12s for a 1 in 100 year condition.

The most recent estimate of extreme resultant waves for this area, which reflect the combined influence of wind-waves and swell waves, is provided by the Environment Agency commissioned project *Parameters for Tidal Flood Risk Assessment – Wave Parameters* (Royal Haskoning, 2012) (see **Table 2-2b**). This dataset also shows that the largest and longest waves tend to come from the south.

TABLE 2-2A

Extreme swell wave climate (significant wave height, m) for Sidmouth BMP frontage (from Environment Agency, 2011a).

	Swell Wave Directions								
	Southeast			South			Southwest		
Return Period (1inX yrs)	Wave Height (m)	Confidence Limit (+/- m)	Wave Period (s)	Wave Height (m)	Confidence Limit (+/- m)	Wave Period (s)	Wave Height (m)	Confidence Limit (+/- m)	Wave Period (s)
1	2.6	0.2	8	3.7	0.2	12	2.9	0.1	8
2	2.8	0.2	8	3.99	0.3	12	3.03	0.1	12
5	3.03	0.3	12	4.34	0.4	12	3.17	0.1	12
10	3.18	0.3	12	4.58	0.4	12	3.27	0.2	12
20	3.32	0.4	12	4.8	0.5	12	3.35	0.2	12
25	3.36	0.4	12	4.87	0.6	12	3.37	0.2	12
50	3.48	0.5	12	5.07	0.7	12	3.44	0.2	12
75	3.55	0.5	12	5.18	0.7	12	3.48	0.2	12
100	3.59	0.6	12	5.25	0.8	12	3.5	0.2	12
150	3.65	0.6	12	5.36	0.8	12	3.54	0.2	12
200	3.69	0.6	12	5.43	0.9	12	3.56	0.2	12
250	3.72	0.7	12	5.48	0.9	12	3.57	0.2	12
300	3.74	0.7	12	5.52	0.9	12	3.59	0.2	12
500	3.8	0.7	12	5.63	1	12	3.62	0.3	12
1000	3.87	0.8	12	5.78	1.1	12	3.66	0.3	12

TABLE 2-2B

Extreme resultant wave climate (significant wave height, m) for Sidmouth BMP frontage (from Royal Haskoning, 2012).

	Resultant Wave Directions					
	Southeast		South		Southwest	
Return Period (1inX yrs)	Wave Height (m)	Wave Period (s)	Wave Height (m)	Wave Period (s)	Wave Height (m)	Wave Period (s)
1	4.16	8	5.68	10	4.73	8
2	4.29	8	5.91	10	4.93	8
5	4.42	8	6.18	10	5.16	10
10	4.49	8	6.35	10	5.31	10
20	4.54	8	6.51	10	5.44	10
25	4.55	8	6.55	10	5.48	10
50	4.59	8	6.68	10	5.59	10
75	4.61	8	6.75	10	5.65	10
100	4.62	8	6.79	10	5.69	10
150	4.63	8	6.85	10	5.74	10
200	4.64	8	6.89	10	5.78	10
250	4.65	8	6.92	10	5.8	10
300	4.65	8	6.95	10	5.82	10
500	4.66	8	7.01	10	5.88	10
1000	4.68	8	7.08	10	5.94	10

2.2 Water levels

2.2.1 Tidal information

This area is a meso-tidal coastline with a spring tidal range (for Lyme Regis) of 3.7m (see **Table 2-3**).

Within the wider Lyme Bay, flood-tide currents flow in a north-eastward direction and ebb-tide currents flow in a south-westward direction (SCOPAC, 2004). Float track data collected for the Sidmouth Coastal Defence Scheme Modelling (HR Wallingford, 1992), found tidal flows offshore to be quite slow and did not exceed 0.25m/s during the spring tidal cycle. Tidal measurements collected inshore, on the 18th April 1992 near the Sidmouth Outfall for the Sidmouth Coastal Defence Scheme Modelling (HR Wallingford, 1993), varied between 0.05m/s and 0.17m/s relative to high water. The modelling predicted (HR Wallingford, 1993) that the breakwaters would reduce current flow during the eastward flood tide.

There is no data available on post-scheme conditions.

TABLE 2-3
Tide levels (in mOD) for Lyme Regis, the nearest tide data point to Sidmouth (UKHO, 2014).

Tidal Condition	Tide Level (mOD)
Highest Astronomical Tide (HAT)	2.45
Mean High Water Spring (MHWS)	1.95
Mean High Water Neap (MHWN)	0.75
Mean Sea Level (MSL)	-
Mean Low Water Neap (MLWN)	-0.65
Mean Low Water Spring (MLWS)	-1.75
mOD to mCD conversion	*-2.35m*

2.2.2 Extreme water levels

The Environment Agency's R&D project *Coastal Flood Boundary Conditions for UK Mainland and Islands* (Environment Agency, 2011a) provides the most recent assessment of extreme water levels. **Table 2-4** presents this data, which has been increased to present day (2013) and a range of future years to allow for sea level rise using the change factor sea level rise assumption defined in **Section 2.4**.

TABLE 2-4
Extreme tide levels for a range of return periods at Sidmouth (Environment Agency, 2011a).

Year	Assumed increase in Sea Level (m)	MHWS Level (mOD)	Extreme Water Levels (mOD) by return period (1 in X years) and APO (%)								
			1 (100%)	5 (20%)	10 (10%)	20 (5%)	50 (2%)	100 (1%)	200 (0.5%)	500 (0.2%)	1000 (0.1%)
2013	*0*	1.95	2.72	2.88	2.95	3.02	3.12	3.18	3.26	3.37	3.44
2025	*0.05*	2	2.77	2.93	3.00	3.07	3.17	3.23	3.31	3.42	3.49
2050	*0.15*	2.1	2.87	3.03	3.10	3.17	3.27	3.33	3.41	3.52	3.59
2075	*0.27*	2.22	2.99	3.15	3.22	3.29	3.39	3.45	3.53	3.64	3.71
2100	*0.41*	2.36	3.13	3.29	3.36	3.43	3.53	3.59	3.67	3.78	3.85

2.3 Joint probability extreme waves and water levels

A joint probability analysis assessing the combinations of extreme water levels (**Table 2-4**) and extreme swell (**Table 2-2a**) and extreme resultant (**Table 2-2b**) wave heights was undertaken in developing this BMP. This analysis was undertaken using the simple desk based approach provided in the Defra/EA R&D project *Joint Probability Dependence Mapping and Best Practice* (Defra/Environment Agency, 2005). The joint probability extreme wave and water levels derived are presented in Appendix E of the detailed coastal processes assessment provided as **Appendix B** of this BMP.

2.4 Climate change and risk

Climate model projections suggest that the global average rate of sea level rise will increase in the 21st Century. A general assumption is that any increase in mean sea level is likely to cause an equal increase in all other water levels, including extreme water levels.

Information on the impacts of climate change is available from *Advice for Flood and Coastal Erosion Risk Management Authorities* (Environment Agency, 2011b). This is the latest guidance and highlights that the main risk of climate change in relation to beach management is from sea level rise. The latest advice from the Environment Agency based on this guidance is that beach management should take account of a 'change' factor covering the whole of the decision lifetime. The change factor is defined as follows:

"The change factors quantify the potential change (as either mm or percentage increase depending on the variable) to the baseline. It is recommended that option are developed planning for the change factor covering the whole of the decision lifetime. However, rather than base options solely on the change factor the upper and lower end estimates can be used to refine the options to prepare for a rider range of future change."

The guidance (Environment Agency, 2011b) states that predictions of the future rate of sea level rise for the UK coastline should be taken from UKCP09. Data downloaded from UKCP09 provides sea level rise from 1990. Anticipated rates of relative sea level rise and surge estimates over three time periods are presented in **Table 2-5** for ease of reference. The following estimates are presented in the table:

- Lower End Estimate: this is the low emissions scenario, 50% frequency, taken from the UKCP09 User Interface.
- Change Factor: this is the medium emissions scenario, 95% frequency, taken from the UKCP09 User Interface.
- Upper End Estimate: these are generic values of sea level rise provided in the climate change guidance; they are 4mm (up to 2025), 7mm (2026 to 2050), 11mm (2051 to 2080), and 15mm (2081 to 2115).
- H++ Scenario: these are generic values of sea level rise provided in the climate change guidance; they are 6mm (up to 2025), 12.5mm (2026 to 2050), 24mm (2051 to 2080), and 33mm (2081 to 2115).
- Upper End Estimate + Surge Estimate: This is the upper end estimate plus the upper end surge estimate. The surge estimate are generic values provided in the climate change guidance; they are 20cm (up to the year 2020's), 35cm (up to the year 2050's), and 70cm (up to the year 2080's). With regard to the surge increase, the uncertainty with surge increase is even greater than for sea level rise.

The climate change guidance (Environment Agency, 2011b) recommends that in planning future coastal management options, the Change Factor (medium 95% frequency scenario) be used as the preferred scenario. All other scenarios are included to demonstrate the sensitivity of decision making through time, and can be used to refine the options to prepare for a wider range of future change.

TABLE 2-5
Relative sea level rise estimates for Sidmouth. *See text above for an explanation of the terms used in this table.

Time Period	Various estimates of relative sea level rise and surge (m increase over time period)					
	Low Estimate 50%ile	Change Factor	Upper End	*Surge for Upper End*	Upper End + Surge	H++
2014 to 2025	0.04	**0.04**	0.06	*0.20*	0.26	0.08
2014 to 2055	0.15	**0.17**	0.29	*0.35*	0.64	0.52
2014 to 2105	0.42	**0.49**	0.94	*0.70*	1.64	1.94

2.5 Sediment transport

2.5.1 Sediments

There are very limited contemporary inputs of shingle to the BMP frontage. The sediment that forms these beaches was originally sourced from periglacial deposits which are now exhausted or lie in deep waters offshore, beyond the influence of waves and currents.

The key supply of new sediment to this system is therefore through artificial nourishment. As part of the Sidmouth Coastal Defence Scheme (refer to **Section 3.1**), 185,000 tonnes (approximately 105,000m^3) of flint gravel was placed on the Sidmouth beach between West Pier and East Pier Groyne (SCOPAC, 2004). Later, in 2000, a further 6,000m^3 was placed between the existing York Steps Groyne and East Pier

Groyne. The nourishment material was sourced from a local inland quarry and reported to be similar in size to the indigenous beach sediment (SCOPAC, 2004).

Further details on sediments and sediment supply in relation to the BMP area and wider coastal sediment cell are provided in Section 4 of **Appendix B**.

2.5.2 Sediment transport mechanisms

Although there is a not a great deal of information available on tidal currents, it is believed that these are low and not capable of moving gravel-sized sediment along the beach (Posford Duvivier, 1991; HR Wallingford, 1992; HR Wallingford, 1993). Therefore, movement of beach material (i.e. gravel / shingle) alongshore and cross-shore is determined by wave strength and direction.

The predominant wave influence (see **Section 2.1**) along the coastline between Otterton Ledge and Beer Head is from the south-west, with less frequent but sometimes large waves from the south-east.

SCOPAC (2004) produced a map of the sediment transport mechanisms, for various sediment types, for the area between Otterton Ledge and Beer Head (see **Figure 2-3**). For the Sidmouth frontage this indicated that there is potential for gravel and sand to be transported in both directions. SCOPAC (2004) also reported a predominant weak west to east sediment transport pathway along the coast from Otterton Ledge to Beer Head, and at Sidmouth there is indirect evidence for east and south-east waves to create a short-term littoral drift reversal. The map also suggests a potential fluvial input to the frontage; however, this is believed to be low due to trapping by weirs within the River Sid upstream of the mouth.

Based on observations and available data, sediment transport along the BMP extent can be summarised as follows:

1. Otterton Ledge to Chit Rocks: transport is confined to individual pocket beaches with negligible by-passing of headlands (SCOPAC, 2004).
2. The Chit Rocks headland and shore platform, to the west of Sidmouth, acts as a natural barrier to the eastward transport of material from Jacob's Ladder Beach to Sidmouth Beach, with little or no drift into Sidmouth frontage from the west bypassing Chit Rocks and the adjacent nearshore detached breakwaters (SCOPAC, 2004).
3. Similarly, at the eastern end of Sidmouth frontage, the River Sid training wall, combined with the eastern-most groyne (Pier Groyne), inhibit littoral transport in both west-east and east-west directions. There is, however, disagreement within the literature regarding the effectiveness of this barrier. Posford Duvivier (2001) report that there is very little, if any, linkage between Sidmouth Town Beach and East Beach. However, SCOPAC (2004) reports that some "outflanking seaward" by both sand and gravel in an eastwards direction may occur at the (easternmost) terminal rock groyne and the mouth of the Sid; it is assumed that this statement means that material is able to bypass the end of these structures from west to east. The SCOPAC (2004) report suggests that the sediment pathway is via a nearshore sediment store which is reported to exist south and east of the mouth of the River Sid and that any movement of sediment eastwards across the Sid occurs as pulses. SCOPAC (2004) goes on to suggest that further evidence for this pathway is the composition of natural clasts on Sidmouth Beach, most are either flint or chert and thus must ultimately derive from cliff erosion between Salcombe Hill and Beer Head to the east. However, this conclusion appears to be based on visual observations of beach composition as the report also states that no quantitative analysis of the beach lithology has been undertaken.
4. Certainly there is evidence that material can be transported across the river mouth from east to west, but this appears to become trapped on the western (Sidmouth Town) side of the training wall and outfall structure (though historical photographs show this has not always been the case when a large beach was present along the Sidmouth frontage; refer to Section 5.6 of **Appendix B**). Without further analysis it is not possible to determine whether this material is then able to bypass the end of the structure to feed Sidmouth frontage. The westward movement of shingle in this way can temporarily block the river mouth forcing the river to discharge to the sea by seeping through the shingle (SCOPAC, 2004). Observations made over a 30 year period between the early 1930s and late

1960s (Laver, 1981) found that the average length of time during which the river mouth was blocked by shingle was 16 days, but that it could be up to 3 to 4 months.

5. Along the Sidmouth frontage itself, the rate of longshore transport is controlled by the two detached breakwater structures and three rock groynes. The alignment of the coast relative to the predominant wave directions means that drift can commonly occur in both directions. Before the construction of the most recent scheme, HR Wallingford (1992) calculated a net west to east residual transport flux of around 6,350m^3/year, based on modelling of inshore waves, but that over a year the gross potential rate averages over 52,000m^3. This means that there is potential for large volumes of shingle to be transported in a westwards direction, driven by easterly and south-easterly storms, which although low in frequency can be of high magnitude (large wave heights/periods) and capable of moving large volumes of beach material in a short period of time (Posford Duvivier, 2001). When the scheme was reviewed in 1998, it was found that the plan shape of the beach had changed significantly since 1996, with a net accretion of sediment in the lee of the breakwaters, to the detriment of the frontage between York Groyne and Bedford Steps. Although the original design had anticipated sediment accumulation behind the breakwaters, this change had taken place much quicker than anticipated and this was attributed to a period of easterly conditions in winter 1995/6 which resulted in material effectively becoming trapped behind the breakwaters. This emphasised the importance of the less frequent easterly conditions, compared to the more normal westerly conditions.

6. East of the BMP frontage, between East Beach and Beer Head, longshore transport takes place relatively freely, but localised and temporary interruptions can be caused by eroded cliff debris on the beach.

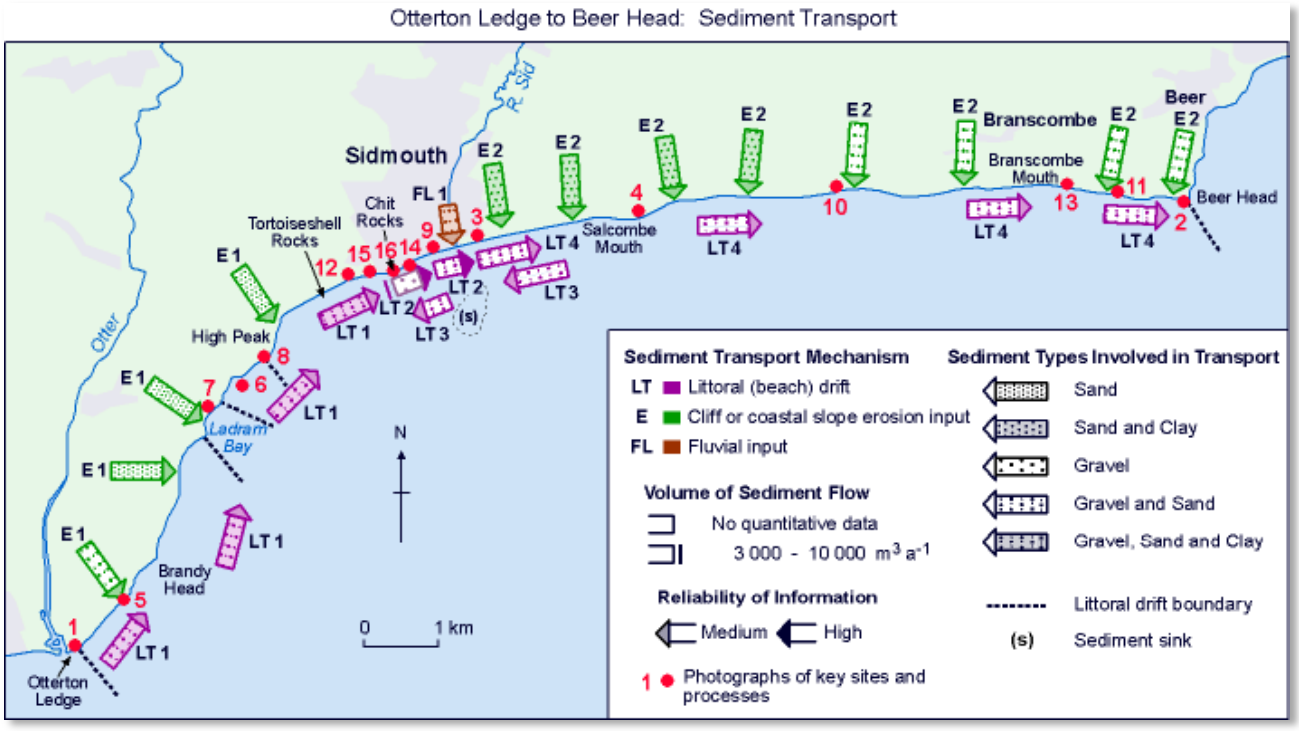


FIGURE 2-3
Sediment Transport for Sidmouth and the surrounding area (SCOPAC, 2004).

The beaches along this frontage are known to have been very volatile in the past and subject to large drawdown of sediment during storm periods. Tindall (1929) undertook analysis of beach profile data from 1922 to 1926 and found that beach levels were lower in winter as the beaches were drawn down and higher in summer as they recovered and aggraded. He reported that beach behaviour was strongly affected by individual storms and thereby the direction and continuity of longshore drift, itself determined by incident wave direction. Laver (1981) concluded that beach levels were actually lower in the 1920s than in the 1970s.

Posford Duvivier (2001) reported that storms from the south west result in draw down and depletion of Sidmouth Beach, whilst recovery of the beach is dependent on storms from the south east, which are reported to occur less frequently. SCOPAC (2004) reports that the same processes occur along East Beach and that under these conditions, the drop in beach level often at East Beach due to draw down has a knock-on effect of exposing the cliff toe to greater weathering.

2.6 Shoreline movement

2.6.1 Overview of the evolution of this shoreline

Formation of the current coastline between Otterton Ledge and Beer Head began when sandstones and mudstones were laid down during the Triassic Period, some 203 to 250 million years ago. Subsequent tectonic activity led to the uplift and faulting of the bedrock, creating the complex exposures evident in today's cliff line. Over the past 2.5 million years (the Quaternary Period), there has been erosion of these deposits, in response to changes in climate and sea-level, which has led to the development of the coastline and cliffs that are exposed today.

A diagrammatic geological cliff section of the coastline between Otterton Ledge and Salcombe Mouth (located just to the east of Sidmouth) is shown in **Figure 2-4**, whilst **Figure 2-5** shows the geology of the coastline between Big Picket Rock and Salcombe Hill (located just to the east of Sidmouth).

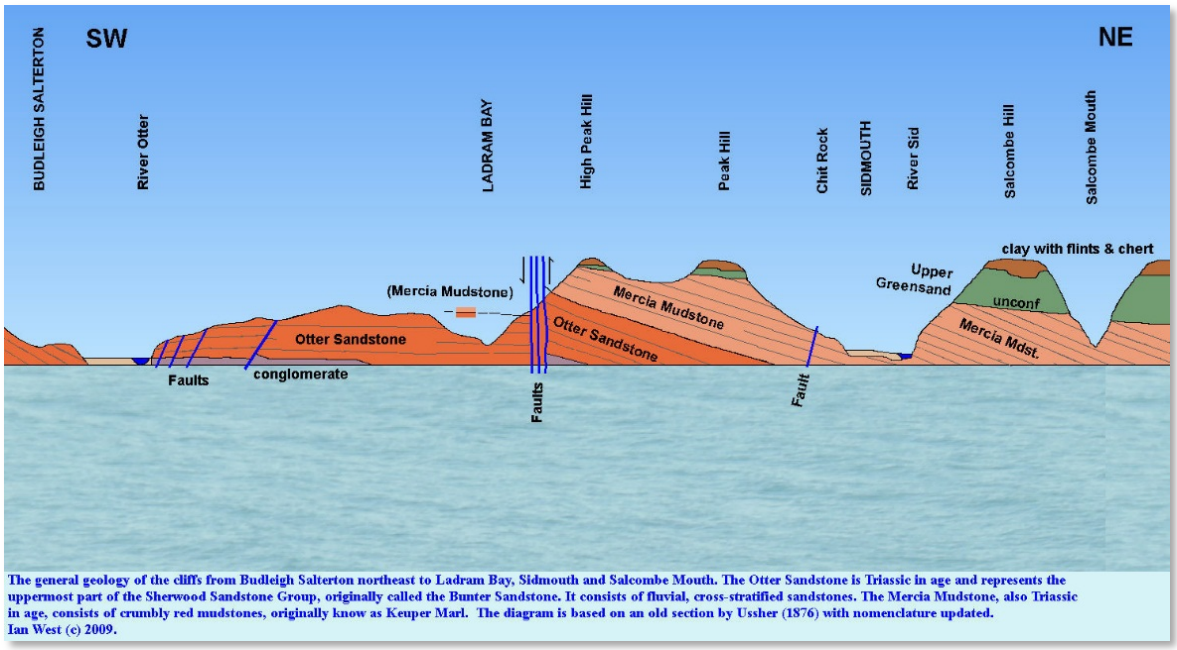


FIGURE 2-4

Diagrammatic geological cliff section of the coastline between Otterton Ledge and Salcombe Mouth (east of Sidmouth), looking inland from the sea (West, 2013). The Otter Sandstone outcrop at Chit Rocks and at the base of Pennington Point (NE of the River Sid), and faults in cliff east of River Sid have been omitted for clarity.

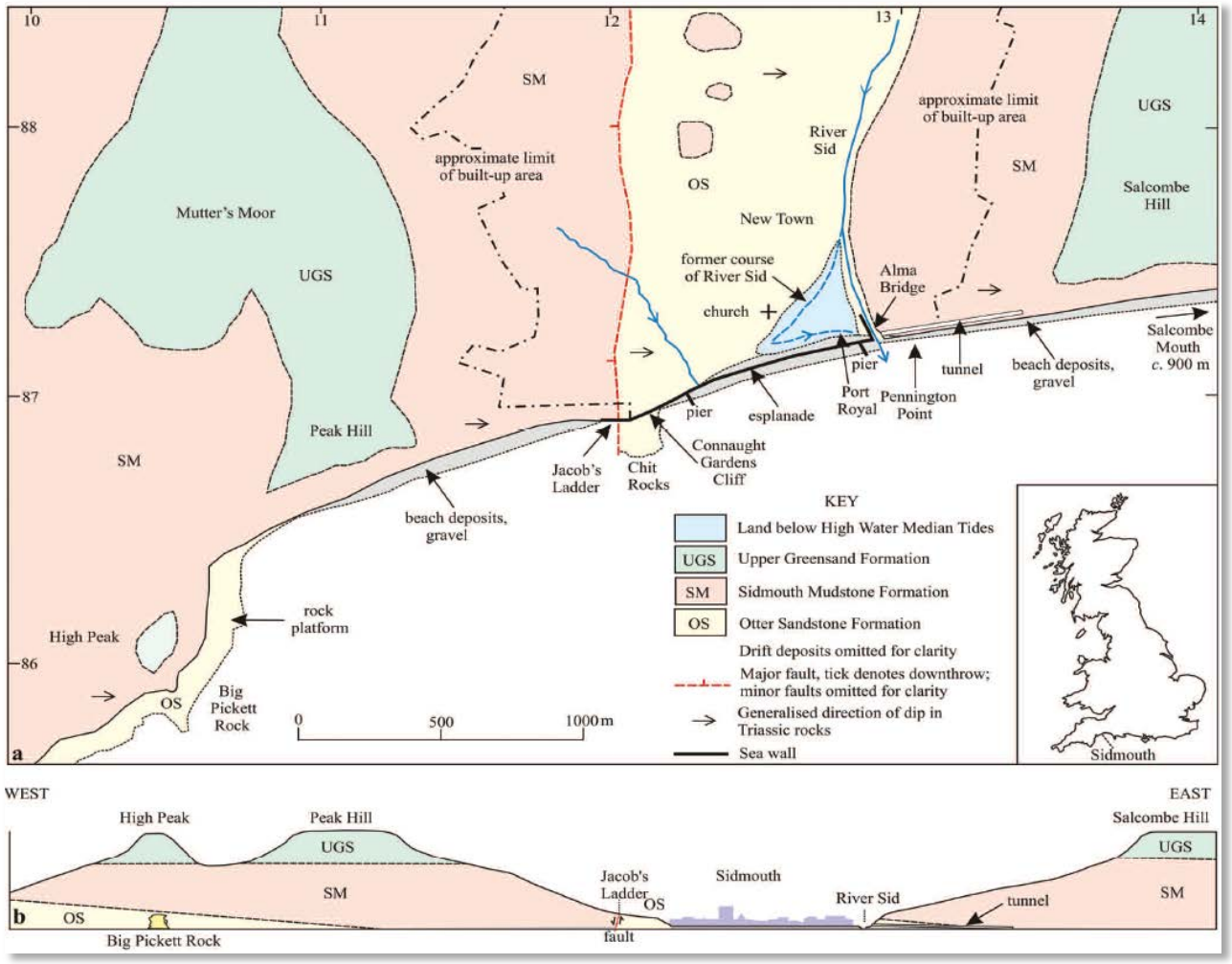


FIGURE 2-5

Above (a) Geological sketch map of Sidmouth and the adjacent area showing key locations. Geological data based on BGS 1:50,000 solid geology mapping. Below (b) Geological sketch section of the coast (Gallois, 2011).

