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Isles of Scilly – Design Services for Off Islands Coastal Erosion Defence and Dune Management

Climate Adaptation Scheme - Preliminary Design -
St Martin's



DKR6499-RT004-R02-00

December 2021

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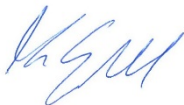
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