During the most recent cold climate phase, between c.26,000 and 13,000 years ago, glaciers advanced as far south as the midlands and sea-level was up to 100m lower than present. At this time, the English Channel was a river valley draining southern England and northern continental Europe. Periglacial processes deeply weathered the cliffs to form a debris apron that extended offshore from the current coastline and the rivers deposited extensive spreads of gravel into the English Channel during high discharge summer melts. Glaciers advanced further south during earlier glaciations, reaching Bristol and London, but the south Devon coast has never been glaciated.

As temperatures warmed during the Holocene (c.10,000 years ago), the glaciers melted and sea levels rose. The period between 10,000 and 5,000 years before present was characterised by rapidly rising sea-levels from c. -25m to -5m OD at a mean rate of 5mm/year (Shennan and Horton 2002). During this time the sea re-occupied the English Channel. This resulted in the following processes:

a) Coastal erosion processes were initiated, first with the removal of the periglacial debris apron (as described below) and then erosion of the bedrock. Differential erosion of different bedrock materials has resulted in the formation of the present configuration of the shoreline, consisting of a series of headlands and embayments (for example, Otterton Edge, Big Picket Rock and Beer Head).

b) The periglacial debris apron and spreads of river gravels were reworked by rising sea levels, from what is now the sea bed, landwards and alongshore to form a long barrier gravel beach that extended from Otterton Ledge as far as Chesil Beach (Portland) (SCOPAC, 2004). Pebbles only

present in cliffs at Budleigh Salterton, are today found in beaches as far east as Chesil Beach and the Isle of Portland, demonstrating the continuity of this former beach system.

Large volumes of gravel that have been mapped offshore indicate that some beaches/barriers could not respond to rising sea-levels and were drowned, resulting in moribund deposits that are too deep to be transported by waves or currents under present day sea-level.

By c. 5,000 years ago sea-level was approaching current elevation and the rate of rise reduced to 1mm/year. The periglacial sediments had been reworked (or become overstepped by rising sea levels), and erosion of bedrock cliffs was initiated. In the last 2,000 years on-going cliff erosion has resulted in the development of headlands and bays. As the barrier continued to migrate onshore and meet with a coastline that varied in orientation and geological resistance, it became segmented and today exists at only a few locations between Otterton Ledge and Beer Head, for example Sidmouth and Branscombe (Halcrow, 2011). The supply of periglacial sediment is now exhausted and sediment is primarily supplied by erosion of cliffs and shore platforms and, as in the case of Sidmouth, beach replenishment. There is also no contemporary sediment supply from the River Sid due to human modification of the river channel upstream from the mouth which prevents sediment reaching the shoreline. Overall, this means the rate of sediment supply today is significantly lower than it was earlier in the Holocene, and this has been the situation for several centuries.

Documentary evidence from Domesday records of the 11th Century indicate that the rivers Otter, Sid and Axe were once fronted by gravel spits and the sheltered river mouths were used as harbours. However, intense storms, believed to be associated with a period of climate cooling known as the Little Ice Age (between the 14th and 19th Centuries) blocked the river mouths with gravel and forced abandonment of the harbours by the 15th Century. This period of storminess is also likely to have also caused increased cliff recession and a pulse in sediment supply, accentuating the problems at the harbour mouths.

Cliff recession and sediment supply at Sidmouth over the last 10,000 years is therefore a result of:

- A step change from the continuous barrier beach system, formed at a time of very high sediment supply, to the current pattern of headlands and bays with poor long-shore drift linkages and negligible sediment supply from cliffs that are dominated by fine-grained materials, and small rivers with limited coarse sediment bedload.
- Reduction in the amount of sediment stored within the beaches, as gravel is worn down, drawn offshore or submerged by rising sea-levels.

Human influences on the shoreline have occurred in recent centuries, with the resulting observed implications:

- Construction of the first defences along the River Sid sometime during the 18th century fundamentally altered the future of this frontage, through diverting the course of the river to permanently outflow along the toe of the Pennington Point cliffs.
- Subsequent construction of the promenade and seawall in the 1830s fixed the backshore position at Sidmouth, and may have advanced it slightly with defences reportedly being built on, rather than behind the gravel bank.
- Records indicate that the beaches have historically been very volatile, resulting in recorded damage to defences over time. The limited data available suggests that these periods have generally been associated with severe storms such as those between 1988 and 1990. Historical photographs also show periods when beach levels were high, followed by periods of very low beaches. Observations by made Laver (1981) over a 30 year period shows that beach levels were actually lower in the 1920s than in the 1970s. The anecdotal evidence also supports the view that beach levels in the 1920s were low, and that this period was marked by numerous cliff failures at Pennington Point and East Cliff.
- Despite the construction of defences between the 1880s and the 1990s, the beaches at Sidmouth suffered periodic depletion. From the late 1980s, beach levels and volumes steadily fell (SCOPAC, 2004) and following some of the most severe storm events in 1989/1990 (Posford

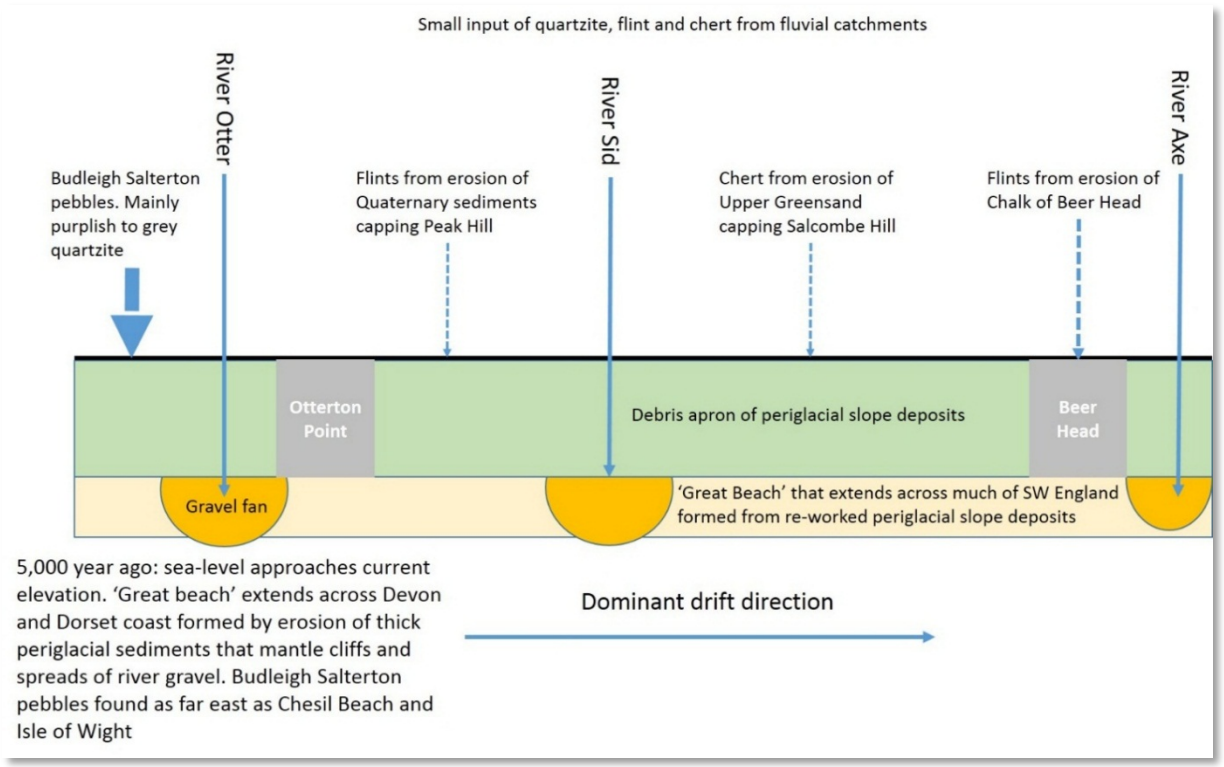
Duvivier, 2001) the beach suffered from severe beach drawdown and loss of sediment to offshore sinks (SCOPAC, 2004). This led to the construction of the Sidmouth Coastal Defence Scheme in the mid-1990s to 2000, which was designed to reduce levels of wave energy reaching the beach face and to minimise reflective wave scour from the seawall fronting the low-lying area of Sidmouth (SCOPAC, 2004).

- Since construction of the defence scheme at Sidmouth and nourishment of the beach, the beach monitoring data shows that sediment appears to be redistributed within the frontage, with shingle from groyned sections tending to be moved and retained behind the rock breakwaters. The first Five Year Monitoring Programme (2000 to 2005) found there to be gains in the order of 4,000 to 5,000m^3 in the lee of the detached rock breakwaters and losses in the region of 5,000 to 6,000m^3 between the three rock groynes; suggesting, when considered as a whole frontage, there had been no net loss or gain, with a net east to west movement of material. A similar pattern of net shingle redistribution had been indicated by the more recent data (between 2002 and 2012, prior to the 2014 storm (PCO, 2013).
- More recent data, covering the period 2007 to present also shows that there has been a tendency for material to accrete in the lee of the breakwaters, but that the rate of this accretion over the period 2007 to 2012 was much less than previously. The profile data also indicates that shingle within the groyne bays tends to be moved back and forth between the groynes, although the net movement over the period considered was easterly, based on the net losses from the Bedford Steps groyne to York Steps groyne bay.
- Up to the 2014 storms, data suggested that once sediment ended up in the lee of the breakwaters it became trapped and was not returned eastwards under usual south-westerly conditions. However, the 2014 storms resulted in the erosion and redistribution of some of the material held behind the breakwaters. Future monitoring data will reveal the subsequent recovery of the beaches, but it is suspected that material will start to build behind the breakwaters over the next few years.
- A crude estimate of beach volumes, based on interpolating cross-sectional areas derived from the beach profile data, indicates that there appears to have been a net loss of sediment from the Sidmouth frontage, compared to the design profiles. Using data from July 2014, PCO have calculated that there has been a possible loss of around 63,000m^3. In comparison, a similar calculation undertaken using the 2007-2012 datasets suggested a loss of around 39,000m^3, using the design beach volume calculated by PCO. However, when compared to the beach data for 2007, the net change from 2007 to 2012 was negligible, and change in volumes between the two dates tended to be less than 10% of the volume along the frontage. However, these values should be used with caution for a number of reasons:
    - the available data does not allow any assessment of whether the changes relate to sand or shingle;
    - the method of determining volumes is fairly crude due to the availability of data and the distribution of profile locations; these means that the volume analysis poorly replicates the movement of material from one end of the bay to the other. To gain a more accurate understanding of future beach volumes and changes, either a Grid-based GPS survey or LiDAR data would provide better coverage of the beach; and
    - uncertainty regarding the placed beach volumes compared to the design beach volumes – records indicate that the quantity of beach material imported onto the Phase 2 scheme frontage during the course of the works was, in the event, less than the design requirement as determined by the physical model. The deficit was largely contained within the York Groyne to Bedford steps frontage - which is also the area which has tended to experience net losses over time.
- Historically the Sidmouth frontage and adjoining frontages have been susceptible to storms, with shingle becoming stripped from the beaches, leading to exposure and damage to defence

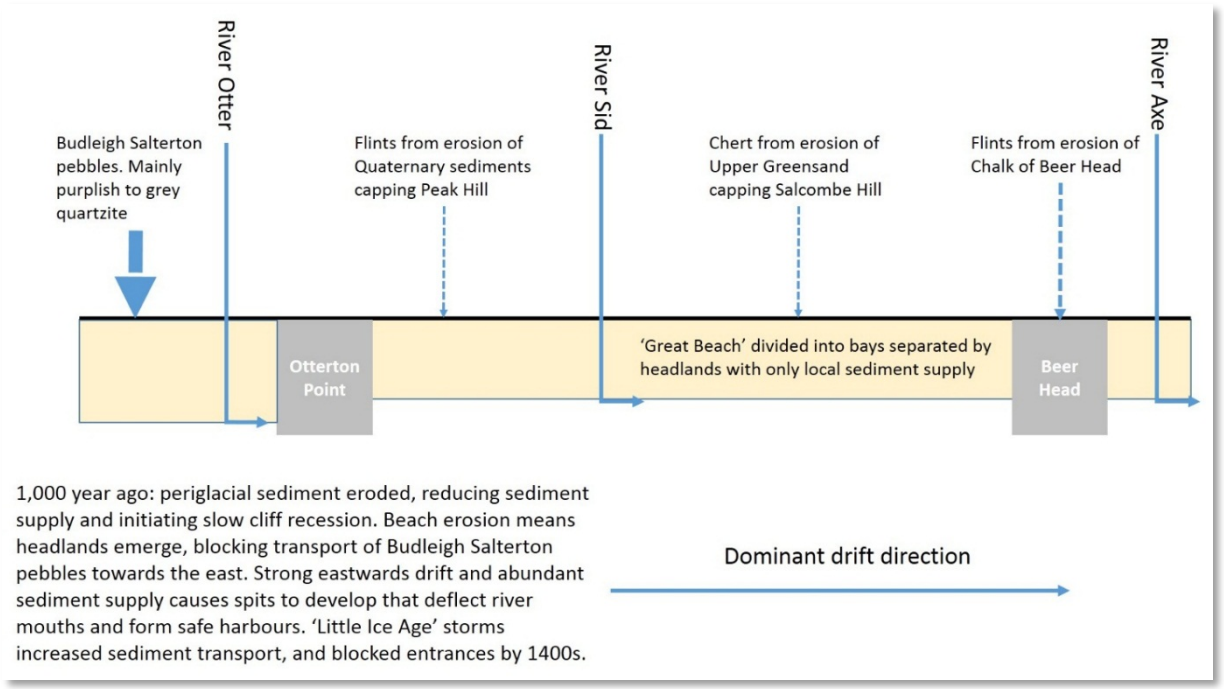
structures. Storm analysis of beach behaviour indicates that the beaches remain vulnerable to storms, with material becoming redistributed within the groyne bays, depending upon the prevailing wave directions during this storm. This tends to result in material becoming stripped from one end of the bay and being moved alongshore. Analysis of post-storm profiles show that the beaches within the BMP extent do recover after storms and have even at some locations reached their highest recorded levels.

- Particularly severe storms were experienced in February 2014; the largest since the scheme was constructed. Data collected by PCO shows that during this storms there was significant redistribution of sediment across the frontage, with erosion of the beach behind the breakwaters; an area which previous monitoring indicated as a net store of sediment. The data also suggests that sediment bypassing of the groynes may have occurred, indicated by beach accretion along the length of the groynes (although it is not possible to define whether this is sand or shingle). Through this mechanism material may be able to pass between groyne bays.
- To the east of Sidmouth, cliff recession events in the form of blocky rock falls and muddy collapses from the upper cliff have occurred throughout the historical period. The anecdotal evidence suggests failures have been particularly common at Pennington Point, which is probably due its exposed position and the weaker materials exposed here. Pennington Point forms a cross section through the eastern valley side slope of the River Sid and consequently the materials exposed comprise a greater thickness of colluvium and a greater depth of weathering to than seen elsewhere along the coast.
- Based on anecdotal evidence and analysis of aerial photography, it is evident that cliff recession along East Beach over the last c.100 years is driven by two independent factors: (1) low beach levels, which allow toe erosion and undercutting of the lower cliff, and (2) higher than average rainfall, which weakens slope materials and promotes collapse of the upper cliff irrespective the beach condition. The cliffs have a history of episodic landsliding, but there is very limited data documenting the frequency or location of such events, particularly in the historical record. Many of the failures experienced in recent years have involved collapse of the cliff top, to form deep embayments in the gardens of properties along Cliff Road.
- Beach levels along this East Beach frontage have tended to fluctuate both historically and since the scheme has been introduced. Beach profile data for the frontage shows that in general this level fluctuates by up to a metre – but, unlike elsewhere, changes do not appear to be seasonal. During the February 2014 storms, the data indicates that the beach was particularly affected with erosion of the cliffs and drawdown of material to form a shingle-sand bank around the MLWS mark, along the training wall of the River Sid. Development of a storm ridge along beach to the east, suggests that some of the sediment removed from Pennington Point/East Cliff may also have been transported further east.
- Meteorological data shows that high rainfall years have become more common in recent years. The top 5 wettest years since 1873 have occurred in the last 20 years. High rainfall is a known contributor to cliff instability, particularly in weak materials such as the weathered Mercia Mudstone, Clay-with-Flints and colluvium that forms the upper part of the cliffs along much of the Sidmouth frontage. Large cliff falls at Pennington Point and East Cliff occurred in the mid-1920s and mid-1990s, which were exceptionally wet periods for the region.
- Along the beaches to the west of the Sidmouth frontage, cliff recession does not appear to relate to beach volumes, but instead the rapid change between 1890 and 1938 is associated with exceptionally wet years in 1882, 1903 and 1926, and the change indicated from 2006 onwards is associated with exceptionally wet years in 2002, 2012 and 2014.

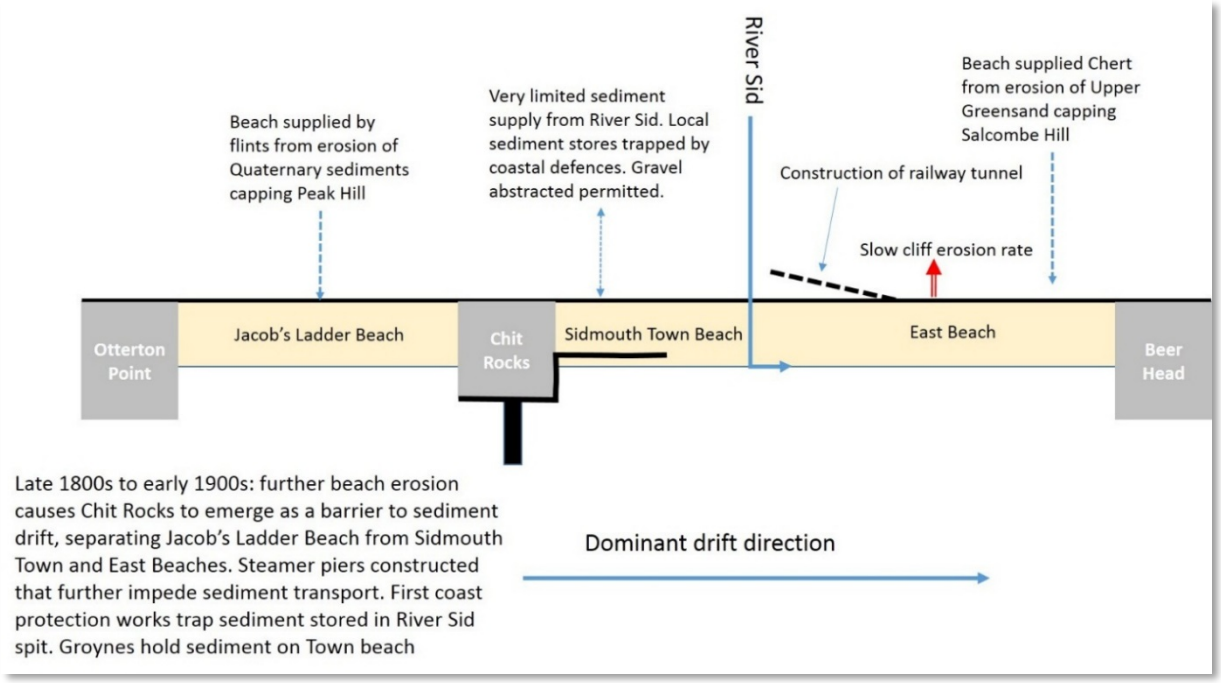
A conceptual evolutionary model for the coastline between Otter Ledge and Beer Head is presented in **Figure 2-6**. Further details are provided in **Appendix B**.



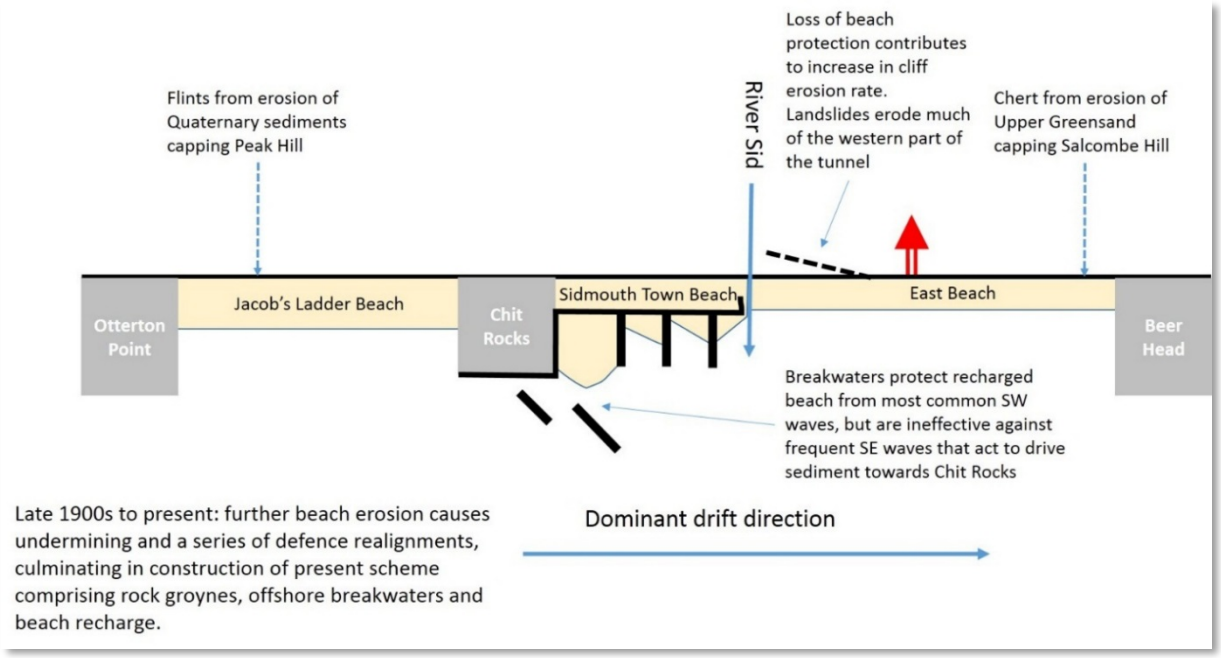
Sea-level rising to near current elevation around 5,000 years ago.



Establishment of headlands and bays around 1,000 years ago.



Initiation of first defences in response to declining sediment budget, around 100 years ago.



Additional defences in response to recent storms and on-going declining sediment budget.

FIGURE 2-6
Conceptual evolutionary model for the coastline between Otter Ledge and Beer Head.

2.6.2 Beach profile analysis

Changes in beach profile been assessed in detail in Section 5.5.1 and Section 5.5.2 of **Appendix B**. This analysis has been based upon a range of beach profile survey data captured since the current coastal defences at Sidmouth were constructed, including most recently survey data captured since 2007 as part of the South West Regional Coastal Monitoring Programme (SWRCMP).

Changes observed since 2007 are best summarised in the overview plot produced by Plymouth Coastal Observatory (PCO) for the SWRCMP (see **Figure 2-7**); this shows changes in cross-sectional area along a number of beach profiles along the Sidmouth BMP frontage between Spring 2007 and Spring 2013.

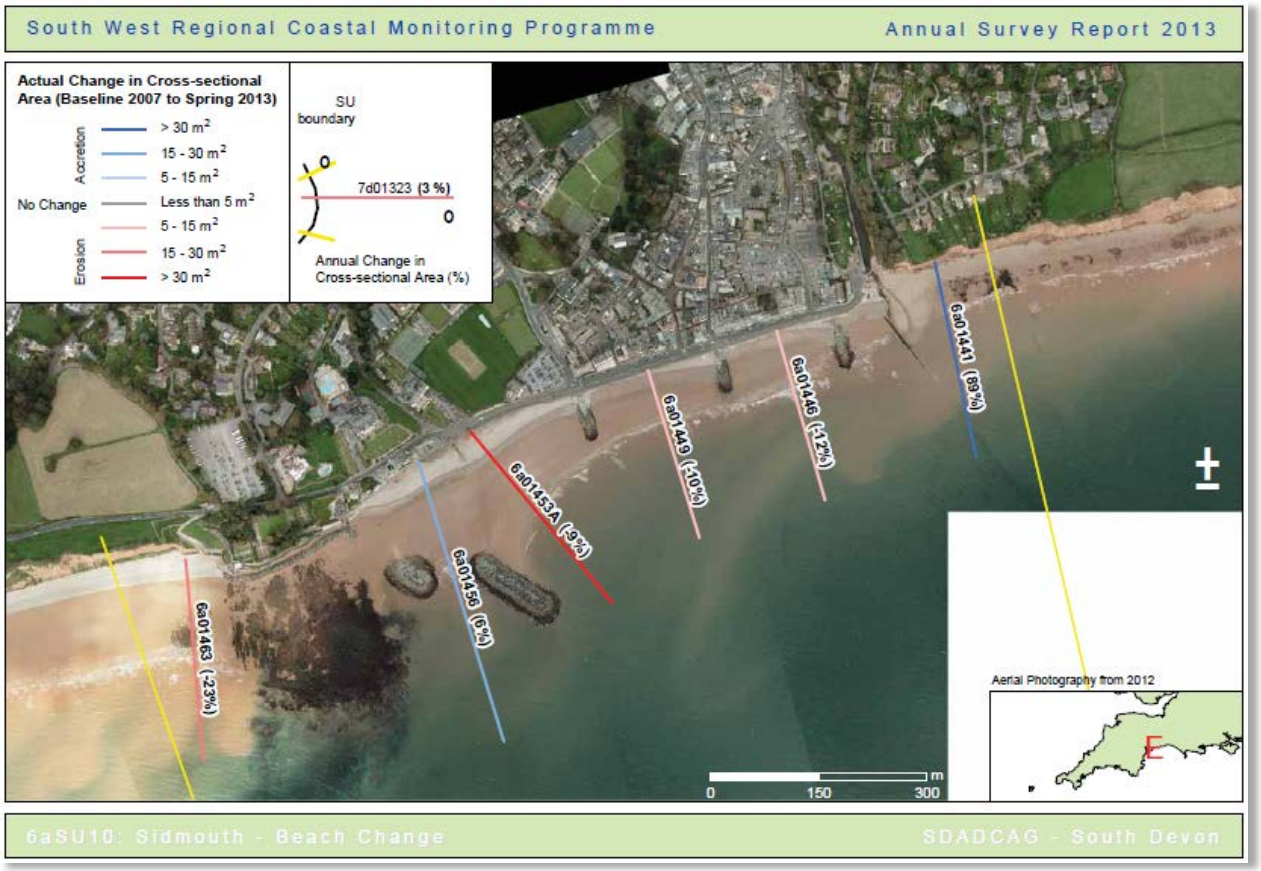


FIGURE 2-7
Change in cross-sectional area for the Sidmouth BMP frontage (from PCO, 2013).

Analysis of beach volume changes is particularly key for guiding future management of the BMP frontage. This is described in detail in Section 5.5.2.4 of **Appendix B**, but in summary, the volume change analysis shows that between 2007 and 2012, beaches at the western and eastern ends of the Sidmouth frontage gained sediment, whilst those in the centre lost sediment. During this period, the gains were of a similar magnitude to the losses, when the whole frontage is considered. This concurs with data for the period 2000 to 2005. The sediment accumulation behind the breakwater was larger in the period 2000 to 2005, than between 2007 and 2012, and the losses also much greater. In comparison, losses and gains of sediment during the first three years of the scheme (1995 to 1998), i.e. prior to construction of the Bedford Steps Groyne, were also much larger, but with a net gain of around 18,000m^3. From this it may be inferred that the beaches may becoming more stable. However, it is important to note that this latest analysis of volumes only includes data up to 2012 and there are significant limitations associated with the data available, namely:

- The available data does not allow any assessment of whether the changes relate to sand or shingle; and
- The method of determining volumes is fairly crude due to the availability of data and the distribution of profile locations; this means that the volume analysis poorly replicates the movement of material from one end of the bay to the other. Methods to address this as part of future ongoing monitoring are set out in **Section 4.2.1**.

It should also be noted that the analysis described above was based on available data at the time. The storm analysis results discussed in **Section 2.6.3** shows that the situation in 2012 was significantly

changed as a result of the 2014 storms, although data was not available for analysis at the time it was completed for this BMP.

2.6.3 Beach profile storm response

Historical and anecdotal information indicates that this coastline is susceptible to storms, with beach drawdown in the past resulting in significant (albeit sometimes temporary) beach loss.

Since 2007, in addition to undertaking routine beach profile surveys, PCO has also undertake post-storm surveys as part of the SWRCMP (refer to **Section 4.2.2**). As part of the SWRCMP, the response of the beach to storms has been regularly assessed and post-storm profile data is available for 2008, 2009, 2010, 2012 and 2014. The data indicates that during storms there is significant redistribution across the frontage, with some profiles exhibiting build-up whilst others exhibit significant sediment loss. This process is very sensitive to the direction of the prevailing storm waves.

Further detail and analysis of storm impacts on the BMP frontage are provided in Section 5.5.3 of **Appendix B**. Some of the key observations from this analysis are:

- Even with the current coastal defence scheme in place, the Sidmouth frontage remains sensitive to storms with beach levels changing significantly in response. It is, however, difficult to determine from the data available whether material from the beaches is significantly drawn down, or whether it is simply redistributed within the bays.
- In some situations material is pushed up the beach during storms creating a steeper beach and upper beach storm ridge or berm in the lee of breakwaters. Elsewhere, the beach has become drawn down from the upper beach, exposing the toe of the seawall.
- East Beach is also very dynamic and susceptible to beach drawdown; evidence collected by PCO indicates that the beach can become stripped of shingle during storms, as occurred in 2009. At Pennington Point, the post-storm survey for 11th July 2012 showed particular movement of the beach between MLWN and MLWS, with the formation of a berm, likely to be supplied by the cross-shore movement of material in that area. Changes here also affect the flow of the river, as shown in photographs. This change demonstrates the dynamic nature of the beach here.
- The available data suggests that the beach at East Beach is particularly sensitive to storms from the south/south-west, with low beach profiles recorded in November 2009 and July 2012.
- Subsequent beach profile data indicates that beach recovery does occur following storms, with material redistributed across the beach; at some locations an area of beach which was eroded during one storm is observed to accrete in a following storm.

2.6.4 Predictions of future shoreline change

Assuming current coastal management continues, future coastal recession will continue, as a result of a combination of toe erosion, which occurs during most high tides with the currently depleted beach, and rainfall-driven failures of the upper cliff. The rate of annual erosion, and the magnitude and frequency of landsliding are likely to be increased by the forecast impacts of climate change, which include an acceleration in the rate of sea-level rise and increased levels of winter rainfall.

A 100 year projection is presented **Figure 2-8** and **Figure 2-9** for East Cliff and Peak Hill respectively. No attempt has been made to determine annual cliff losses or erosion rates. The actual erosion experienced in a given year is determined by the level of the beach, which is itself determined by the direction of waves that determines net drift direction; the timing, intensity and frequency of storms; and the amount of rainfall, none of which can be confidently predicted. Due to the current low beach levels, it is likely that the high rates of erosion seen in recent years will continue for several years, but that erosion will reduce in the near future once sediment has drifted back towards the west and a beach has accumulated.

The timing of a future reduction in cliff recession rate is uncertain, but several feedback mechanisms dictate that a continuation of a high rate of cliff recession for 100 years is not credible. Consistent accelerated erosion along a short section of coast would lead to formation of a set-back section of the

cliff line where the cliff would become progressively further away from breaking waves causing erosion to reduce. Furthermore, a set-back section of coast would allow a pocket beach to accumulate, which would absorb wave energy and reduce erosion. Further details are provided in Section 7.2 of **Appendix B**.

It should also be noted that as East Cliff recedes over the next 100 years (as indicated in **Figure 2-8**), the Alma Bridge will become unsustainable in its current position in the near future, whilst the western wall of the River Sid, that provides fluvial flood defence at the present time, will become increasingly exposed to full coastal conditions (particularly during south-easterly storm events) in the medium to longer term. Such exposure, which will start to occur if East Cliff receded by about a further 10-15m from its 2015 position, will increase the likelihood of defence failure and thus incurrence of flood damages over time; this would also impact critical infrastructure located behind the western wall of the River Sid that serves the wider area, notably the Sewage Pumping Station operated by South West Water located immediately upstream of western Alma Bridge abutment. This serves to demonstrate that whilst measures along the Sidmouth Town frontage to reduce flood risk from wave overtopping are appropriate (i.e. reduce economic damages from flooding), this benefit would be for nought if the risk posed by outflanking from the east is not also addressed at the same time.

FIGURE 2-8
Cliff recession projection for 100 years at East Cliff. Note the projection is made from the 2015 cliff top, but are overlain on the 2012 image.

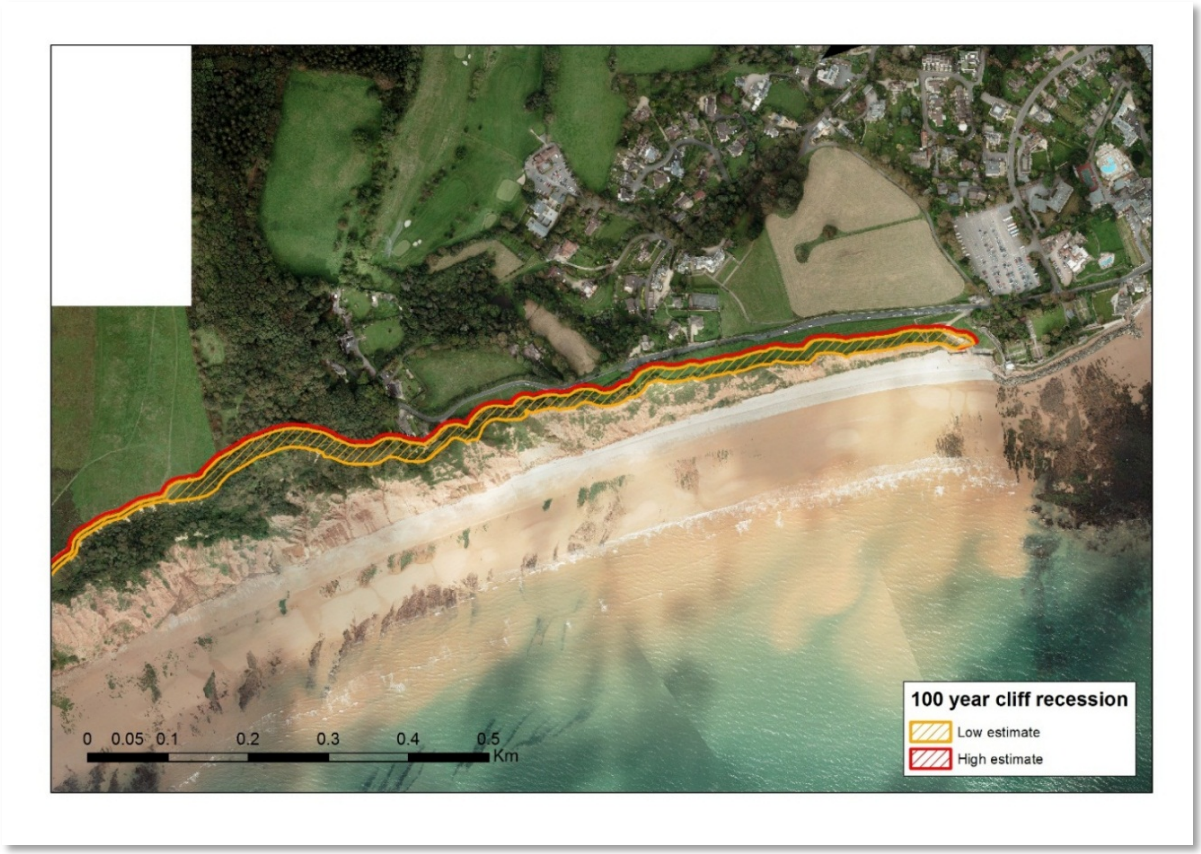


FIGURE 2-9
Cliff recession projection for 100 years at Peak Hill mapped. Note the projection is made from the 2012 cliff top and overlain on the 2012 image.

2.7 Environmental characteristics

This section provides an overview of the environmental setting and identifies key environmental features within the BMP area (refer to **Figure 1-1**) used to inform environmental assessment of options for future beach management activities for Sidmouth as described in the Options Appraisal Report provided in **Appendix C** (refer also to **Section 1.1**).

The section is structured around a number of environmental topics as highlighted in the first column of **Table 2-6**. These follow the recommended structure contained in the Beach Management Manual (CIRIA, 2010). The second column in **Table 2-6** makes reference to the environmental aspects documented in Annex 4 of the European Union Directive 2011/92/EU '*on the assessment of the effect of certain public and private project on the environment*' (the EIA Directive).

This is provided by way of cross-reference to the EIA requirements such that the information in this report is able to be developed further should the need arise at a future date, e.g. if the preferred option is determined to present a significant scale or impact as to need a statutory Environmental Statement (ES) to accompany the consent applications. As well as helping to identify the important environmental issues locally, this will provide a robust level of documentation to support the project at this stage and subsequent stages.

TABLE 2-6
A summary of the environmental topic and cross-reference to EIA Directive topics

Environmental topics (with reference to the Beach Management Manual 2nd edition)	Sub-topics	BMP section reference	Reference to the environmental aspects outlined in Annex 4 of the EIA Directive
Geology and Geomorphology	Geology	2.7.1.1	Soil
	Designated Geological Sites	2.7.1.2	
	Geomorphology	2.7.1.3	
Sediment quality		2.7.2	Soil
Water quality		2.7.3	Water
Ecology	Designated Nature Conservation Sites	2.7.4.1	Flora and Fauna
	Biodiversity Action Plan Habitats and Species	2.7.4.2	
	Fish Ecology	2.7.4.3	
Fisheries	Commercial fisheries	2.7.5.1	Material Assets including the architectural and archaeological heritage
	Recreational fisheries	2.7.5.2	
Navigation		2.7.6	Material Assets including the architectural and archaeological heritage
Landscape setting	Designations	2.7.7.1	Landscape
	Landscape character	2.7.7.2	
Archaeology and Cultural Heritage		2.7.8	Material Assets
Air quality		2.7.9	Air
Noise		2.7.10	Population
Amenity value		1.3.5	Population

2.7.1 Geology and geomorphology

2.7.1.1 Geology

Royal Haskoning (2002) describes the geology of the Study Area as; '*The cliffs on this stretch of coast are the most westerly exposed Cretaceous strata in southern England. The whole succession shows signs of having been deposited in near-shore or shallow marine conditions'.* This description is developed further in **Section 2.7.1.3** of this report.

2.7.1.2 Designated Geological Sites

The geological importance of the region is recognised by the following designations: SSSI and the UNESCO Dorset and East Devon World Heritage Site.

Parts of the Study Area lay within the Sidmouth to Beer Coast SSSI (refer to **Figure 2-10**) which has been designated for both its geological and biological interest. It contains important geological and stratigraphic features and is famous for its fossil deposits. As described by the SSSI citation, *"…These cliff*

sections provide the finest exposures of the Foxmould Sands and Chert Beds (Upper Greensand) in South-West England…The quality of exposure allows particularly good opportunities to study the sedimentology of Upper Greensand Chert and hardground formation. The site is also of importance as it contains some of the most westerly major Upper Cretaceous exposures in England, which are of great stratigraphic importance." It should be noted that not all of the features of interest described in the SSSI citation lie within the BMP study area (see **Appendix F**).

The Study Area contains 2 GCR sites; Ladram Bay to Sidmouth (GCR 3215) and Sidmouth (GCR 814). The description of these sites underpins the SSSI and the World Heritage site designations. The geology of this section of coast is outlined in the Ladram Bay to Sidmouth GCR's introduction – *"The coastal cliffs around Ladram Bay and toward Sidmouth preserve an excellent section through the upperpart of the mid Triassic Otter Sandstone Formation. The formation comprises approximately 210m of cross-bedded sandstone associated with gravels, conglomerates and mudstones. These are overlain by red marls of the Mercia Mudstone Group."*

Chit rocks to the west of the Study Area forms part of GCR 814, yielding fossilised remains of internationally rare Middle Triassic fossil fish, amphibians and reptiles. The same GCR includes the cliffs and foreshore of Pennington Point, which also yields these rare fossils.

The cliffs on both side of the town lie within the UNESCO Dorset and East Devon World Heritage Site ('Jurassic Coast') designated by for their geological importance. The cliffs between Exmouth in East Devon and Studland Bay in Dorset contain a nearly complete sequence through the entire Mesozoic period of geological time displaying evidence of 185 million years of evolution from the Triassic, Jurassic and Cretaceous periods. The Jurassic Coast's management plan policies seek to avoid or mitigate any negative impacts of coastal defence works on the natural processes of erosion and exposed geology (see **Section 1.7.3**).

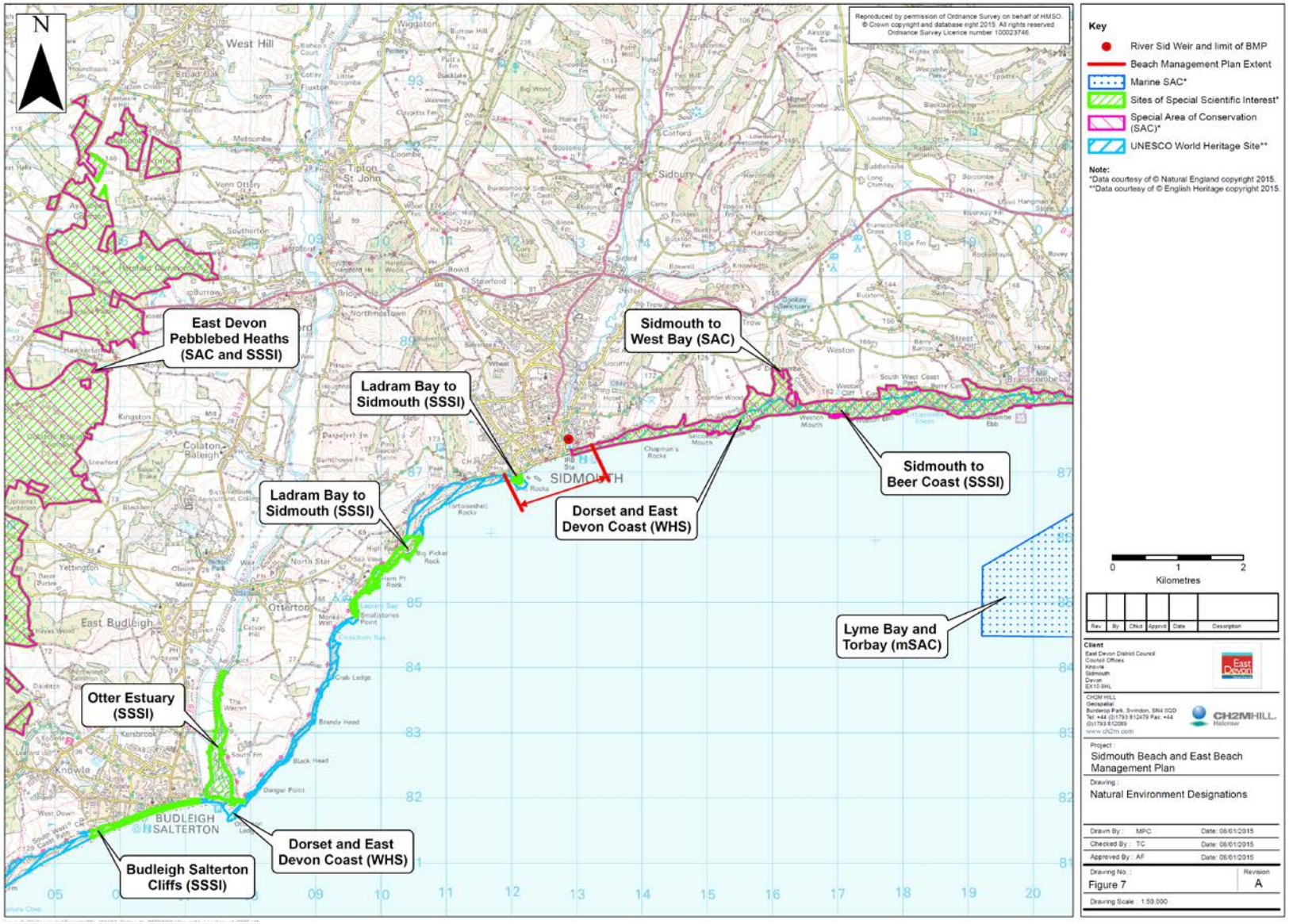


FIGURE 2-10

Natural environmental designations.

2.7.1.3 Geomorphology

The Study Area comprises a section of very dynamic section of coast. Sediments are reported to input into this section of coast from contemporary terrestrial sources as described by SCOPAC (2004):

> *'The River Sid discharges to the east of Sidmouth, where its mouth is constrained by a training wall. It is non-tidal and regulated and channelised in its lower course through the town. It has a compact catchment with steeply sloping valley sides and tributary streams. It is estimated to deliver an annual load of approximately 400m^3 of fine sediment and 100m^3 of coarse material with much of this is likely to occur during high discharge events. It is considered that this material (sand and gravel) is mobilised [under easterly storm conditions] from a nearshore store [at east beach] that accumulates south and east of the mouth of the Sid.'*

It is likely that the supply of sediment from the River Sid is constrained by upstream engineering projects.

There are also sediment inputs from the western end of the frontage. However, these are limited by Chit Rocks and the promontory of Connaught Gardens. This headland prevents the movement of shingle from west to east although finer grained sediment will past this boundary. There is little evidence to support offshore to onshore sediment transport from the supporting reference although a number of authors have speculated on this mechanism including HR Wallingford (1992).

The beach at Sidmouth was replenished as part of the scheme to construct the offshore breakwaters. SCOPAC reported 185,000 tonnes of gravel were placed behind the breakwater, comprising of flint gravels sourced from a local quarry.

Sediment transport along the frontage is predominantly from the west to the east. This is influenced by south-westerly waves. There are also a less frequent, lower duration, reversal of this transport through the large waves from the south-east during easterly storm conditions. Further details of this transport and the geology and geomorphology are presented in the coastal processes baseline prepared alongside this report as part of developing the BMP.

2.7.2 Sediment quality

As noted in CIRIA (2010), sediment quality data is not readily available for beach locations, unless the dredge material was sourced from a capital or maintenance dredges. Andrews (1996, cited in SCOPAC, 2004) describes the material used to replenish the beach at Sidmouth as being: *"comprised of mostly flint gravels sourced from a local inland quarry which produces material similar in size to the indigenous beach sediment.'* However, the chemical composition of this material does not appear to have been recorded.

2.7.3 Water quality

The Environment Agency displays the results of their water quality monitoring activities on online at https://environment.data.gov.uk/bwq/profiles/) and describes the catchment surrounding Sidmouth:

> *"The catchment surrounding Sidmouth is approximately 4200 hectares. The River Sid rises on the edge of Pen Hill Woods above Ottery St Mary and flows south through Sidbury to the sea at Sidmouth 330m east of the Environment Agency monitoring point. The steep catchment means rain runs off rapidly into the River Sid and onto the beach. The Bickwell Brook is approximately 2.3 kilometres long and flows through the western part of Sidmouth to the sea 280m west of the Environment Agency monitoring point. The catchment close to the beach is urban, and in the wider catchment it is mostly agriculture and forestry."*

Figure 2-11 shows the location of the Environment Agency's monitoring points in relation to the BMP area. The Sidmouth Town water sampling point has been monitored since 1988 in line with the Bathing Water Directive, (1976) and also with the Water Framework Directive, (2003) after 2006. In 2014 the results of the water sampling at "Sidmouth Town" and "Sidmouth Jacobs Ladder" recorded a measure of 'meets higher standards' (see **Table 2-7**). This means that the bathing water meets the 2006 Bathing Water Directive standards (NB: the standards for bathing water were tightened in 2015 but no data is yet published using these).

TABLE 2-7

Environment Agency Bathing Water Sampling Compliance with 2006 Bathing Water Quality guidelines

Location	Annual Compliance Results				
	2010	2011	2012	2013	2014
Sidmouth Town	Minimum	Higher	Minimum	Minimum	Higher
Sidmouth Jacobs Ladder	Higher	Higher	Minimum	Higher	Higher

FIGURE 2-11
Bathing water quality monitoring points within the vicinity of Sidmouth BMP frontage

2.7.4 Ecology

2.7.4.1 Designated nature conservation sites

The following nature conservation designations and their qualifying interest features are all within or lie in close proximity to the BMP area and will require consideration during the detailed development of the preferred option (refer to **Section 1.1**). This section should be read with reference to **Figure 2-10** above and **Appendices E and F**):

- **Sidmouth to West Bay SAC**
  - The following Annex 1 habitats (listed under Annex 1 of the EC Habitats Directive) are the primary reasons for the designation; Vegetated sea cliff of Atlantic and Baltic coasts and Tilio-Acerion forests of slopes, screes and ravines (described as a priority feature). Annual vegetation of drift lines are described in the SAC designation as being present but are not the primary reason for the designation. The presence of these habitats within the BMP Study Area (and within this section of the SAC) were identified in the 2002 Ecological Survey and Assessment of Salcombe Hill Cliffs, Sidmouth (SouthWest Ecological Surveys, 2002).This survey was commissioned to support a planning application for a coastal defence structure at Pennington Point. The survey report notes that the vegetation in this section of the SAC is very varied and includes important pioneer communities on recent slips next to more mature vegetation. Vegetated sea cliffs were noted throughout the survey area (from the mouth of the River Sid 1700m east, surveying the cliff top and cliff face), Tilio-Acerion forest and to a lesser extent annual vegetation of drift lines were noted at the eastern section of the survey area. The report also comments that the cliffs are likely to hold significant invertebrate interest.
  - In relation to the vegetated sea cliffs, the survey report noted that '*the plant assemblages on the lower cliffs within the Study Area [as define in this report] do not coincide either with the cliff communities or shingle communities. This suggests that these may be unique to the area or they may in fact be so infrequent that they do not qualify as distinct communities*.' … '*The plants found on the lower cliff faces are obviously sourced from the seeds of the strandline species blowing up from the cliffs and seeds from plants on the cliff top of upper cliff falling down' … 'Condition on much of the cliff faces are extreme and maintained at an early successional stage by the constant erosion'* … '*This assemblage is likely to be unique and is dependent on the continuing erosion and prevalent maritime exposure. The constant erosion keeps large areas in a state of permanent early succession. It is therefore considered to be of very high conservation value and of national importance.'*
  - To date, this survey report is the principal reference to describe the habitats at Pennington Point and eastward towards Salcombe Hill Cliff. The survey report acknowledges a number of limitation included survey timing (later September) and access to the cliffs. Although the timing of the survey could be improved to coincide with the flowering season it is unlikely on the grounds of Health and Safety that a closer inspection of the cliff face could be made. Whilst additional survey effort would improve the underlining dataset and make it more contemporary, it is very unlikely to supersede the key findings of the report.
  - Tilio-Acerion forests of slopes, screes and ravines[1] - This habitat is listed under Annex 1 of the EC Habitats Directive. A mosaic of Tilio-Acerion, sycamore *Acer pseudoplatanus* woodland, mixed scrub, grassland and pioneer communities is present. This mosaic of habitats is rich in invertebrates, especially bees and wasps, such as *Ectemnius ruficornis, Andrena simillima* and *Nomada fulvicornis*. The woodland has a hazel *Corylus avellana* understorey and a ground-flora dominated by ivy *Hedera helix* (with numerous ivy broomrape *Orobanche ederae*) and hart's-tongue *Phyllitis scolopendrium*, with abundant dog's mercury *Mercurialis perennis* and tutsan *Hypericum androsaemum*. The Red Data Book lichen *Parmelia quercina* occurs on ash *Fraxinus excelsior* trees.

[1] This habitat is labelled as a priority feature in the Sidmouth to West Bay SAC designation sheet.

- Annual vegetation of drift lines - This feature is an Annex 1 habitat, although it is not given in the designation as the primary reason for site selection. Typically where this habitat is found it is likely that the following species would be present: Sea beet *Beta vulgaris ssp*. Maritime and orche *Atriplx ssp,* Sea-kale *Crambe maritime* and sea pea *Lathyrus japonicus* in the stony banks.

- **Lyme Bay and Torbay SAC**
  - Reefs

    The Lyme Bay Reefs area is indicative of offshore breakwaters, where sea squirts (such as *Ascidiella aspersa* and *Phallusia mammillata*), sponges (such as *Cliona celata*), anemones (such as *Aiptasia mutablilis* and *Urticina felina*), corals (such as *Alcyonium digitatum, Caryophillia smithii* and *Leptopsammia pruvoti*), sea fans (such as *Eunicella verrucosa*) and bryozoans (such as *Pentapora fascialis*) dominate and sustain a wide diversity of other species. The location of these reefs has been charted by NE. The reefs recorded within the Study Area are outside the boundary of the SAC but are likely to representative of the biodiversity recorded within the geographic boundary of the SAC.
  - Submerged or partially submerged sea caves

    These features are characterised by communities of mussels *Mytilus edulis*, barnacles *Balanus crenatus*, cushion sponges, encrusting bryozoans and colonial ascidians. There are no sea caves recorded in the Lyme component of the SAC (NE, SAC Selection Assessment).

- **Sidmouth to Beer Coast SSSI**

  Many of the habitats (as noted below) and species that have given rise to the designation of this site are terrestrial in nature and are unlikely to be found within the defined study area.
  - Species rich chalk grassland
  - Broadleaved woodland
  - Invertebrate fauna

2.7.4.2 Biodiversity Action Plan (BAP) habitats and species

The following are listed as UK priority BAP habitats and are either represented in the Study Area or are within 1km. Only habitats that are considered relevant to the Study Area, i.e. they are likely to be impacted upon or are likely to have an influence on the proposed scheme, have been described (refer also to **Figure 2-12**). The associated targets are quoted under them:

- **Maritime cliffs and slopes**
  1. Maintain the existing free-functioning maritime cliff and slope resource;
  2. No overall net loss of cliff and slope functionality as a result of coast protection or engineering works;
  3. Increase the extent of maritime cliff and slopes unaffected by coastal engineering/coast protection;
  4. Increase the area of cliff-top semi-natural habitats; and
  5. Achieve favourable or recovering condition.

- **Coastal Vegetated Shingle**
  1. Ensure no loss in the extent or quality of coastal vegetated shingle;
  2. Restore quality of damaged or degraded shingle habitats where natural regeneration is unlikely; and

     Establish demonstration site.

- ***Sabellaria alveolata* reefs**

1. Maintain the extent and quality of the existing resource;
2. Survey to determine the full extent of the habitat;
3. Ensure water quality is sufficient to maintain habitat;
4. Re-establish/ restore *Sabellaria alveolata* reefs where they were formerly present;
5. Continue to survey and monitor to improve our knowledge of the habitat; and
6. Raise awareness of the wildlife value of the habitat.

- **Sub-littoral sands and gravels**
  1. Maintain the extent and quality of marine priority habitats;
  2. Assess feasibility of restoration of damaged habitats;
  3. Improve understanding by promoting research and survey; and
  4. Promote awareness amongst public, especially divers.

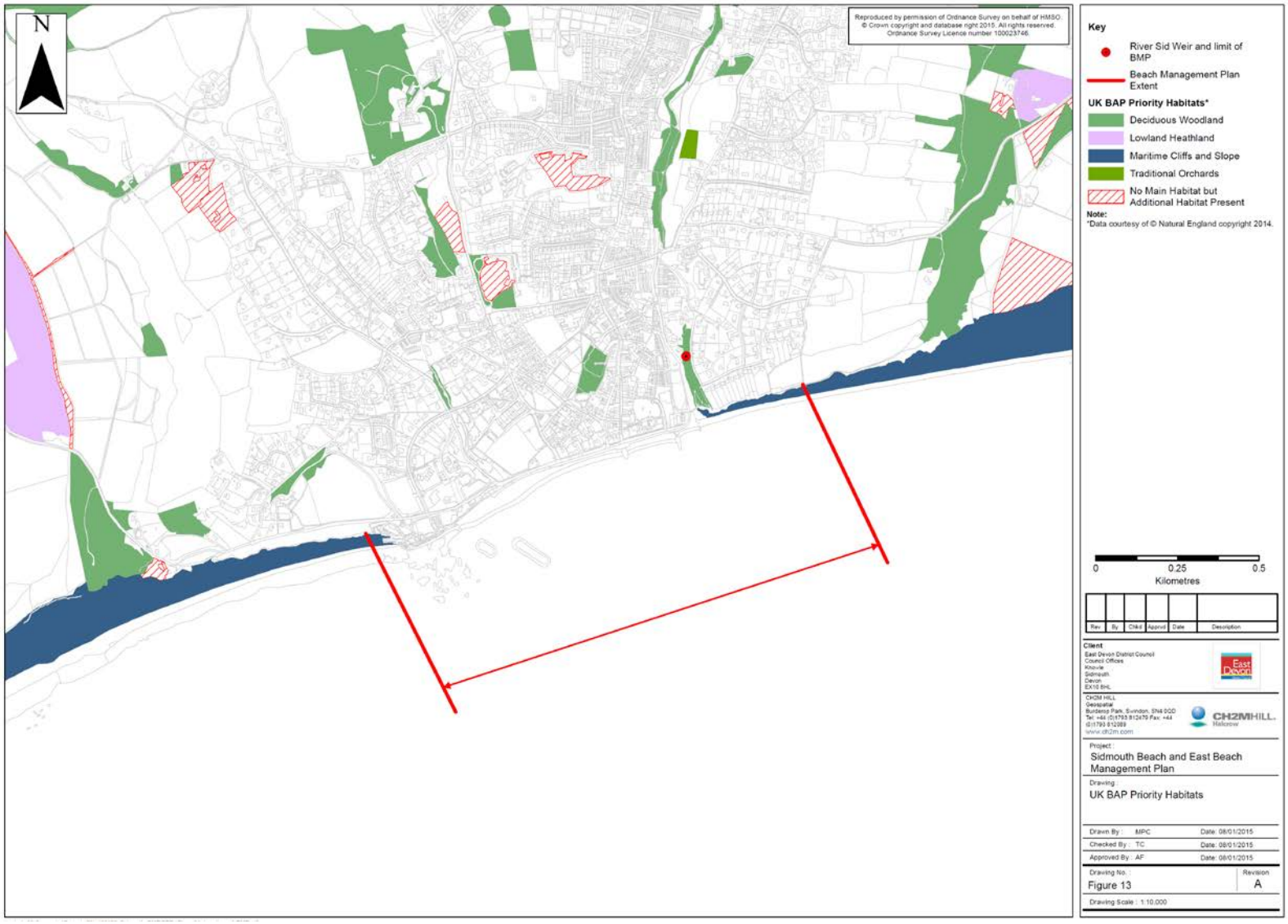


FIGURE 2-12
UK BAP Priority Habitats

2.7.4.3 Fish ecology

Cefas's Spawning and Nursery grounds of selected fish species in UK water (Ellis, J.R, *et al*, 2012) reported the following species that utilised the coastal water of Sidmouth for either spawning or nursing:

- *Spurdog Spulaus acanthias* – Low intensity nursery area
- Thornback ray *Raja clavata* - Low intensity nursery area
- Spotted ray *Raja montagui*- Low intensity nursery area
- Anglerfish Lophius piscatorus - Low intensity nursery area
- Sandeels *Ammodytidae* – Low intensity spawning area
- Mackeral *Scomber scombru* – High intensity nursery area
- Sole *Solea solea* - Low intensity spawning area

There are no Shellfish protected areas within the Study Area.

2.7.5 Fisheries

2.7.5.1 Commercial fishing

The Study Area is within the Southern Inshore Fisheries and Conservation Authority's (IFCA) district.

As reported in the site visit, December 2013, there are a number of commercial fishers working from small vessels (less than 12m) stored and launched from the beach at Sidmouth. These fishers are likely to utilise a variety of gear and target locally available species. In the wider context, Lyme Bay commercial fishers are likely utilised trawling, pair trawling, drift/fixed netting, potting, scallop and hook and line.

The offshore commercial fishing activity from Lyme Regis to Portsmouth was reported in the 2009 Navitus Bay offshore windfarm scoping report (ENECO, 2009). This document reported the results of overflight data which identified between 430 and 470 fishing vessels active in this extended area. These vessels target a variety of species depending on the season.

2.7.5.2 Recreational fishing

Sidmouth attracts recreational fishers fishing from the beach. The beaches along this section of coast are well known for catches of bass, smoothound, plaice and rays.

2.7.6 Navigation

Royal Haskoning (2002) provides the following information about navigation in and around the Study Area:

> *"A number of small sailing dinghies and open angling boats launch from the beach, many of which are based at the Sidmouth Sailing and Angling Club. Larger recreational craft may pass Sidmouth on route between Exmouth and harbours to the east such as Beer, Axmouth and West Bay. It is possible that these may anchor off the beach for lunch or overnight in settled weather.*
>
> *"Rescue services in the area are provided by the Sidmouth Inshore Rescue Service which is an independent trust operating an inshore lifeboat from Sidmouth beach.*
>
> *"Vessels passing the site are unlikely to pass close in shore as there would be a danger of hitting the beach or running aground. Some hazard to navigation is likely to be already presented around Chit Rocks by the existing offshore breakwaters."*

From discussion held during site visits and engagement events, we believe this information remains valid. In addition, the following points are also of note regarding navigation in and around the study area:

- The Exmouth ferry, which runs regularly throughout the summer, requires access to the shore and a suitable place for disembarkation (to lower a ramp directly onto Sidmouth Beach).
- An increasing number of small pleasure craft launched from holidaymakers on the beach.

2.7.7 Landscape setting

2.7.7.1 Landscape designations

The importance of landscape to the Sidmouth area is recognised by the following nationally and regionally important designations and quoted below and the East Devon Local Plan policies listed in **Section 1.7.2**:

- The East Devon Area of Outstanding Natural Beauty (AONB) is characterised by vast areas of heathland, small wooded combes, fertile river valleys and outstanding cliffs and hilltops and form the protection setting for the Dorset and East Devon (UNESCO) World Heritage Site.
- The East Devon Heritage Coast, which is included within the East Devon AONB, comprises vivid red sandstone cliffs that are broken by the white chalk headland at Beer and fronted by pebble beaches.
- The Sidmouth Town Centre Conservation Area, which was designated by East Devon District Council under the Listed Buildings and Conservation Areas Act 1990. The area includes the Esplanade from the River Sid to Connaught Gardens which contains features of historical and special architectural interest.

These features are shown in **Figure 2-13**.

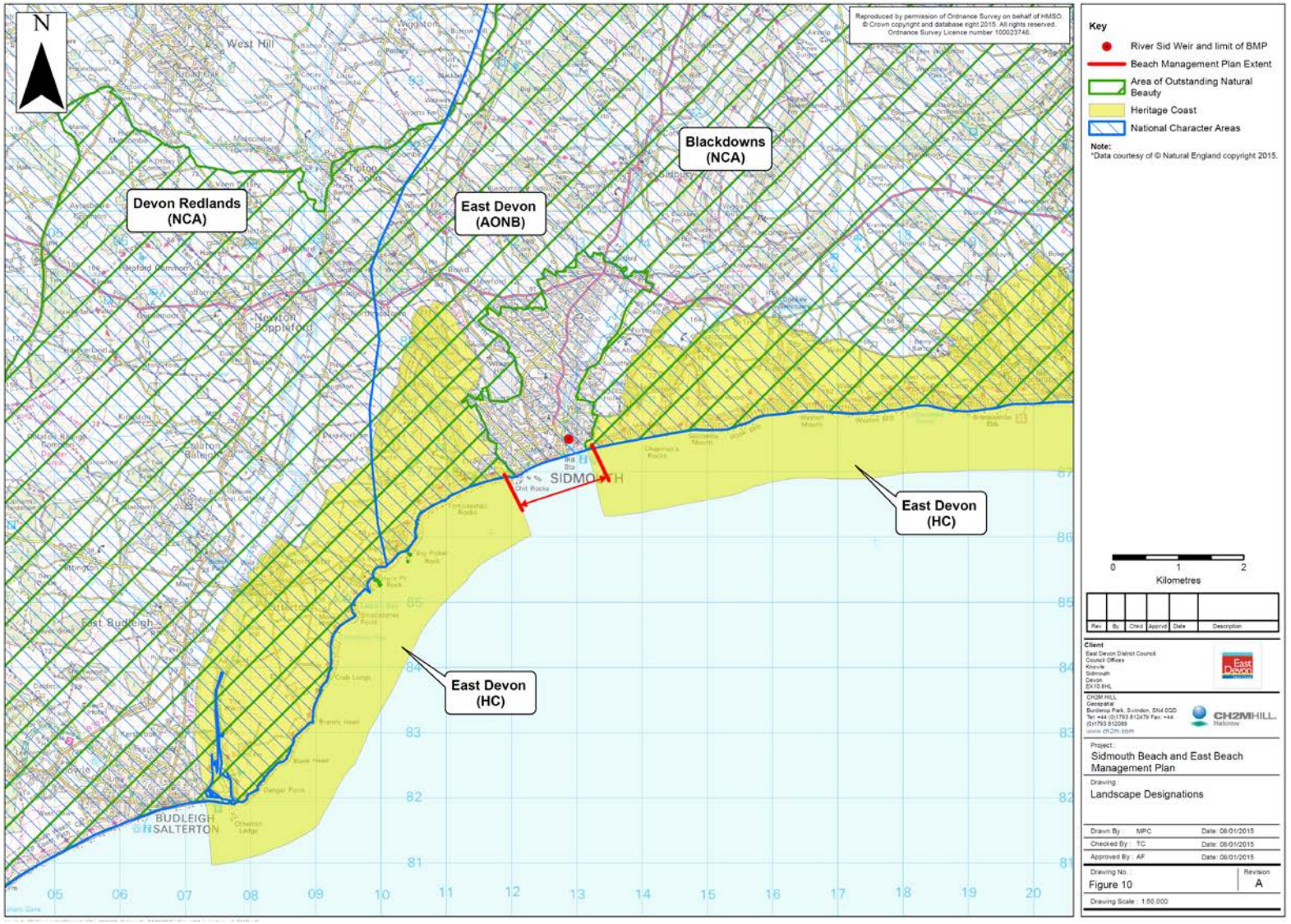


FIGURE 2-13
Landscape designations

2.7.7.2 Landscape character

The following describes the landscape character of the area:

- The Sidmouth and Lyme Bay Coastal Plateau Devon Character Area is described on the Devon County Council's (2014) website as follows:

"This area is made up of a variety of landscape types which together give rise to a distinctive coastal landscape, exposed to salt laden winds and comprising open plateau, dramatic cliff, secretive undercliff, steep wooded combe valleys and river estuary. Here the senses are stimulated by stunning scenery and dramatic landform, lofty remoteness on the plateau tops and contrasting dark secretive inaccessible undercliff and intimate picturesque settled combes. Both the plateau top and estuaries have a strong horizontal emphasis and a sense of space and air while from the cliff tops there are distinctive views out to sea and also along the cliffs. In parts the distinctive coastal cliffs are of chalk and limestone and are unique in a Devon context while to the west the cliffs are red sandstone."

- The Blackdowns National Character Area (NCA) [not to be confused with the Blackdown Hills AONB which is a different designation that is not relevant to the Study Area] is one of 159 distinct natural areas. Natural England (2014) explains that these areas *"are defined by a unique combination of landscape, biodiversity, geodiversity and cultural and economic activity."*

2.7.8 Archaeology and cultural heritage

The landscape character of Sidmouth is of primary importance due to its distinctive steep red cliffs that as well as being geologically important, attract and maintain high levels of tourism. The Study Area is included within several character areas which include the Blackdown National Character Area, the Sidmouth and Lyme Bay Coastal Plateau Devon Character Area, and the Sidmouth Town Conservation Area. There are no Scheduled Monuments within the Study Area although Connaught Gardens, located near Chit Rocks, is a Registered Parks and Gardens. There are over 100 listed buildings and structures within the town of Sidmouth, along the Esplanade and near to Chit Rocks.

The Sidmouth Folk Festival has been held during the first week of August since 1955 and attracts thousands of visitors to the town.

Detailed information about the archaeology in and around the Study Area can be found in Royal Haskoning (2002). This explains that submerged forests and peat deposits provide evidence of a prehistoric landscape in Sidmouth. There are several scattered finds within the western beach area and possibly as far as the River Sid and East Beach. There is also evidence of Bronze Age and roman activity and habitation although it is likely that these settlement sites have become obscured by extensive urban development.

Fifteen sites of reference to archaeological or historical assets are known near to the Study Area. These include a possible site of medieval harbour, 19th Century commemorative stone, Alma Bridge and an ancient parish boundary. A further 60 sites or references to archaeological or historical assets are located within 1 km.

There is a record of at least one shipwreck in the Sidmouth area and the potential exists for further finds.

Figure 2-14 shows the designated historic environment features within the vicinity of the BMP area, whilst **Figure 2-15** shows the non-designated features identified in Devon County Council's Historic Environment Records.

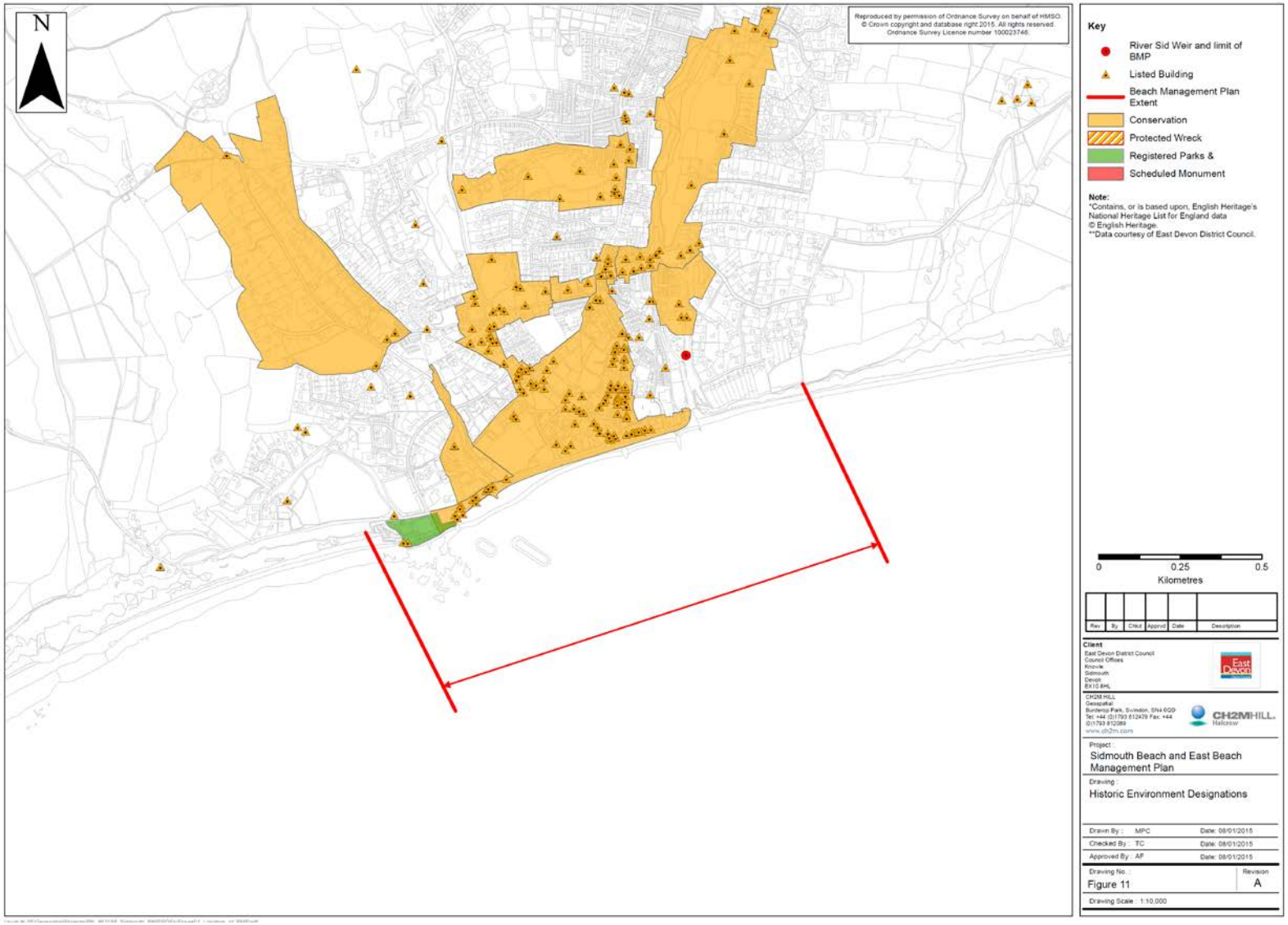


Figure 2-14
Historic environment designations

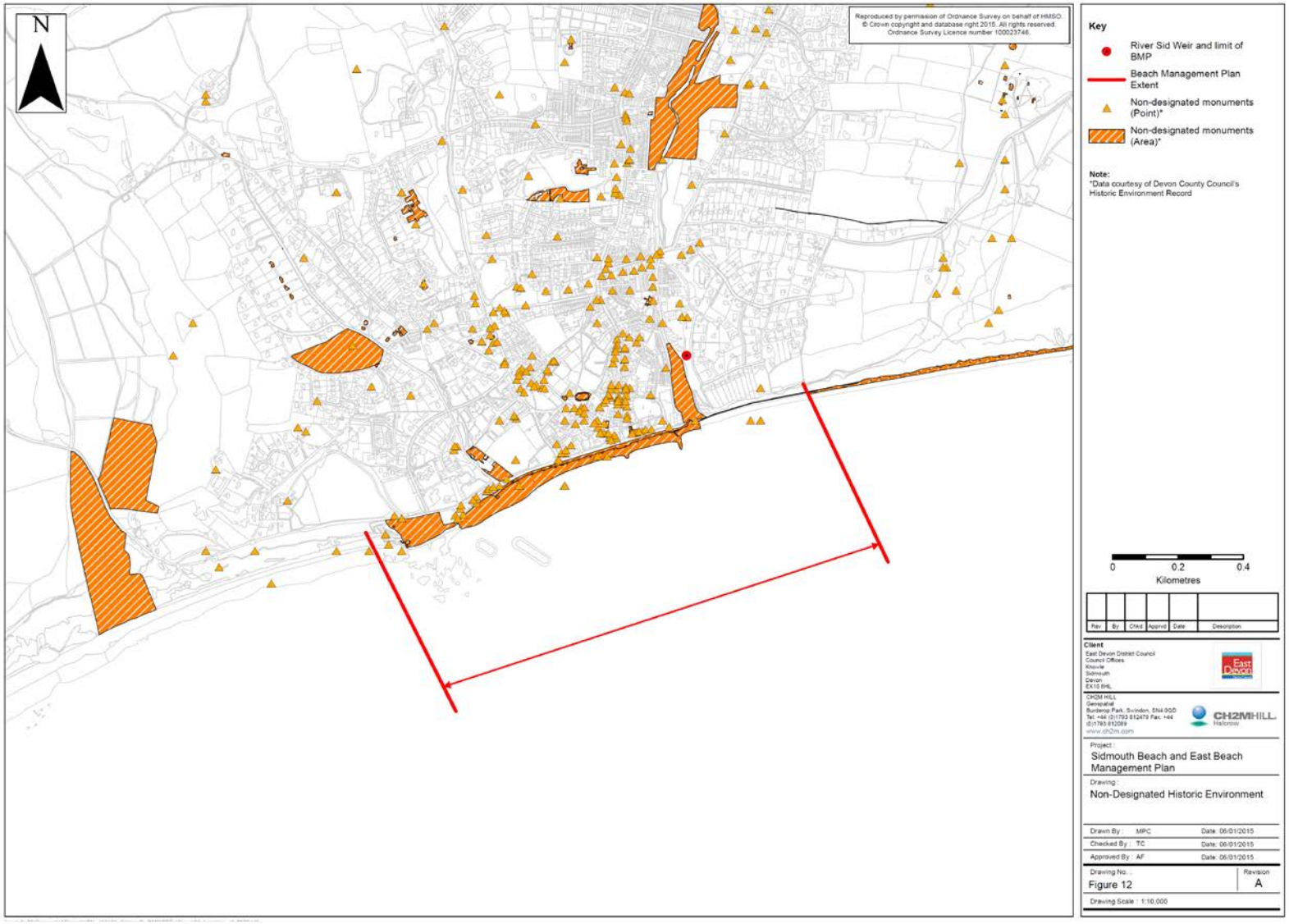


Figure 2-15
Non-designated historic environment features

2.7.9 Air quality

There are no Air Quality Management Areas in the BMP area.

2.7.10 Noise

No baseline data on existing background noise level has been sourced for this baseline report. This may be required prior to any management activities depending on their scale and scope to produce elevated levels of noise.

3 Scheme Design

3.1 Scheme description

As described in **Section 1.3.3**, coastal defences along the Sidmouth BMP frontage have developed over many years. This section presents details of the key phases of recent construction that have resulted in the coastal defences presently located along the frontage.

3.1.1 Sidmouth Coast Protection Scheme: Phase I (Completed in 1991)

Following a series of storms in 1989 and 1990, a coastal protection scheme was determined necessary to further protect the Sidmouth frontage against the risk of coastal erosion. The scheme was planned to be undertaken in several phases and this section details the first phase.

Following the series of storms there was extensive damage to the frontage. Substantial volumes of shingle moved to beaches to the east of Sidmouth and were drawn down seaward of the low water mark. The seawall was badly abraded in areas and masonry facing blocks were worn away exposing concrete. Some blocks has also been pulled away. The old wall was exposed in areas where breaches occurred and showed signs of weakness. In some areas, the seawall coping had been lifted. The lowering of the beach, which prior to the storms had been almost to the top of the seawall, also exposed derelict timber groynes. **Figure 3-1** shows the Sidmouth frontage following the storm event.

FIGURE 3-1
Sidmouth beach frontage after the 1990 storms (image from Posford Duvivier, 1990)

The existing groynes along the frontage that were exposed by the lowering of the beach, comprising of bullhead railway rails and timber planking, were deemed to have reached the end of their working life and were no longer effective due to the combined effects of severe abrasion, marine borers and undermining.

It was advised by Posford Duvivier to undertake a coastal protection scheme in phases. Phase I was to provide urgent measures necessary to safeguard the existing seawall against further damage and comprised the following:

- Encasing the remaining exposed sections of the original masonry seawall.
- Encasing the old wall (beach concrete) immediately west of the East Pier.
- Providing a low-level rock apron to the sea wall between groynes 1 and 3.
- Removing existing timber groynes 1 and 5 to 12.
- Securing the East Pier at its present length.
- Encasing the seaward end of the West Pier.

Details of these construction works are shown below in **Figure 3-2** and **Figure 3-3** showing the proposed seawall repairs/improvements and the groyne removal works respectively.

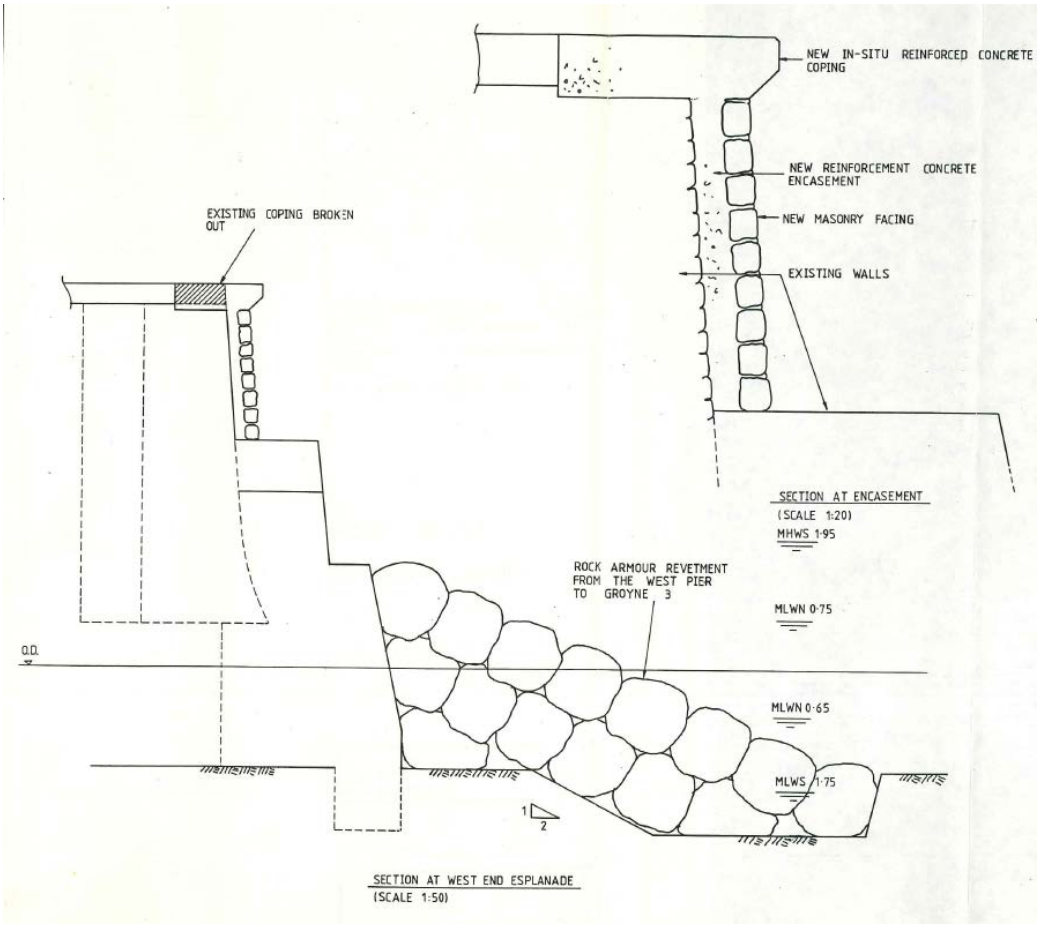


FIGURE 3-2
Phase I proposed repairs and improvements to the Esplanade seawall at Sidmouth (from Posford Duvivier, 1990)

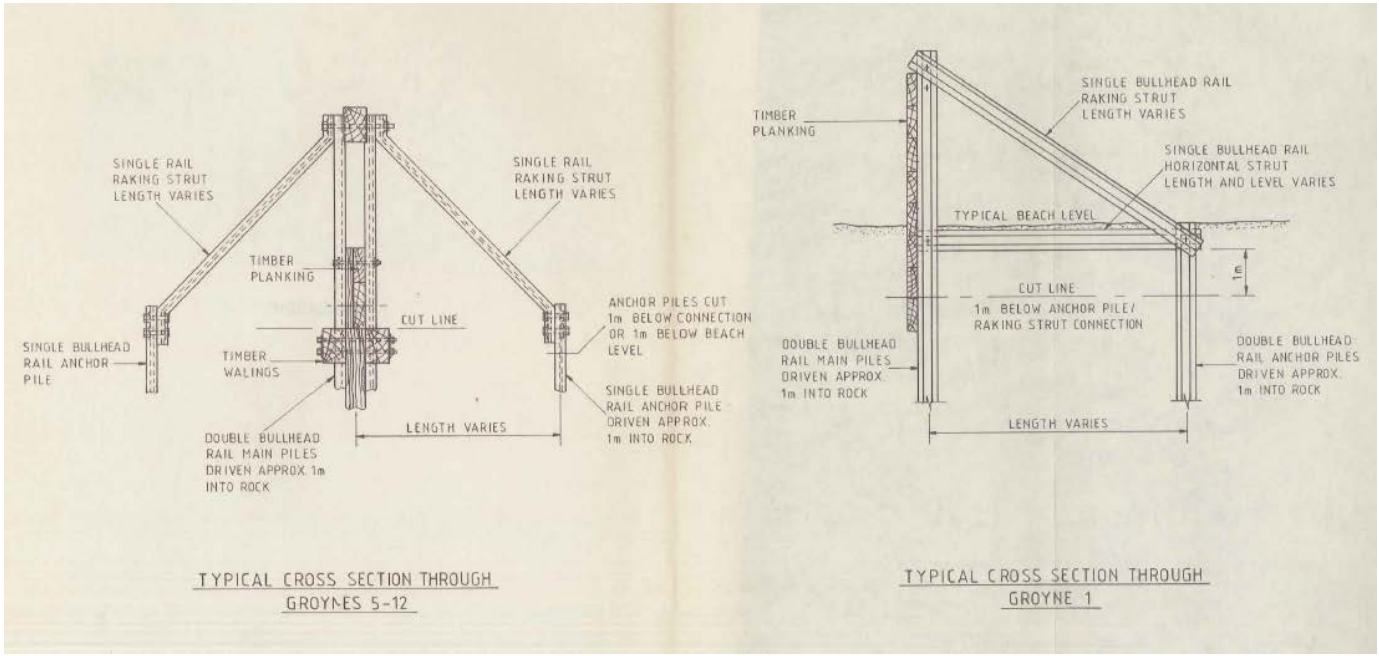


FIGURE 3-3
Phase I proposed groyne removal works at Sidmouth (from Posford Duvivier, 1992)

3.1.2 1993 Emergency Works

In January 1993 further lowering of beach levels along the frontage occurred, prompting EDDC to take immediate measures to secure the sea wall from collapse. Posford Duvivier (1993) states that there were outstanding objections to the Phase II scheme (although does not provide details) which would have provided a solution to these issues, so 'Emergency Works' were required to be undertaken instead. The beach lowering can be seen below in **Figure 3-4**.

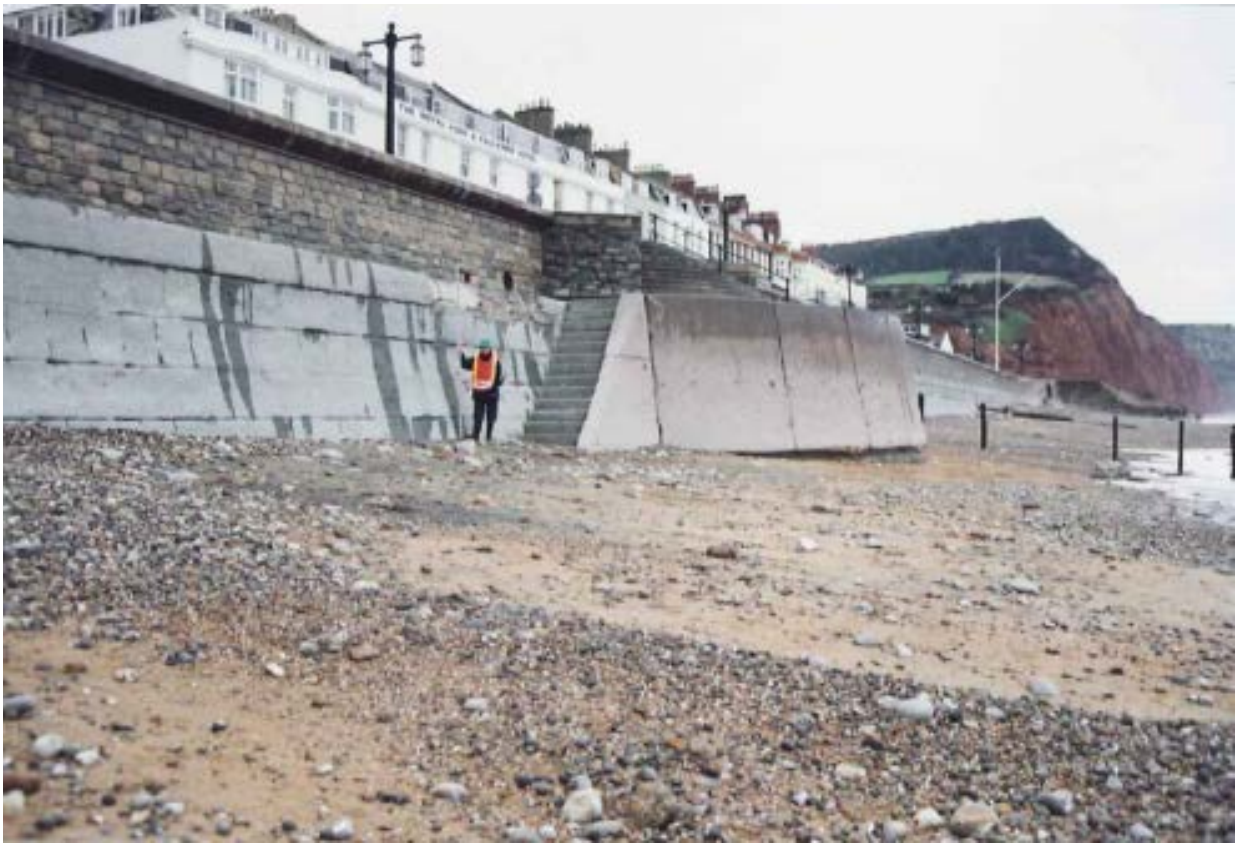


FIGURE 3-4
January 1993 following beach lowering at Sidmouth (from EDDC records).

The works consisted of a low level rock revetment at the foot of the seawall for approximately 400m extending between West Pier and York Steps. Concrete access steps were provided at the existing York, Bedford and Belmont step locations to maintain access for beach users. Repairs to the seawall were also undertaken, mainly pointing to the existing stonework.

A number of options were considered to provide protection to the base of the seawall, such as beach recharge, but due to various constraints the rock revetment was determined to be the preferred solution. The rock revetment would later be incorporated into the Phase II scheme by being buried below the beach recharge level constructed during that phase. This also meant the rock revetment reduced the beach recharge volumes required and thus the corresponding cost of the Phase II works. Details of the rock revetment can be seen below in **Figure 3-5**. Details on beach recharge levels are provided in **Figure 3-8** below.

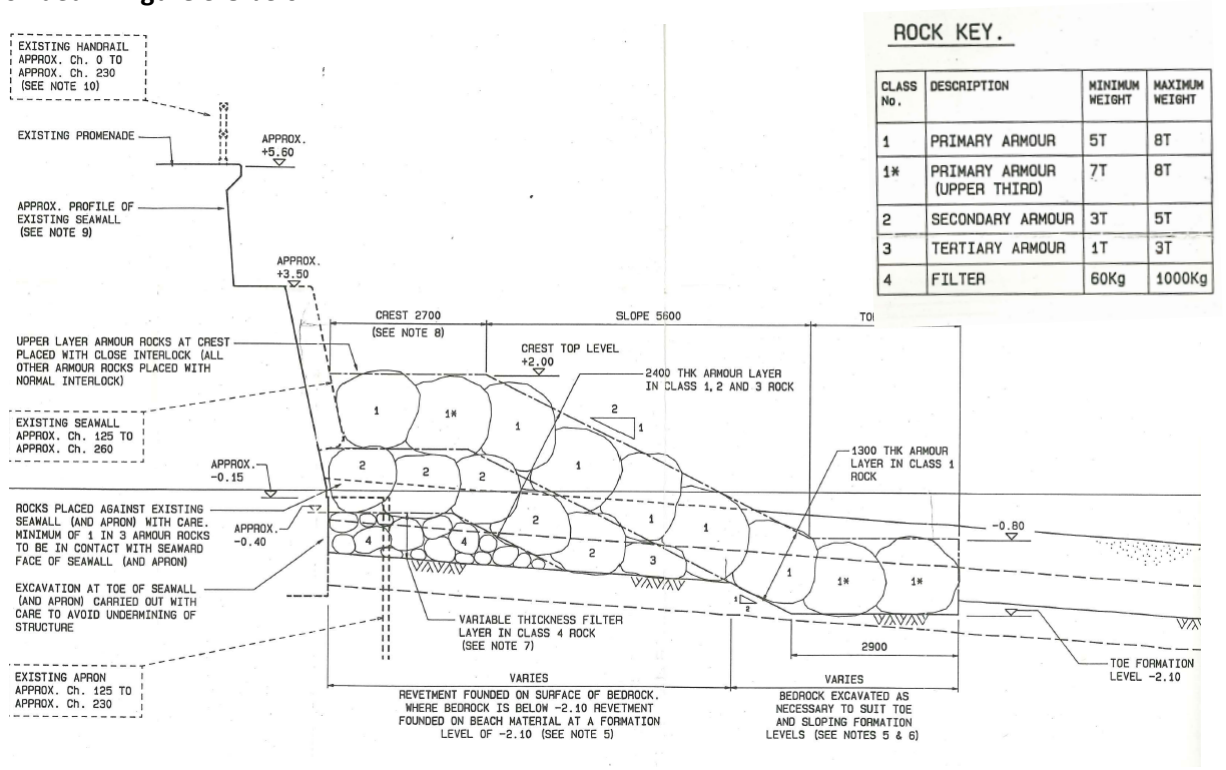


FIGURE 3-5

Revetment Details as part of the 1993 Emergency Works at Sidmouth (from Posford Duvivier, 1993).

3.1.3 Connaught Gardens Coast Protection Scheme: 1994

In January 1994 an inspection was carried out of the Connaught Gardens frontage which revealed that there was insufficient shingle and sand adjacent to the seawall to prevent erosion. Adjacent to the seawall, the rock platform known as Chit Rocks had lowered, exposing the foundations of the wall which consisted of a concrete apron along most of its length. There is evidence to show there was undermining of this apron. **Figure 3-6** below shows the 1957 seawall and the erosion observed during the January inspection (Posford Duvivier, 1994).

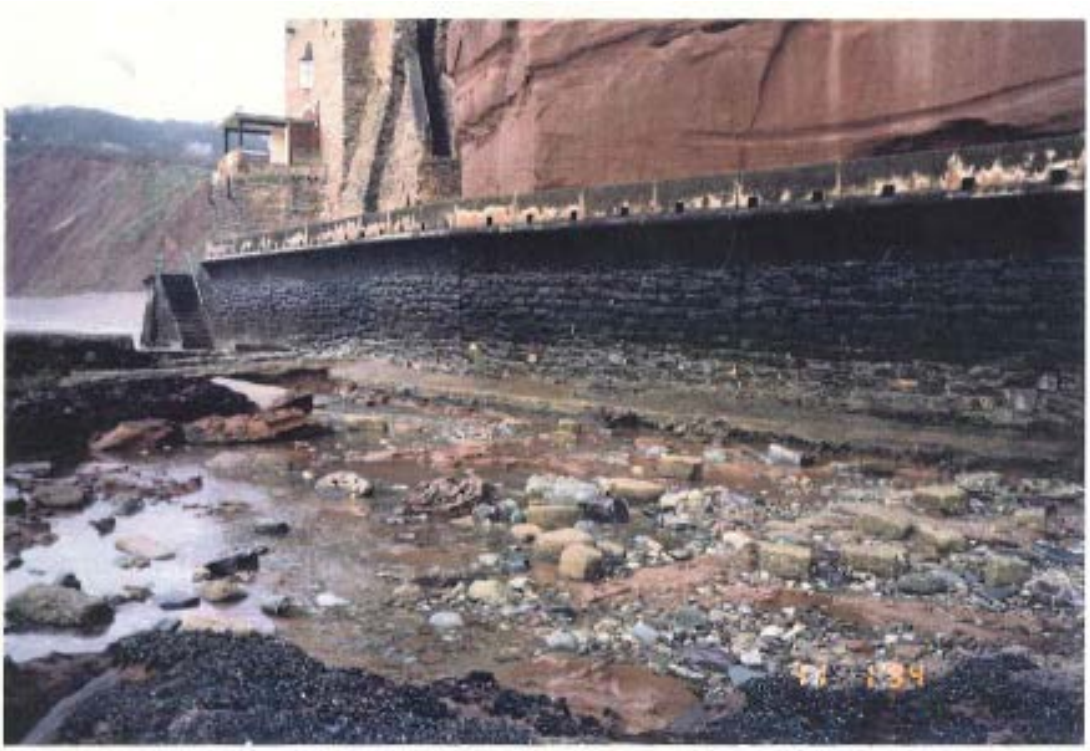


FIGURE 3-6
1957 seawall and the encountered erosion during the 1994 January inspection (from Posford Duvivier, 1994).

In 1994, a rock revetment was constructed in front of the 1957 seawall extending from the western end of the Phase II works (start of Clifton Walkway – see **Section 3.1.4**) for 155m to Jacobs Ladder beach. For amenity and technical reasons, a concrete apron was constructed to protect the seawall return into the adjacent bay to the west (Jacobs Ladder Beach return) for approximately 21m to protect the toe of the wall. In addition, stone repointing was undertaken to the existing seawall masonry. **Figure 3-7** shows the typical construction detail for the 1957 seawall and the rock revetment (Posford Duvivier, 1994).

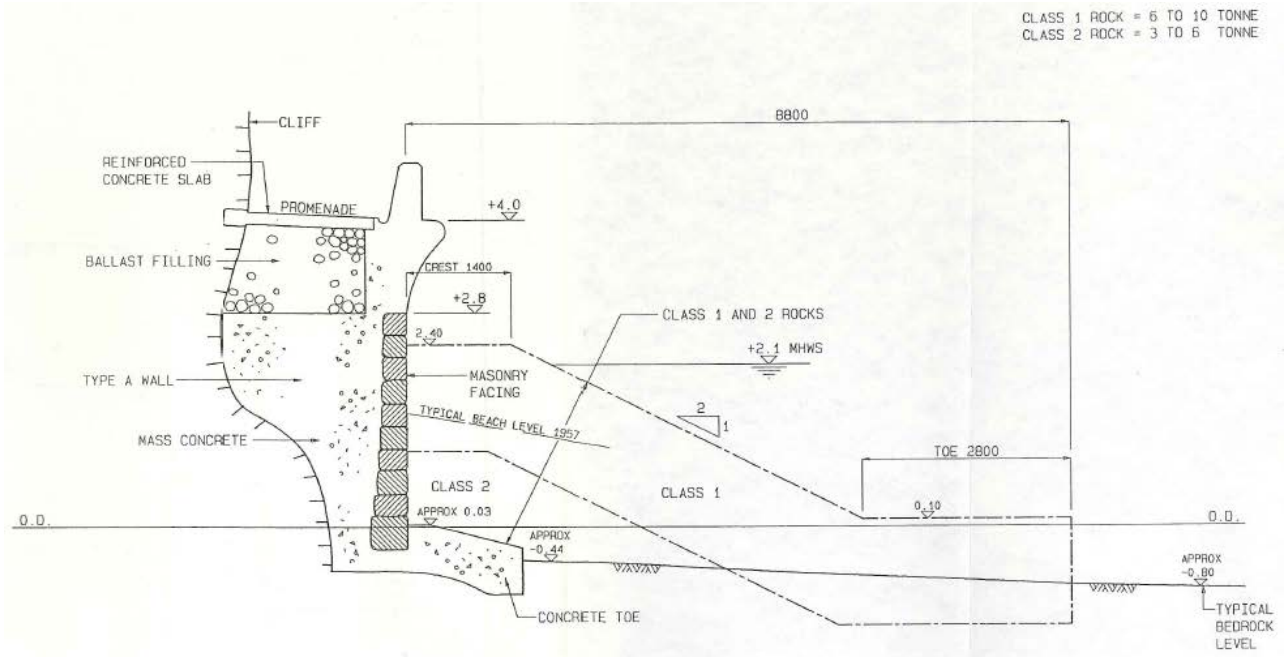


FIGURE 3-7
1957 seawall and the 1994 rock revetment construction details (from Posford Duvivier, 1994).

3.1.4 Sidmouth Coast Protection Scheme: Phase II (Completed in 1995)

Phase II of the coast protection scheme at Sidmouth comprised of a range of construction works to further protect the Sidmouth frontage following the 1989/1990 storm events against the risk of coastal erosion over a 50 year design life. The overall rationale for the scheme was to protect Sidmouth seafront without detriment to Salcombe Hill. The view was taken at the time that without any scheme, the Sidmouth seafront and the beaches to the east would all remain at post-1989 lower storm levels. As such, by recharging the Sidmouth seafront with imported material and having structures to hold it in place, then this would be restoring the Sidmouth seafront to pre-1989 beach levels with minimal impact on Salcombe Hill (as there would not be any other sediment entering the system naturally in any case – so recharge would be adding more to the system than nature would otherwise do). With this rationale in mind, the objectives of these works as described in Posford Duvivier (1996) were as follows:

1. To provide long term and sustainable coast protection against coastal erosion.
2. To reduce wave overtopping at the seawall.
3. To restore as far as possible beach levels to that previously enjoyed for amenity purposes.
4. To minimise the visual intrusion of the scheme.

The works were not completed until 1995 as delays had been encountered in acquiring the necessary approvals to undertake the works, though details of the nature of these delays are not given in the available reports (refer to **Section 3.1.2**). The works, as described on the as-built drawings (Posford Duvivier, 1995), consisted of the following:

- Promenade re-surfacing and installation of hand railing along the esplanade was undertaken to repair surface defects and improve public health and safety.
- Flood gates were installed to span the gaps between the concrete toe wall which existed along the highway side of the promenade.
- Constructing a rock revetment at Clifton Beach extending from the 1994 Connaught Gardens coast protection scheme rock revetment through to west pier at the western extent of the esplanade seawall to reduce damage to the masonry seawall.
- Removal of Glen Road groyne which was situated between West Pier and Belmont Steps; this structure was ineffective and had fallen into a state of disrepair.
- Construction of two large offshore breakwaters to stabilise the beach levels along the Sidmouth frontage and reduce erosion risk which could result in damage to the seawall by reducing wave action at the shoreline (NB: this also has effect of reducing wave overtopping of part of the seawall sheltered by the breakwaters).
- Reinforced concrete encasement of the seawall between east pier and the river training wall (including encasement, but not extension, of the seaward end of the river training wall) as well as coping repair to protect the seawall further and repair the damage resulting from long term abrasion and storm damage.
- Construction of three rock groynes at Clifton Beach, East Pier and York Steps to maintain beach levels and reduce the effects of longshore drift. Both York Steps and East Pier groynes included access ramps to the East and West and Clifton Beach groyne included access steps.
- Beach recharge extending between the 1957 seawall and the proposed East Pier groyne for amenity purposes and to further the protection to the frontage against risk of erosion and wave overtopping of the seawall which could otherwise cause it to suffer structural failure as happened in the 1989/1990 storms. Without the recharge, the beach material recovery had previously shown to be a long term process. The beach recharge would bury the revetment constructed during the 1993 Emergency Works. It should be noted that it was anticipated in the design of the scheme that regular recycling of sediment along the frontage, and periodic further beach recharge would likely be required, the need for which was to be guided by ongoing monitoring and frequent review of the beach management plan produced as part of this scheme

(Posford Duvivier, 1996), however such works have not been deemed necessary since the scheme (as documented in annual BMP reports produced to 2005 by Posford Duvivier/Royal Haskoning.

Construction details of the works described above are shown in **Figures 3-8 to 3-12**.

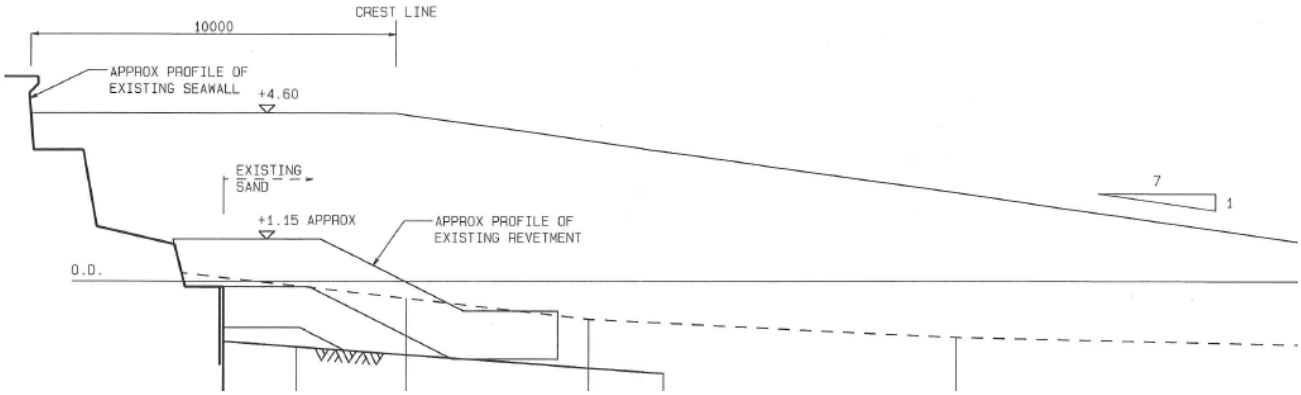


FIGURE 3-8
1993 rock revetment and beach recharge construction detail for the 1995 Phase II works (from Posford Duvivier, 1995).

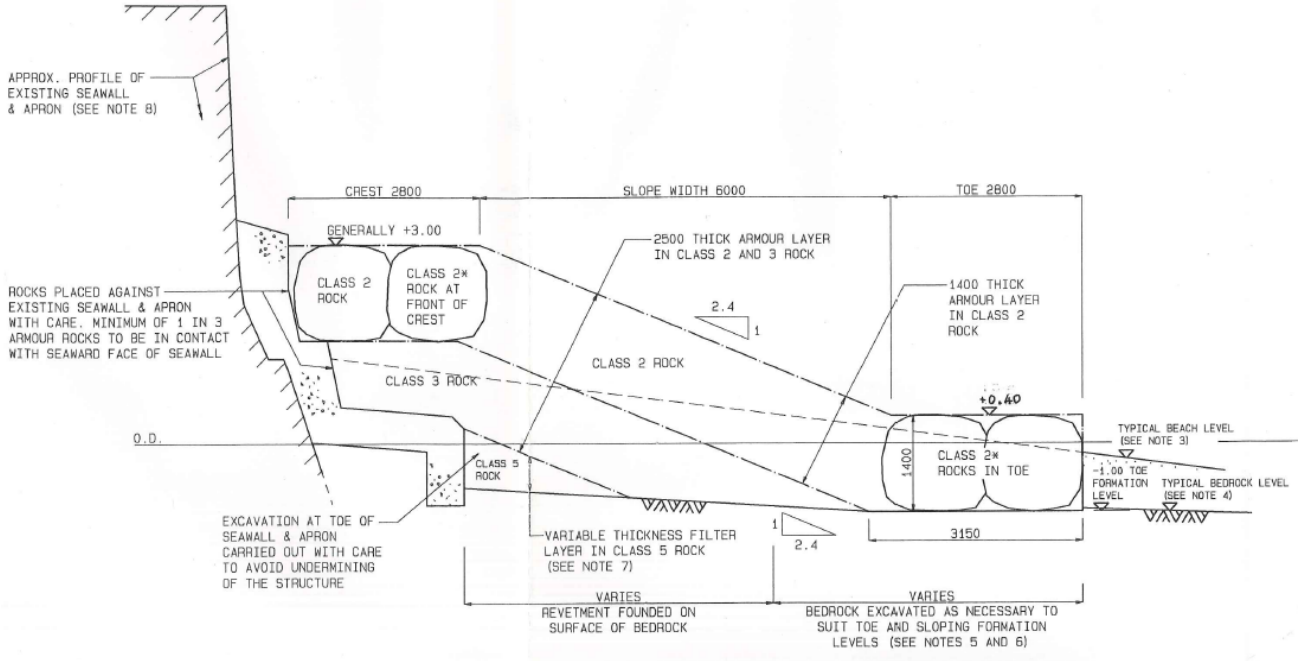


FIGURE 3-9
Clifton Beach rock revetment construction detail for the 1995 Phase II works (from Posford Duvivier, 1995).

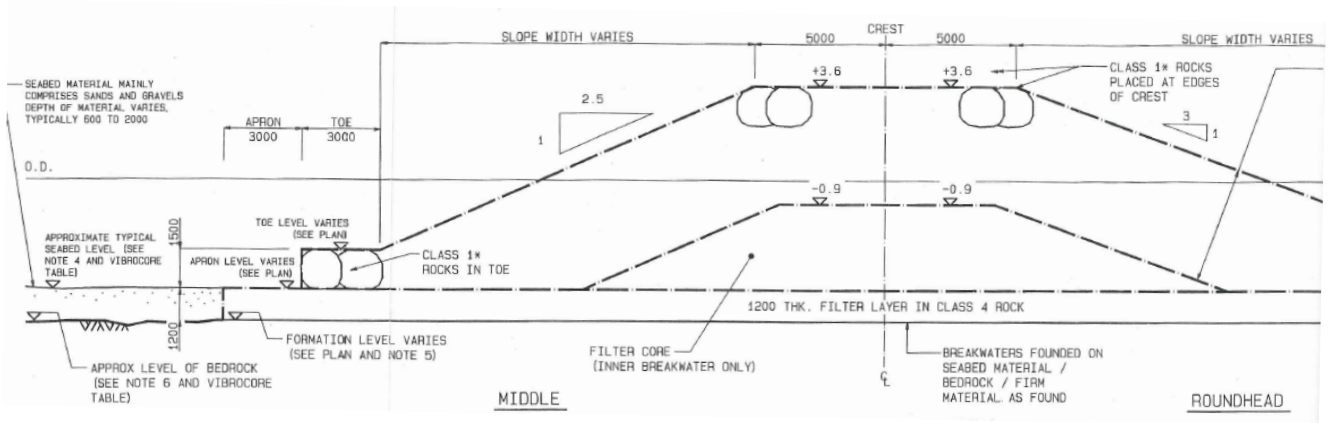


FIGURE 3-10

Offshore breakwaters construction detail for the 1995 Phase II works (from Posford Duvivier, 1995).

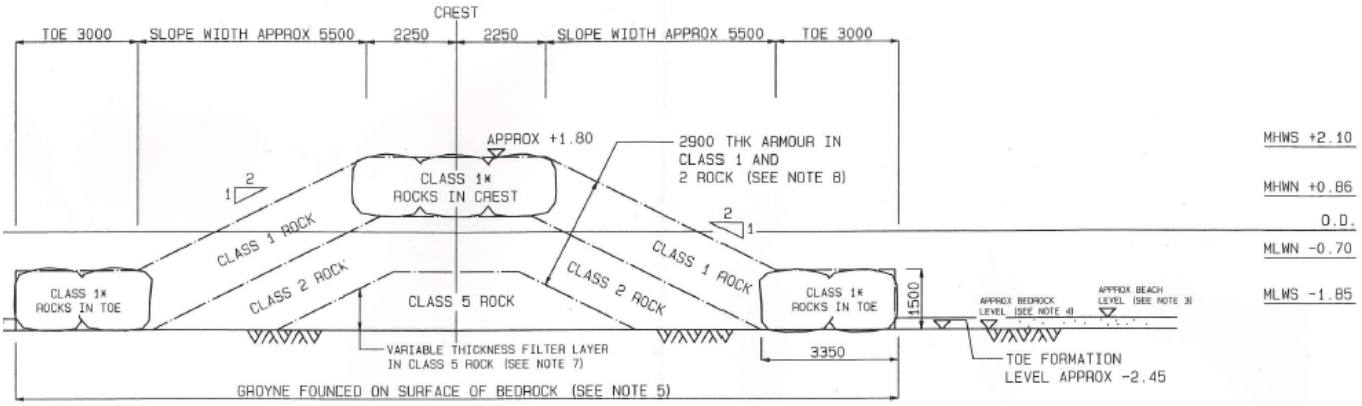


FIGURE 3-11

York Steps rock groyne construction detail for the 1995 Phase II works (from Posford Duvivier, 1995).

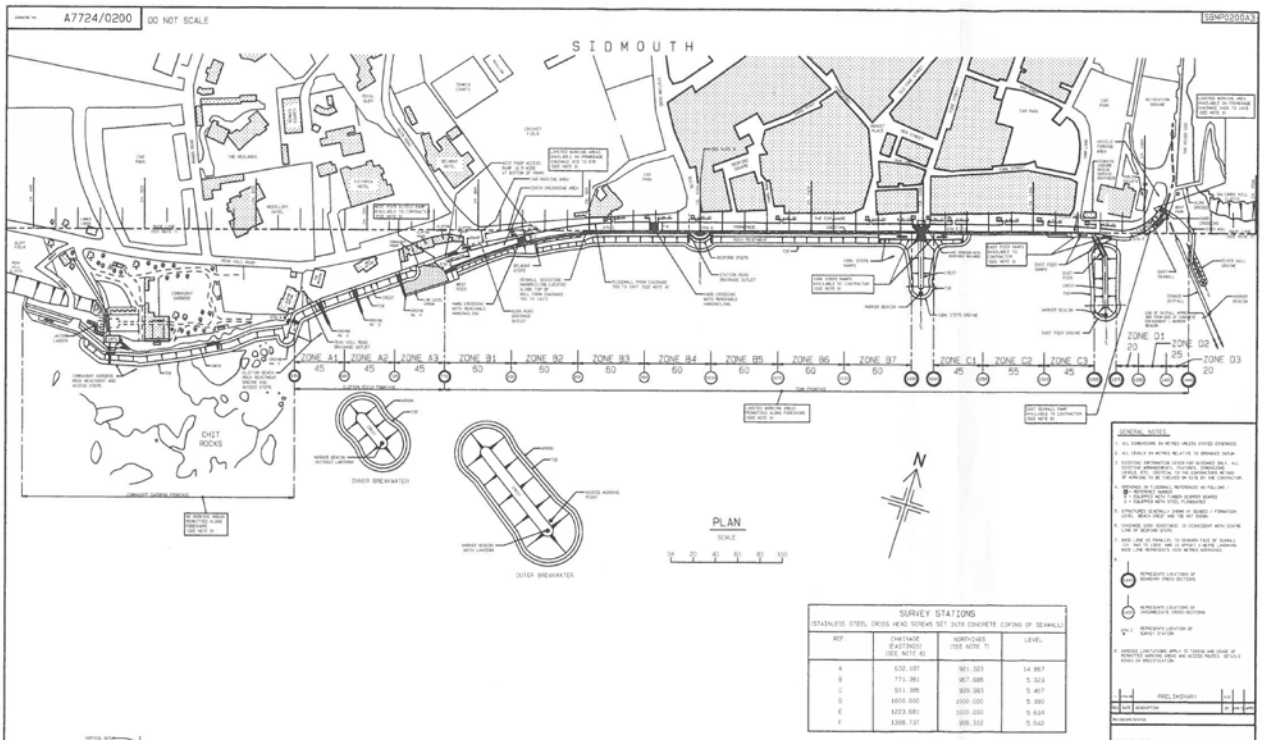


FIGURE 3-12

Plan of 1995 Phase II works layout (from Posford Duvivier, 1996).

3.1.5 Clifton Walkway: 1999

Due to the construction of the revetment extending from the Eastern extent of the 1957 seawall to the Esplanade seawall, resident and visitor access was now limited to the beach frontage in front of the revetment. This meant there were access restrictions depending on tide level.

In 1999, the construction of a walkway on top of the rock revetment was undertaken to provide connectivity from the 1957 seawall to the Esplanade. The walkway is a reinforced concrete slab with block paving pinned to the seawall on one side and supported by steel tubular piles the other side, such that if the rock revetment was undermined the walkway would remain stable. **Figure 3-13** shows the construction details for Clifton Walkway.

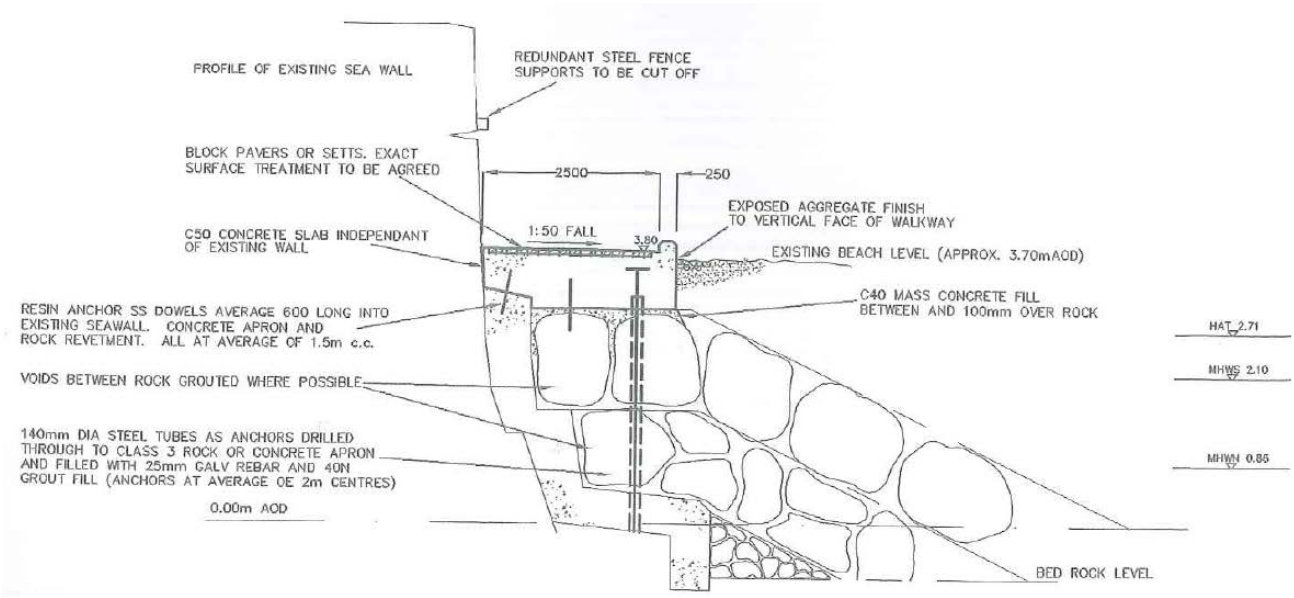


FIGURE 3-13
Drawing showing the construction details for Clifton Walkway 1999 (from Russell Corney, 2014).

3.1.6 Sidmouth Coast Protection Scheme: Phase III (Completed in 2000)

Following completion of the Phase I and II works (refer to **Section 3.1.1** and **Section 3.1.4** respectively), the beach showed signs of cut back at the York Steps groyne (Posford Duvivier, 1998) – something that was identified as being possible in the HR Wallingford physical modelling work to the extent that scheme options with a third groyne (now the Bedford groyne) were tested at the time (HR Wallingford, 1992). It was thought the distance between the offshore rock breakwaters and York Steps groyne was too great such that the beach gradually reduced in profile up to the groyne's western flank (Posford Duvivier, 1998). This could lead to scour and undermining of the groyne as well as the reduced beach protection to the Esplanade seawall. The beach levels immediately behind the offshore breakwaters were very healthy such that it could provide a beach recycling source.

In order to address these issues Phase III was commissioned on the basis of options appraisal reported in the 1998 Revised Beach Management Plan (Posford Duvivier, 1998) to undertake the following works to improve the performance of the Phase II scheme:

- Installing a rock groyne at Bedford Steps which matched the construction detail shown in **Figure 3-11** above for York Steps groyne. This was placed between the offshore breakwaters and the York Steps groyne so that it reduced the distance between control structures and reduced the magnitude of cut back. This was placed at an existing access point and access steps were provided as part of the works.
- Beach recycling was sourced from the beach frontage between the offshore breakwaters and the Belmont Steps and redistributed between Belmont Steps and York Steps groyne.

- Beach recharge and recycling (if material was available) between York Steps groyne and East Pier.

Following completion of the scheme, the performance of the modified scheme with the additional Bedford Groyne was monitored in the same way as Phase II was monitored post-construction to assess the need (or otherwise) for further recycling of sediment along the frontage, and/or periodic further beach recharge. However, such works have only involved one single period of beach recycling, carried out in 2015, to re-distribute beach sediment along the Sidmouth town frontage.

3.2 Standard of protection

3.2.1 Overtopping analysis

One of the key performance criteria of sea defences is the wave overtopping discharge permitted by the structure. One of the aims of the Sidmouth & East Beach Management Plan project that has developed this BMP, is therefore to "Maintain the 1990's Sidmouth Coastal Defence Scheme Standard of Service (Sidmouth Beach)." From the review of defence history relating to the 1990's scheme (refer to **Section 3.1** and **Appendix G**) it was apparent that there was little information presented in the available reports regarding the standard of protection against wave overtopping along the Sidmouth frontage. It is thought that the Phase I and II defences were to provide a standard of protection against coastal erosion of 1 in 50 (Royal Haskoning, 2014). Therefore, as part of developing this BMP, it was necessary to investigate wave overtopping along the Sidmouth frontage to provide a retrospective assessment of what standard was likely to have been provided by the 1990's scheme, and how that has changed in 2014 and how it may change in the future.

This work is documented in detail in Section 4.1 of **Appendix G**, and considered wave overtopping for a range of extreme wave and water level conditions, both in the present and in the future, allowing for sea level rise; and for two beach scenarios – (a) the 1990's design beach profile (refer to **Section 3.1.4**), and (b) a lowered beach profile, based upon beach profile monitoring data. Based upon this wave overtopping analysis, the following key conclusions can be drawn:

- The Connaught Garden (and historical scheme) and Clifton Walkway Schemes provide a standard of protection of less than a 1 in 1 return period for pedestrian safety.
- Overtopping rates are not adversely affected by beach level along Jacob's Ladder Beach and the Clifton Walkway sections at the western end of the BMP frontage. Beach levels are negligible along Chit Rocks, whereas along Clifton Walkway lowering beach levels expose a revetment which has a positive effect on reducing overtopping volumes. However, it should be noted that the reduction in wave energy created by the offshore breakwaters cannot be modelled with this approach. Physical or numerical modelling would be required to assess the effects on wave energy and the associated reduction in overtopping.
- Overtopping along the Sidmouth town frontage is controlled by the beach levels in front of the seawall. Importantly, when the still water level exceeds the beach level at the toe of the wall, the overtopping function changes to vertical wall overtopping which leads to much greater overtopping volumes along these frontages. This highlights the importance of ensuring an adequate beach level is maintained against the seawall to reduce wave overtopping (and so coastal flooding) risk. This is especially significant for the easternmost part of the Sidmouth Town frontage where the beach levels are much lower than adjacent frontages and thus has the greatest risk of wave overtopping; the risks in this area are further exacerbated by the presence of the river training wall which causes reflection of the waves on to the promenade and wave run-up over the concrete slipway in this area, neither of which can be represented in the overtopping techniques available. Physical modelling of this area would be the only way to investigate the wave overtopping risk in this area in a robust way.
- At present day (2014); with current guidance extreme wave and water levels and the 1990s design beach profile, the Phase II scheme is assessed as actually having the potential to provide a standard of protection against structural damage to the seawall crest and promenade in excess of 1 in 200. However, the standard of protection against crest and promenade damage is

actually reduced at the present time due to the lower (than design) beach levels along much of the beach management plan frontage.

- As sea levels rise, the standard of protection will continue to reduce for the entire BMP frontage to typically <1 in 50 by 2064 and <1in 5 by 2114. For the Sidmouth town frontage, the impact of sea level rise could be reduced if beach levels approaching the 1990's design beach profile can be retained.

3.2.2 Undermining/scour risk

Draw down in the level of the beach in front of the seawalls can result in undermining leading to slumping, collapse and failure of the defence. Assessment of this risk was undertaken as part of developing this BMP, and is described in full in Section 4.2 of **Appendix G**. In summary, this assessment concluded that the coastal defences at Sidmouth are at very low risk of failure and damage resulting from scour and undermining as a result of the extensive scour protection constructed over the various phases of construction (refer to **Section 3.1**).

However, the river wall and river training wall are both suffering the effects of scour and undermining and **should be considered for remedial works in the short term to address this risk** if the wall is to remain as part of the preferred option for long-term coastal flood and erosion risk management (refer to **Section 1.1** and **Appendix D**). The river wall is deemed as particularly unstable as the structure is showing signs of structural movement and is behaving as a wave wall and retaining structure.

For the river wall, the main risks are the existing scour holes increasing in width/depth such that the wall spanning the hole suffers a slump failure, or the increase in pressure due to the reduced contact area causes a bearing pressure failure of the rock mass. **In order to assess these risks the following information would be usefully acquired:**

1. Construction details of the existing wall.
2. Flow rates, velocities and water depths for a range of flow conditions (both high and low).
3. Survey of existing scour profile to include scour profile along the length of the wall and measurements of scour depths.

Due to the uncertainties with estimating the scour and undermining risk of the rock mass, it may not be cost efficient to assess the risk of scour and instead, installation of scour protection measures could be a preferable approach to managing the risk.

With regards the offshore rock breakwaters, unfortunately there have been no as-built or post construction surveys of these structures and it is therefore not possible to comment on the scour and undermining risk posed to the structures. Measures to address this are defined in **Section 4.3.2**.

3.3 Trigger levels

When beach levels reach a specific elevation or 'trigger level', an action may be taken (refer to **Sections 5.3 and 5.4**). The guidance within *Toe Structures Management Manual* (Environment Agency, 2012a) recommends estimation of the trigger level consistent with times when the probability of structural failure reaches thresholds that are deemed important. The trigger levels of a beach will often coincide with the point at which beach levels threaten an unacceptable rate of overtopping or probability of stability failure. Multiple trigger levels can be adopted for a beach which will reflect different risk levels or points at which action is required.

Due to the presence of existing rock armour beneath the Sidmouth Town beach along the toe of the seawall, there is no need to define trigger levels with regards undermining risk to the seawall as this is considered to be very low (refer to **Section 3.2.2**). In addition, there is little risk of flooding or erosion along Jacob's Ladder Beach and around Chit Rocks and this will be managed by ongoing maintenance guided by monitoring; as such trigger levels are also not required in this area.

Therefore, based upon the analysis presented in **Appendix G** and summarised in **Sections 3.2.1 and 3.2.2** above, it is only necessary to define 'alarm' and 'crisis' trigger levels for this BMP frontage based upon:

(a) the beach crest level against the Sidmouth Town seawall to achieve a certain SoP against wave overtopping; and

(b) the extent of erosion of East Cliff along East Beach in relation to the outflanking risk posed to low-lying Sidmouth via exposure of the River Sid Western Wall to coastal conditions.

Trigger levels are therefore defined in the following which will (a) introduce increased monitoring of at risk areas, and (b) initiate works to reduce the risk of wave overtopping to ensure the required standard of protection is maintained against flood risk, and reduce the rate of erosion along East Beach.

It is assumed that the target standard of protection for the Sidmouth Town frontage is 1 in 200 years against wave overtopping. The 'alarm' trigger level for this frontage was calculated by determining the beach level at the toe of the defence that would limit overtopping discharge rates to less than 200 l/m/s during a 1 in 200 year extreme event. The 'crisis' trigger level was calculated by determining the beach level at the toe of the defence that would no longer limit overtopping discharge rates to less than 200 l/m/s during a 1 in 200 year extreme event; thus posing increased risk of structural damage and failure of the seawall and so flood risk to low-lying parts of Sidmouth.

Along East Beach, further erosion and so increasing risk of outflanking of the River Sid Western Wall is expected to continue in the future, albeit at a lower rate compared to recent years upon implementation of the preferred scheme for long-term FCERM in this area (refer to **Section 1.1**). As such, there is also a need for ongoing monitoring of East Beach/East Cliff to determine the point at which it is no longer sustainable to manage this risk through beach management, and upgrade of the River Sid Western Wall to full coastal standard is required instead to manage the risk of flooding as a result of outflanking. Given this, trigger levels are also defined to identify when consideration of this change in risk management approach should commence and when it should be implemented.

The trigger levels for the BMP frontage are therefore defined as follows:

- **Alarm Levels:**
    - *Sidmouth Town seawall:* If drop from top of seawall (crest level +5.6mOD) is greater than 2.2m, then instigate more regular monitoring (refer to **Section 5.3**) as there is an increased risk that during a storm even the beach level could lower further to a point where wave overtopping during storms could exceed the 1 in 200 year SoP threshold.
    - *East Beach/East Cliff:* The trigger for commencing the planning of the River Sid Western Wall upgrade to a full coastal standard structure should commence when a further 5m of erosion occurs in the vicinity of Alma Bridge over a 30-50m length of open coast extending eastwards form Alma Bridge (from 2015 position). Based on the assessments made for East Cliff (refer to **Appendix B**), and factoring the potential uncertainty with

regards timing of recession, this increased exposure could potentially occur within the next 20 years (i.e. by 2035).

- **Crisis Levels:**
    - *Sidmouth Town seawall:* If drop from top of seawall (crest level +5.6mOD) is greater than 3.2m, then consider implementing beach recycling or other measures (refer to **Section 5.4**) as there is a significantly increased risk wave overtopping during storms could exceed the 1 in 200 year SoP threshold.
    - *East Beach/East Cliff:* If East Beach/East Cliff recedes by about a further 10-15m from its 2015 position, this will increase the likelihood of defence failure and thus incurrence of flood damages and so require implementation of River Sid Western Wall upgrade.

4 Monitoring Regime

Over the next 5 years, a comprehensive monitoring programme is recommended to be undertaken in order to provide a greater level of quantitative field data. This will aid improved understanding of the coastal processes operating along the Sidmouth BMP frontage and wider coastal area, as discussed in **Section 1.4.4**, and inform future management decisions at Sidmouth.

The following sections discuss the recommended monitoring requirements over the next 5 years with this objective in mind. In doing so, it incorporates the ongoing monitoring undertaken by the Plymouth Coastal Observatory (PCO) as part of the South-West Regional Coastal Monitoring Programme (SWRCMP), who already carry out two annual beach profile surveys (and post-storm surveys when needed), a 5-yearly bathymetry survey, and undertake aerial LiDAR and aerial photography on a frequent basis. **The continuation of this monitoring programme is vital to improving the understanding of the coastal processes that lead to coastal flood and erosion risks along the BMP area**.

4.1 Monitoring programme

Table 4-1 provides an outline programme for implementing the monitoring regime, identifying key tasks and estimated timing of each task. This outline programme covers the next five years, in line with the review period for this BMP. Reference should be made to the rest of this section for more detail about the nature of the monitoring shown in **Table 4-1**.

TABLE 4-1
Outline monitoring programme

	2016		2017				2018				2019				2020				2021		
TASK	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
Ongoing beach profile, LiDAR, bathymetry and aerial photography monitoring as part of the SWRCMP.																					
Establish regular beach profile surveying of additional profiles along frontage, either as part of the SWRCMP or in addition to it.																					
Add profile ID and beach level markers along the study area to aid visual inspections.																					
Provide training to local staff to aid call-out of post-storm surveys.																					
Record storm event details to support post-storm surveys.																					
Ensure records are kept of any beach recycling works.																					
Undertake annual bathymetry surveys supported by sediment sampling of beach and nearshore.																					
Deploy current monitoring devices.																					
Deploy a Met Station along Sidmouth seafront.																					
Undertake visual walkover inspections of structures, including 'dip' measurements at points along the frontage to measure distance of drop from seaward edge of seawall crest to beach.																					
Undertake baseline structural survey/inspection of the offshore breakwaters.																					
Undertake full structural inspection of coastal defences																					
Review all data annually with particular focus on trigger levels.																					

4.2 Beach monitoring

4.2.1 Routine beach profile survey

Topographic beach profile surveys are carried out by the PCO every spring and autumn at pre-defined locations along the BMP frontages (see **Figure 4-1**). **Monitoring of beach profiles every spring and autumn by PCO is to continue as part of the SWRCMP**. Data is available through the PCO website (www.coastalmonitoring.org) from 2007 onwards (when PCO was established).

Table 4-2 provides a summary of the beach profile locations, including origin co-ordinates and dates of first and most recent surveys. It also highlights which profiles are currently surveyed twice per year as part of the SWRCMP, and which of those are also currently used to capture additional post-storm survey profiles (NB: these currently used profiles have not always been used for this purpose; in the past other profiles were used). **It is recommended that the last 3 digits of at least some, if not all, of the Profile IDs listed in Table 4-2 be marked upon the seawall at Sidmouth** to allow ease of identification during future walkover inspections of the area.

In order to improve understanding of sediment movements along the BMP frontage (refer to **Section 1.4.4**), **it is recommended that EDDC work with PCO to make the following changes to the current survey regime, to either be part of the SWRCMP or in addition to:**

(a) As a minimum, a greater number of profiles should be surveyed on a regular basis, with three profiles within each groyne bay (one at each end and one in the middle) and three profiles along East Beach.

(b) **To improve data density and so volume change analysis, consideration should be given to using a grid-base GPS survey or terrestrial laser scan approach for each survey.**

Table 4-2

PCO beach profile survey locations within the BMP area at Sidmouth (NB: those highlighted in yellow are those currently surveyed bi-annually; those not highlighted are surveyed every few years; those in bold are also currently surveyed as post-storm profiles).

Profile ID	Origin Easting	Origin Northing	Date of first survey	Date of most recent survey
6a01440	313021.98	87399.99	30/08/2007	16/02/2016
6a01441	**312974.03**	**87386.01**	**30/08/2007**	**08/03/2016**
6a01442	312926.00	87372.00	30/08/2007	16/02/2016
6a01443	312894.03	87316.01	18/04/2007	16/07/2015
6a01444	312866.92	87293.98	18/04/2007	16/07/2015
6a01445	312820.98	87279.99	18/04/2007	16/07/2015
6a01446	**312761.09**	**87260.03**	**18/04/2007**	**08/03/2016**
6a01447	312697.92	87241.98	18/04/2007	16/07/2015
6a01448	312658.98	87229.99	18/04/2007	16/07/2015
6a01449	**312580.85**	**87211.96**	**18/04/2007**	**08/03/2016**
6a01450	312503.85	87191.96	18/04/2007	16/07/2015
6a01451	312464.95	87183.98	18/04/2007	16/07/2015
6a01452	312421.86	87166.96	18/04/2007	16/07/2015
6a01453	312365.91	87161.97	18/04/2007	16/07/2015
6a01453A	**312339.74**	**87111.68**	**14/10/2011**	**08/03/2016**
6a01454	312323.73	87145.92	18/04/2007	16/07/2015
6a01455	312271.63	87127.89	18/04/2007	16/07/2015
6a01456	**312251.69**	**87122.91**	**18/04/2007**	**08/03/2016**

Profile ID	Origin Easting	Origin Northing	Date of first survey	Date of most recent survey
6a01457	312200.42	87096.12	18/04/2007	16/07/2015
6a01458	312152.63	87075.89	18/04/2007	16/07/2015
6a01459	312094.97	87026.98	18/04/2007	16/07/2015
6a01460	312061.95	86977.98	18/04/2007	16/07/2015
6a01461	312016.03	86956.01	18/04/2007	16/07/2015
6a01462	311995.94	86979.99	18/04/2007	16/07/2015
6a01463	**311940.96**	**87001.00**	**18/04/2007**	**08/03/2016**
6a01464	311882.98	87025.00	18/04/2007	16/07/2015
6a01465	311820.01	87017.01	18/04/2007	10/09/2010

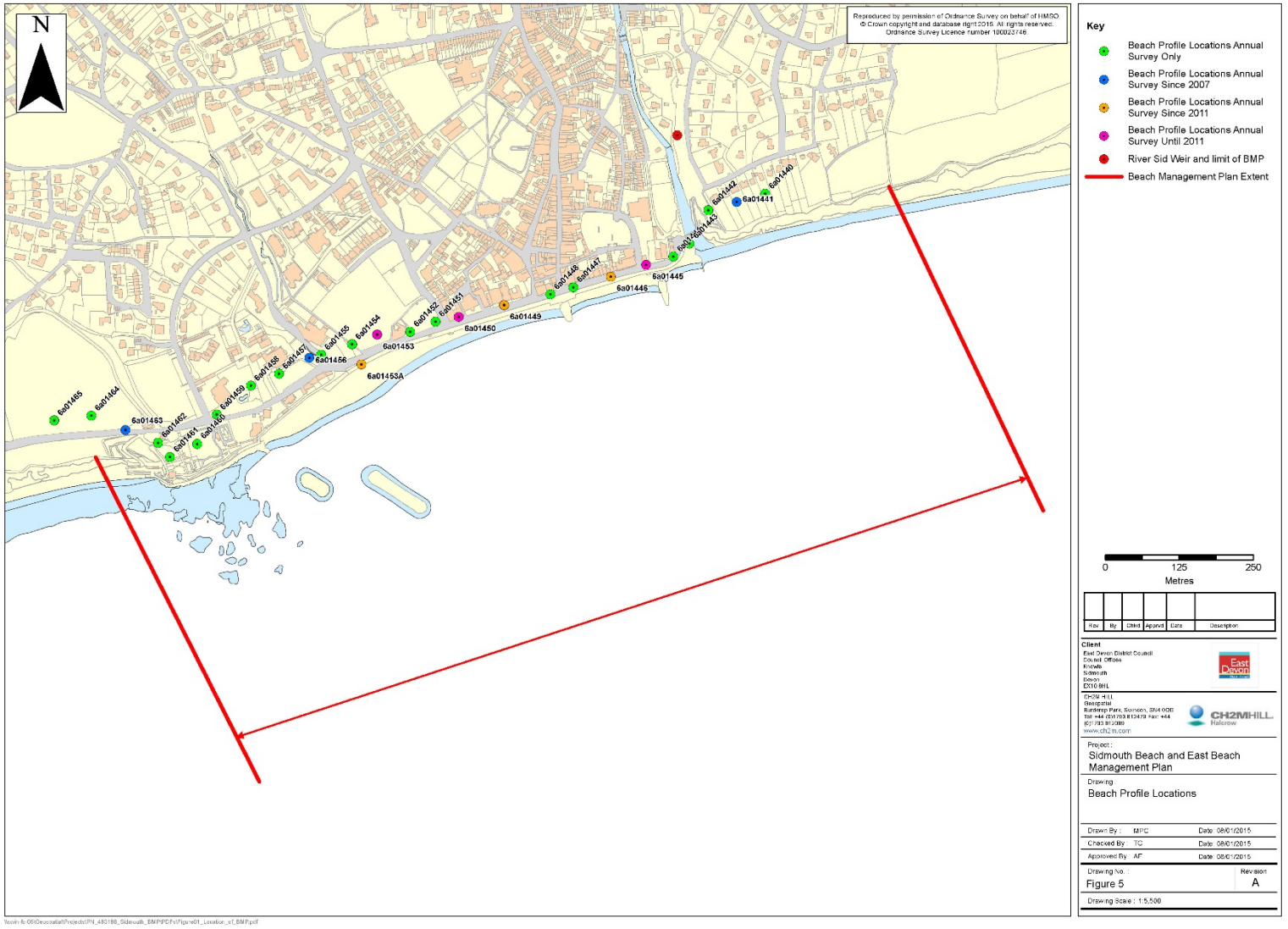


FIGURE 4-1
PCO beach profile survey locations

4.2.2 Post-storm beach profile survey

In addition to undertaking routine beach profile surveys, PCO also undertake post-storm surveys although not always along the same profiles each time (see **Table 4-2**). To date, very few post-storm surveys have been carried out (refer to Section 5.5.3 of **Appendix B**).

In order to capture post-storm surveys in the future, **a number of local authority staff who are regularly on-site should be encouraged to report to a key contact in EDDC and/or the Environment Agency as to when a storm event has occurred and resulted in notable change in the beach levels against the seawall** (refer also to **Section 3.3**). The key contact in EDDC and/or the Environment Agency can then call-out post-storm surveys via PCO. **To support this, some basic training should be provided to the staff who are regularly on-site so they know what to look for**. This could be based upon the Environment Agency's *Condition Assessment Manual* (Environment Agency, 2012b) or key beach crest levels marked upon the seawall (refer also to **Section 4.2.8**). **The arrangements for this, once confirmed, should be captured in a formal communication document so that the role can be communicated to others in the future**.

Once a greater amount of post-storm survey data is gathered, it will be possible to review data and determine if the post-storm profiles surveyed by PCO are the correct ones to be surveying in these circumstances (i.e. are the post-storm profiles representative of storm driven changes in the beaches?). In addition, a greater amount of post-storm survey data may enable **pre-storm profiles to occur if (a) sufficient understanding of the conditions of most concern can be developed through continued capture and review of post-storm surveys in the coming years (refer also to Section 4.5.2), and (b) opportunity arises and/or funding is available.** This is not a key requirement of the monitoring regime but would provide useful additional understanding of the beach behaviour in storm events to inform future management decisions.

4.2.3 Master profile survey

There is uncertainty about the precise volume of sediment along the beaches of the BMP frontage. This uncertainty is a result of a lack of understanding of where the sub-strata on which the beach sits, is located beneath the beach.

To address this uncertainty **a survey of underlying bed level could be undertaken if the opportunity arises and/or funding is available**. This data, in turn, will provide a definitive 'Master Profile' for use in beach profile analysis and will allow more accurate estimates of beach volumes to be made. Definition of the definitive master profile is not essential at this time for assessing trends in beach volume change as changes are referenced to a defined assumed master profile. Therefore this task could be the subject for more academic research in the coming years but not form a requirement of the monitoring programme in the next 5 years.

4.2.4 Beach recycling logs

Whenever beach recycling works occur in the future, then **beach recycling logs are to be maintained** by those undertaking the works, with the records then being passed to EDDC and PCO. This information will allow future analysis of beach volume changes to more accurately account for the effects of beach recycling work and will enable the underlying natural beach movements to be identified.

To support this, a template beach recycling log to be used is provided in **Appendix I**. It is to be completed in a simple manner, by tallying the number of truck or dumper loads (of known capacity) transported along the beach during a recycling event. **This could be supported by completing a pre- and post-beach recycling survey for the first one or two beach recycling campaigns to provide actual data against which the recycling logs can be validated.**

4.2.5 Bathymetric survey

Bathymetric surveys are to continue as part of the SWRCMP, in line with the schedule determined by PCO. The next bathymetric survey for the Sidmouth area is not currently programmed due to budgetary constraints.

In addition, given the changes in seabed reported to have occurred since construction of the current coastal defences in the 1990s, and to further the understanding of the beach/nearshore system (refer to **Section 1.4.4**), **it is recommended that more regular (annual) bathymetry surveys be undertaken for the next five years**; the first of these will be required in the immediate future to support development of the preferred option described in **Section 1.1** (refer also to **Appendix D**). These surveys should be supported by sediment sampling (refer to **Section 4.2.6**).

4.2.6 Sediment sampling

Annual sediment sampling (grab samples and particle size distribution analysis) should occur over the next five years in support of bathymetry surveys (refer to **Section 4.2.5**). Samples should be collected at about the same locations each time and cover both the beach and nearshore area.

4.2.7 Current monitoring

In order to validate and calibrate numerical models to inform design and impact assessment as part of developing the preferred option described in **Section 1.1**, **current monitoring devices (e.g. ADCP/AWAC) should be deployed in the immediate future for a period of several months** to capture data to aid this work.

No other current monitoring is proposed to occur over the next five years.

4.2.8 Walkover survey

Visual walkover inspections should be undertaken by EDDC to monitor beach crest level against the seawall and groynes at Sidmouth.

One walkover survey should be undertaken every month during the winter (October to March) and one survey every two months during the summer (April to September). Throughout the year, additional walkover surveys will need to be carried out prior to and immediately after storm events, as required. Visual inspection of the beach level against the seawall and groynes is required to allow use of the trigger levels identified in **Section 3.3**. **To aid the visual inspection, markers defining the beach level in relation to the beach crest level trigger levels could be marked on the seawalls at Sidmouth.**

These visual walkover inspections should also measure 'dip levels' along the frontage (i.e. distance drop from the seaward edge of the seawall to the beach) to capture useful information about the variation in beach level against the seawall in the periods between regular beach profile surveys (refer also to **Section 4.2.1**). These dip levels will also provide for assessment against trigger levels defined in **Section 3.3**.

4.2.9 Aerial photography and LiDAR

Aerial photography and LiDAR surveys are to continue to be flown every one to three years as part of the SWRCMP. This data is available through the PCO website (www.coastalmonitoring.org). With regards to the aerial photography, **it is recommended that these continue to be delivered as high quality aerial photo surveys – similar to those collected in recent years – and that when undertaken, the survey specification should state the need to achieve a RMSE of better than +/-10cm.**

In addition, and to support the aerial photography and LiDAR surveys, **it is recommended that the East Cliff area also be monitored using dGPS surveys. This may comprise survey of the whole cliff edge position (if safe to do so), or setting up an inland datum and surveying distance to cliff edge. In both cases, a six-monthly survey is recommended**.

Continuation of the SWRCMP aerial photography and LiDAR surveys, combined with the additional cliff monitoring recommended and regular monitoring of beach profiles (refer to **Section 4.2.1**), will inform future derivation of long-term trends of beach volume changes and beach and cliff recession rates.

4.3 Structure monitoring

4.3.1 Visual inspection

There are a number of defence assets located along the BMP frontage under the responsibility of EDDC and the Environment Agency. **Appendix G** notes the condition of these defences is good to fair with

minor maintenance work required to some parts of seawalls and timber groynes within the next two years (refer to **Section 5.2.1**). **To ensure these assets remain in such condition, ongoing maintenance is required and this will be informed by regular re-inspection of the defences in a similar way to that reported in Appendix G at least once every two years, although annually would be preferable if budgets allow**. These inspections should occur during the spring of each year to allow identification of any issues so that subsequent completion of any maintenance works required can be completed prior to the busy summer period, thus avoiding impacting on the amenity use of the beach.

Visual inspections to monitor structures after storms should also occur, since damage to the structures is most likely to occur during storms.

Monitoring of the various structures should be, where possible, undertaken in combination with the visual walkover inspection of the beach as described in **Section 4.2.8**, particularly following storm events. Each visual inspection should be recorded in a consistent way. To aid this, a template is provided in **Appendix J**.

The following items should be checked as part of these inspections:

- Visual checking of the beach level in front of the seawalls at Sidmouth to ensure that the trigger levels defined in **Section 3.2.3** are not reached (refer also to **Section 4.2.8**).
- Visual checking of access ramps, steps, hand rails, etc. to ensure that these are in a safe condition of public use. This should be carried out in accordance with the Environment Agency's public safety risk assessment operational instruction. **Refer also to Section 5.2.1.**
- Visual identification and checking of any defects (e.g. cracks in the seawall; timber groyne planking, etc.) and overall defence condition in accordance with the *Condition Assessment Manual* (Environment Agency, 2012b). Refer also to Section 3 of **Appendix G** as a baseline.

4.3.2 Detailed inspection

In addition to the annual and post-storm visual inspections described in **Section 4.3.1**, **full structural inspections of the Sidmouth coastal defences should be carried out every five years.**

As with the visual inspections, in order to ensure a complete and consistent set of data is recorded as part of these detailed inspections, the template provided in **Appendix J** should be used.

These inspections should also include a photographic record of the structures at the time of the inspection and these should be kept with the inspection records for future reference.

To support these detailed inspections, and with reference to **Section 3.2.2**, as there have been no as-built or post-construction surveys of the offshore breakwater structures, **it is recommended that a baseline survey of these breakwaters is undertaken in the short term against which future five-yearly surveys can then be compared.**

4.4 Environmental monitoring

The area covered by this BMP is within the vicinity of a number of environmental designations, including international and European nature conservation features, designated bathing waters, and local landscape designations (refer to **Section 2.7**). Future beach recycling, beach recharge and/or construction of new coastal defence structures along the Sidmouth BMP frontage (refer to **Sections 5.2 to 5.4**) has the potential to impact upon the some of these designations and so detailed investigation of the physical and chemical characteristics of the any proposed beach recharge source and/or new coastal defence scheme will be needed before any sediment is placed at Sidmouth, or any construction occurs.

If beach recycling or beach recharge occurs in the future, or if new coastal defence structures are constructed, there will be a need to undertake regular water quality monitoring to assess the impacts (if any) of moving/placing material along the shoreline and/or altering the coastal defence arrangement. Bathing water quality monitoring is undertaken by the Environment Agency at several locations along the BMP area (refer to **Section 2.7.3**). This data is considered sufficient to provide a robust baseline for future Water Framework Directive (WFD) assessment that would be needed as part of any potential future beach recycling or beach recharge that may occur. Post-implementation

monitoring could be delivered to ensure the WFD objectives are not compromised by any future works along the frontage.

There are many historic environment features in the area around BMP area (see **Section 2.7.8**) and **visual inspections should seek to identify any impacts on these features as a result of beach works (or indeed if 'new' features are uncovered by storm events)**. In the event of impacts or new features being identified, then the Devon Historic Environment Service should be contacted.

4.5 Physical conditions

4.5.1 Sea conditions

Wave climate is monitored by wave buoys located approximately at the -10mCD contour offshore of Dawlish Warren and West Bay (refer to **Section 2.1.1**). These wave buoys are maintained by PCO as part of the SWRCMP and recorded data is available through the PCO website (www.coastalmonitoring.org). There is currently only a short-period of data available. The continuation of data capture by these wave buoys is vital to improving the amount of information available for future assessment of typical and extreme wave climate in the area, and validating numerical models.

Tide level data is recorded by PCO at West Bay as part of the SWRCMP, and by the Environment Agency at Exmouth.

4.5.2 Storm events

The movement of material along the BMP frontage, and the risk of beach lowering leading to increased wave overtopping and/or undermining of the seawall, is significantly increased during storms as a result of increased wave action, particularly when storms waves combine with high tide levels. In order to understand the effect of storm events upon the beach response, **details of the storm conditions (waves, winds and water levels) will need to be recorded** in support of the post-storm profile surveys (refer to **Section 4.2.2**).

Data from the wave buoys at Dawlish and West Bay, the tide gauges at West Bay and Exmouth (refer to **Section 4.5.1**) should be used for obtaining details of the wave and water level conditions at the time of the storm event.

Additional information on the offshore wave climate should also be recorded from other data sources such as near real time data from the National Data Buoy Centre (www.ndbc.noaa.gov/) and the CEFAS Wavenet (www.cefas.co.uk/data/wavenet.aspx) websites. These websites provide data for a number of locations between the Atlantic and the English Channel that are relevant to the BMP frontage, and recording of this information will allow assessment of any linkages between offshore and nearshore wave climate to be made once a sufficient data set is collected.

To aid future understanding, a local wind gauge located along the promenade at Sidmouth should also be installed to record wind speed and direction as both can have a significant impact on the effect of storm events on the beach response.

This wind, wave and tide data should be recorded as part of the storm event record. This storm record should contain details of all storm events including the prevailing conditions (as discussed in this section), any pre/post-storm surveys, and effects/impacts of the event.

4.6 Warning and emergency procedures

4.6.1 Flood warning and response procedures

Flood warnings and responses are co-ordinated by the Environment Agency's Flood Incident Management Duty Officer based in Exeter. The Duty Officer procedures are available through the Environment Agency's South West Incident Management (SWIM) website (www.imflooding.co.uk) – note this is a secure site for approved Environment Agency users only and all duty officers have access to the SWIM website. Up-to-date hard copies of the procedures are held in the Environment Agency Area Incident Room in Exeter.

4.6.2 Pollution incidents

Pollution incidents can occur at varying scales. Minor pollution such as litter and small debris are typically dealt with by EDDC.

Larger pollution incidents are dealt with by a range of organisations including EDDC, Devon County Council and the Environment Agency. The responses to large pollution incidents are guided the *Devon County Council Coastal Pollution Plan* (June, 2008).

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 beaches and coastal defence assets along the BMP frontage for coastal flood and erosion risk management purposes.

Following each scheduled twice-yearly beach profile survey, the information collected is uploaded for storage and analysis to a database system that operated by the South West Regional Coastal Monitoring Programme at PCO. Additional survey data that is to be collected as per the requirements set out in this BMP, should be collected, stored and analysed in accordance with PCO quality standards and be compatible with PCO's database system (if PCO are not used to undertake the additional survey work).

Additional monitoring data, obtained from sources such as the post-storm visual walkover inspections (with associated storm event data – see **Section 4.5.2**), beach recycling logs (see **Section 4.2.4**), or defence inspection reports (see **Section 4.3**) should also be stored in the same database. The database should include any photographs taken during each survey.

This information should be used in assessing the need/potential for future beach recycling/recharge, as well as compiling future annual beach monitoring reports produced by PCO and for use in future studies along the BMP frontage.

In addition, **each year a review of all survey data should be carried out with particular focus on trigger levels defined in Section 3.3 and associated coastal flood and erosion risks**.

5 Maintenance Regime

The following describes the maintenance regime that is necessary to ensure that the beach and defences at Sidmouth continue to provide adequate coastal flood and erosion risk management of the area in the immediate future.

5.1 Maintenance programme

Table 5-1 provides an outline programme of beach maintenance works that shows the key activities to be carried out over the next five years until the next BMP review. Reference should be made to the rest of this section for more detail about the nature of the works shown in **Table 5-1**.

TABLE 5-1
Outline programme for implementing beach management works over the next 5 years

	2016		2017				2018				2019				2020				2021		
TASK	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
Coastal defence assets maintenance (as required), ensuring any defects and/or repairs are recorded consistently.																					
Undertake actions to address public safety issues identified in this BMP and by future visual inspections.																					
Undertake periodic beach recycling and/or beach recharge, guided by ongoing monitoring.																					
Undertake works to stabilise River Sid Training Wall (downstream of Alma Bridge) in order to stabilise it.																					
Undertake works to address exposed reinforcement along access ramp at Jacobs Ladder Beach to prevent risk of failure if structure is to be maintained to maximise its predicted residual life.																					
Ensure that maintenance works, when undertaken, utilise appropriate methods and materials in order to maximise effectiveness and extend structure life as long as possible into the future.																					

5.2 Ongoing works

5.2.1 Structure maintenance

Routine maintenance works to the various coastal defence structures at Sidmouth will be guided by ongoing inspection (refer to **Section 4.3**). **When either routine inspection or rapid assessment following a storm event identifies a defect in the defence, be it a crack in the defence or damage to public safety aspects of the defence (e.g. buckled hand railings or trip hazards, etc.) then the following steps are to be followed**:

1. **Increased defect monitoring** – should any defects be identified then it may be appropriate to implement an increased level monitoring rather than immediately undertaking remedial works. This could also involve the use of additional monitoring devices such as crack gauges. This step would only occur if the identified defect is not considered an immediate safety risk (i.e. this step is optional and may or may not occur prior to Step 2).
2. **Remedial works** – once an identified defect is considered to be in need of remedial work, then the design of remedial works should be undertaken and an appropriate repair specification generated. To ensure consistent information on repairs undertaken is recorded, a defence repair record template is provided in **Appendix K**.

In respect of public safety issues along the BMP frontages, the following issues need to be addressed in the immediate future (refer also to Section 1.4.3 and/or Appendix G):

- Along the Jacob's Ladder Beach to Clifton Walkway section of the BMP frontage:
    a. The hand railing in a number of locations is corroded, with full thickness loss in some places. Replacement is advised for safety reasons.
    b. A life ring was found to be partially buried due to it being situated on the beach. It is suggested that the life ring be moved so as it can be easily accessed and used if required.
- Along the River Sid Training Wall, hand railing could be extended further than its present extent, given the considerable height above the beach exists (particularly when there are periods of low beach levels along East Beach).

5.2.2 Beach recycling

Beach recycling is to occur periodically, guided by ongoing monitoring and with regards to trigger levels defined in **Section 3.3**, to move sediment along the frontage from areas of accretion to areas of erosion. This will continue to be the case after implementation of the scheme to deliver the preferred option described in **Section 1.1**.

5.2.3 Beach recharge

Beach recharge is next expected to occur along the BMP frontage as part of a scheme to implement the preferred option described in **Section 1.1**. Work to develop that scheme in the immediate future (refer to **Appendix D**) will determine volume of recharge required and where to place it along the frontage as part of that scheme.

Further beach recharge is expected to occur periodically after scheme construction, guided by ongoing monitoring and with regards to trigger levels defined in **Section 3.3**, to ensure there is sufficient volume of sediment in the system and along the shoreline to provide the required beach levels.

5.2.4 Modifications to existing defences

As part of works to implement the preferred option described in **Section 1.1**, it is expected that the East Pier Rock Groyne and the River Sid Training Wall seawards of Alma Bridge will be modified (shortened). Further detailed investigations (refer to **Appendix D**) will define these modifications as part of scheme development.

However, in advance of any such modifications to those structures, **the River Sid Training Wall seawards of Alma Bridge requires immediate action to stabilise it**. As a minimum it requires concrete patching of

cracks and holes, addressing corrosion and abrasion in the steel sheet pile toe, and construction of scour protection along the toe. There is also a need to address risk of instability from wave loading on the western side of the training wall where there is no material on eastern side. Measures to reduce wave reflection along both sides of the training wall would also be beneficial to reduce wave scour.

In addition, **along Jacob's Ladder Beach there is exposed reinforcement along the access ramp at which needs to be addressed in near future** to prevent risk of failure if structure is to be maintained to maximise its predicted residual life.

5.3 Alarm trigger level works

If the Alarm Level (refer to **Section 3.3**) is reached, the primary response will be to undertake more frequent monitoring of the beach levels through visual inspection (refer to **Section 4.2.8**) to determine if it is persistent or if it is merely a temporary occurrence as a result of naturally dynamic beach level fluctuations. This more frequent monitoring will ensure that if the beach level lowers further to the Crisis Level, then this will be observed in a timely manner and not be missed by less frequent planned beach profile surveys.

In addition to increased frequency of monitoring, if the Alarm Level is reached then consideration should also be given to recycling beach sediment along the frontage. Any decision to undertake recycling in this situation will need to be based upon an assessment at the time of the beach volume distribution along the BMP frontage, and need to consider if recycling of material from one area to another will adversely affect beach levels, and so Standard of Protection, in the source area (refer also to **Section 5.2.2**).

If Alarm Levels persist, then implementation of a beach recharge campaign could also be considered (refer also to **Section 5.2.3**).

5.4 Crisis trigger level works

If a Crisis Level (refer to **Section 3.3**) is identified as being reached on a profile along the Sidmouth frontage, the immediate task would be to carry out a visual inspection of the profile(s) concerned to validate the survey data and that it is representative of the general beach area (i.e. not a localised 'low' point). If the Crisis Level is shown to be a general problem to be addressed, then timely action will be required to safeguard the integrity of the seawall and/or reduce cliff erosion risk along East Beach and subsequent flood risk to Sidmouth Town by outflanking of the River Sid defences from this direction.

Ultimately the response to the Crisis Level being reached along a sizeable length of the frontage will be for capital beach recharge works to be carried out. If not already in process, then planning and implementation of capital works should begin (refer also to **Section 5.2.3**).

Along East Beach, the need for further capital beach recharge works will need to be considered alongside the extent of exposure posed to the River Sid Western Wall and whether or not at the time being considered, it is more sustainable to upgrade the wall rather than to continue to recharge East Beach (refer to **Section 3.3**).

5.5 Implementation of works

Should any works described in **Sections 5.2 to 5.4** be required along any part of the BMP frontage, which will be guided by ongoing monitoring (refer to **Section 4**), then it is important to **ensure that maintenance works utilise appropriate methods and materials in order to maximise effectiveness and extend structure life as long as possible into the future**.

In addition, when works are undertaken then the items detailed below will also form important considerations for actual implementation of any works.

5.5.1 Plant requirements

No specific plant requirements are defined in this BMP.

The plant required to undertake capital works will depend upon the nature of the works and should be considered by the designer and contractor at the time any such works are to occur along the frontage covered by this BMP. A key factor in this regards will be the capacity of the access points (refer to **Section 5.5.2**).

5.5.2 Access

When any works are to be carried out along the Sidmouth frontage, consideration will need to be given as to the access requirements given the size of any plant being considered, and with regards to the limited tidal window for working along the respective frontage (particularly along East Beach). However, the following locations are likely to be suitable for plant access to the beach:

- Access ramp from Peak Hill Road to Jacob's Ladder Beach at the western end of the BMP frontage.
- Access ramp at the landwards end of York Steps and East Pier rock groynes along Sidmouth Town part of the BMP frontage.
- Access ramp/slipway adjacent to the River Sid Training Wall seawards of the Alma Bridge towards the eastern end of the BMP frontage.

5.5.3 Public access, amenity and safety

Beach and coastal defence works, when they are required, should avoid the peak holiday season, weekends and public holidays where possible. 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 elsewhere has shown that closing the beach entirely is likely to be impractical, **and it is suggested that a banks-man is present with each machine, and that spare personnel along with signage are employed to direct public access to safe sections of the shoreline during works.**

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 L** contains a best practice guide on how to communicate with the public and local businesses when undertaking beach maintenance works.

5.5.4 Notifying others

In addition to communicating effectively with the public (refer to **Section 5.5.3**), **it is recommended that explicit notification of any works, and contact details should there be any queries, be provided to the following organisations/groups as appropriate depending upon the location where works are occurring:**

- The local Town Council;
- The Crown Estate;
- The Marine Management Organisation;
- The National Trust;
- South West Water;
- Local fishermen and those people who have a day to day interest in what is happening along the frontage where works are to occur, i.e. any businesses that may be affected;
- Local residents directly affected by any road or access closures along the frontage when works occur;
- Sidmouth lifeboat station;
- Natural England (in relation to nature conservation and coastal access interests);
- Devon Historic Environment Service (in relation to historic environment interests).

6 Action Plan

6.1 Overview

This section provides a summary of the recommendations made above in the form of an Action Plan (**Table 6-1**). The Action Plan is presented below and identifies actions grouped by type as being either for 'Management', 'Monitoring', 'Maintenance' or 'For Future Studies', although there is some inter-relationship between these broad action types.

It is intended that this Action Plan be used to guide future management of this area.

TABLE 6-1
Sidmouth BMP Action Plan

Action No.	Action Description	Who by?	Date action First Defined?	When by?	Related BMP Section	Current Status
MANAGEMENT ACTIONS						
MAN_001	Undertake a review of the BMP in 5 years' time.	EDDC	September 2016	December 2021	Section 1.2	Not started
MAN_002	It is strongly recommended that a Scoping Opinion be sought from the MMO in the immediate future to clarify this and determine whether or not a Marine Licence is required for ongoing beach recycling covering a period of ten years or so (in advance of any new scheme being implemented) and, if needed and given the time-scale involved in obtaining a Marine Licence (typically 14 weeks), obtain a Marine Licence from the MMO in good time to enable beach management works to be implemented when it becomes required.	EDDC	September 2016	December 2017	Section 1.6.1	Not started
MAN_003	If beach recycling works are to occur along the East Beach part of the BMP area, without a Marine Licence and/or planning permission being in place, then consent will always be needed from Natural England each time works are carried out in the SSSI area.	EDDC	September 2016	As required	Section 1.6.1	Not started
MONITORING ACTIONS						
MON_001	Monitoring of beach profiles every spring and autumn by PCO is to continue as part of the SWRCMP	SWRCMP	September 2016	Ongoing	Section 4.2.1	Ongoing (current phase funded to 2021)
MON_002	It is recommended that the last 3 digits of at least some, if not all, of the Profile IDs listed in Table 4-2 be marked upon the seawall at Sidmouth to allow ease of identification during future walkover inspections of the area.	EDDC	September 2016	December 2016	Section 4.2.1	Not started
MON_003	In order to improve understanding of sediment movements along the BMP frontage, it is recommended that EDDC work with PCO to make the following changes to the current survey regime, to either be part of the SWRCMP or in addition to: (c) As a minimum, a greater number of profiles should be surveyed on a regular basis, with three profiles within each groyne bay (one at each end and one in the middle) and three profiles along East Beach. (d) To improve data density and so volume change analysis, consideration should be given to using a grid-base GPS survey or terrestrial laser scan approach for each survey.	EDDC / SWRCMP	September 2016	March 2017	Section 4.2.1	Not started
MON_004	In order to capture more post-storm surveys in the future, a number of local authority staff who are regularly on-site should be encouraged to report to a key contact in EDDC and/or the Environment Agency as to when a storm event has occurred and resulted in notable change in the beach levels against the seawall. The key contact in EDDC and/or the Environment Agency can then call-out post-storm surveys via PCO. To support this, some basic training should be provided to the staff who are regularly on-site so they know what to look for. This could be based upon the Environment Agency's *Condition Assessment Manual* (Environment Agency, 2012b) or key beach crest levels marked upon the seawall (refer also to **Action #MON_010**). The arrangements for this, once confirmed, should be captured in a formal communication document so that the role can be communicated to others in the future.	EDDC	September 2016	December 2016	Section 4.2.2	Not started
MON_005	Undertake a survey of underlying bed level.	EDDC	September 2016	If the opportunity arises and/or funding is available	Section 4.2.3	Not started
MON_006	Whenever beach recycling works occur in the future, then beach recycling logs are to be maintained by those undertaking the works, with the records then being passed to EDDC and PCO (see **Appendix I**). This could be supported by completing a pre- and post-beach recycling survey for the first one or two beach recycling campaigns to provide actual data against which the recycling logs can be validated.	EDDC	September 2016	Whenever beach recycling works occur.	Section 4.2.4	Not started

Action No.	Action Description	Who by?	Date action First Defined?	When by?	Related BMP Section	Current Status
MON_007	Undertake more regular (annual) bathymetry surveys for the next five years outside of those by the SWRCMP.	EDDC	September 2016	Annually each Spring	Section 4.2.5	Not started
MON_008	Annual sediment sampling (grab samples and particle size distribution analysis) should occur over the next five years in support of bathymetry surveys (refer to **Action #MON_007**). Samples should be collected at about the same locations each time and cover both the beach and nearshore area.	EDDC	September 2016	Annually each Spring	Section 4.2.6	Not started
MON_009	In order to validate and calibrate numerical models to inform design and impact assessment as part of developing the preferred option (refer to **Action #FUT_001**), current monitoring devices (e.g. ADCP/AWAC) should be deployed in the immediate future for a period of several months to capture data to aid this work.	EDDC	September 2016	July 2017	Section 4.2.7	Not started
MON_010	Visual walkover inspections should be undertaken by EDDC to monitor beach crest level against the seawall and groynes at Sidmouth. To aid the visual inspection, markers defining the beach level in relation to the beach crest level trigger levels could be marked on the seawalls at Sidmouth. These visual walkover inspections should also measure 'dip levels' along the frontage (i.e. distance drop from the seaward edge of the seawall to the beach) to capture useful information about the variation in beach level against the seawall in the periods between regular beach profile surveys.	EDDC	September 2016	Ongoing (at least annually and post-storm)	Section 4.2.8	Not started
MON_011	Aerial photography and LiDAR surveys are to continue to be flown every one to three years as part of the SWRCMP. With regards to the aerial photography, it is recommended that these continue to be delivered as high quality aerial photo surveys – similar to those collected in recent years – and that when undertaken, the survey specification should state the need to achieve a RMSE of better than +/-10cm.	EDDC / SWRCMP	September 2016	When aerial photography surveys are flown	Section 4.2.9	Not started
MON_012	In support of the aerial photography and LiDAR surveys (refer to **Action #MON_011**), it is recommended that the East Cliff area also be monitored using dGPS surveys. This may comprise survey of the whole cliff edge position (if safe to do so), or setting up an inland datum and surveying distance to cliff edge. In both cases, a six-monthly survey is recommended.	EDDC	September 2016	Every six months from January 2017	Section 4.2.9	Not started
MON_013	To ensure assets remain in good to fair condition, ongoing maintenance is required and this will be informed by regular re-inspection of the defences in a similar way to that reported in Appendix G at least once every two years, although annually would be preferable if budgets allow.	EDDC	September 2016	Every one to two years, in Spring	Section 4.3.1	Not started
MON_014	Full structural inspections of the Sidmouth coastal defences should be carried out every five years.	EDDC	September 2016	July 2021	Section 4.3.2	Not started
MON_015	To support detailed inspections (refer to **Action #MON_014**), as there have been no as-built or post-construction surveys of the offshore breakwater structures it is recommended that a baseline survey of these breakwaters is undertaken in the short term against which future five-yearly surveys can then be compared.	EDDC	September 2016	July 2017	Section 4.3.2	Not started
MON_016	If beach recycling or beach recharge occurs in the future, or if new coastal defence structures are constructed, there will be a need to undertake regular water quality monitoring to assess the impacts (if any) of moving/placing material along the shoreline and/or altering the coastal defence arrangement.	EDDC	September 2016	As required, when beach recycling/ recharge occurs	Section 4.4	Not started
MON_017	There are many historic environment features in the area around BMP area (see **Section 2.7.8**) and visual inspections should seek to identify any impacts on these features as a result of beach works (or indeed if 'new' features are uncovered by storm events). In the event of impacts or new features being identified, then the Devon Historic Environment Service should be contacted. Refer also to **Action #MON_010**.	EDDC	September 2016	Ongoing	Section 4.4	Not started
MON_018	Details of the storm conditions (waves, winds and water levels) are to be recorded in support of the post-storm profile surveys.	EDDC	September 2016	Ongoing	Section 4.5.2	Not started
MON_019	A local wind gauge located along the promenade at Sidmouth should be installed to record wind speed and direction as both can have a significant impact on the effect of storm events on the beach response.	EDDC	September 2016	July 2017	Section 4.5.2	Not started
MON_020	Each year a review of all survey data should be carried out with particular focus on trigger levels defined in Section 3.3 and associated coastal flood and erosion risks.	EDDC	September 2016	Annually	Section 4.7	Not started
MAINTENANCE ACTIONS						

Action No.	Action Description	Who by?	Date action First Defined?	When by?	Related BMP Section	Current Status
MAI_001	When either routine inspection or rapid assessment following a storm event identifies a defect in the defence, be it a crack in the defence or damage to public safety aspects of the defence (e.g. buckled hand railings or trip hazards etc.) then the following steps are to be followed: 1. **Increased defect monitoring** – should any defects be identified then it may be appropriate to implement an increased level monitoring rather than immediately undertaking remedial works. This could also involve the use of additional monitoring devices such as crack gauges. This step would only occur if the identified defect is not considered an immediate safety risk (i.e. this step is optional and may or may not occur prior to Step 2). 2. **Remedial works** – once an identified defect is considered to be in need of remedial work, then the design of remedial works should be undertaken and an appropriate repair specification generated. To ensure consistent information on repairs undertaken is recorded, a defence repair record template is provided in **Appendix K**.	EDDC	September 2016	As required	Section 5.2.1	Not started
MAI_002	In respect of public safety issues along the BMP frontages, the following issues need to be addressed in the immediate future (refer also to **Section 1.4.3** and/or **Appendix G**): • Along the Jacob's Ladder Beach to Clifton Walkway section of the BMP frontage: a. The hand railing in a number of locations is corroded, with full thickness loss in some places. Replacement is advised for safety reasons. b. A life ring was found to be partially buried due to it being situated on the beach. It is suggested that the life ring be moved so as it can be easily accessed and used if required. • Along the River Sid Training Wall, hand railing could be extended further than its present extent, given the considerable height above the beach exists (particularly when there are periods of low beach levels along East Beach).	EDDC	September 2016	June 2017	Section 5.2.1	Not started
MAI_003	Undertake works to stabilise the River Sid Training Wall seawards of Alma Bridge.	EDDC	September 2016	June 2017	Section 5.2.4	Not started
MAI_004	Along Jacob's Ladder Beach there is exposed reinforcement along the access ramp at which needs to be addressed in near future to prevent risk of failure if structure is to be maintained to maximise its predicted residual life.	EDDC	September 2016	June 2017	Section 5.2.4	Not started
MAI_005	Should any works be required along any part of the BMP frontage, then it is important to ensure that maintenance works utilise appropriate methods and materials in order to maximise effectiveness and extend structure life as long as possible into the future.	EDDC	September 2016	Ongoing	Section 5.5	Not started
MAI_006	Beach and coastal defence works, when they are required, should avoid the peak holiday season, weekends and public holidays where possible. 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. It is also suggested that a banks-man is present with each machine, and that spare personnel along with signage are employed to direct public access to safe sections of the shoreline during works. Information boards should be displayed whilst the works are being carried out to explain what is being done and why.	EDDC	September 2016	When works are being planned/undertaken	Section 5.5.3	Not started
MAI_007	It is recommended that explicit notification of any works, and contact details should there be any queries, be provided to the following organisations/groups as appropriate depending upon the location where works are occurring: • The local Town Council;	EDDC	September 2016	When works are being planned/undertaken	Section 5.5.4	Not started

Action No.	Action Description	Who by?	Date action First Defined?	When by?	Related BMP Section	Current Status
	• The Crown Estate; • The Marine Management Organisation; • The National Trust; • South West Water; • Local fishermen and those people who have a day to day interest in what is happening along the frontage where works are to occur, i.e. any businesses that may be affected; • Local residents directly affected by any road or access closures along the frontage when works occur; • Sidmouth lifeboat station; • Natural England (in relation to nature conservation and coastal access interests); Devon Historic Environment Service (in relation to historic environment interests).					
FOR FUTURE STUDIES/RESEARCH						
FUT_001	Undertake tasks to develop and implement the preferred option is to be developed and implemented as soon as possible as per the Forward Plan defined in **Appendix D**. This is to include Appropriate Assessment in line with the Habitats Regulations Assessment requirements (see **Appendix E**).	EDDC	September 2016	December 2019	Sections 1.1 and 1.2	Not started
FUT_002	Included within the adopted East Devon Local Plan is a commitment to designate a Coastal Change Management Area (CCMA) at Sidmouth to manage the impact of future coastal change, though no timescale for CCMA designation is stated. Monitoring data defined by this BMP in Section 4 should be used to inform CCMA development within the next few years.	EDDC	September 2016	December 2018	Section 1.7.2	Not started
FUT_003	Once a greater amount of post-storm survey data is gathered, undertake study to determine if sufficient understanding of the conditions of most concern can be developed through review of captured data to define criteria to trigger pre-storm profile surveys. If criteria can be determined, and funding is available, seek to implement pre-storm surveys. This is not a key requirement of the monitoring regime but would provide useful additional understanding of the beach behaviour in storm events to inform future management decisions.	EDDC	September 2016	If the opportunity arises and/or funding is available	Section 4.2.1	Not started

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Appendix A
Economics Baseline Report

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Appendix B
Coastal Processes Baseline Report

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Appendix C
Options Appraisal Report

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Appendix D
Forward Plan to Develop Preferred Option Scheme

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Appendix E
Habitats Regulation Assessment (HRA)

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Appendix F
Environmental Designation Information

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Appendix G
Coastal Defences Baseline Assessment Report

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Appendix H
Contact Details

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Appendix I
Beach Recycling Log Template

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Appendix J
Defence Inspection Pro-Forma

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Appendix K
Defence Repair Pro-forma

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Appendix L
Environment Agency Guide to Engagement

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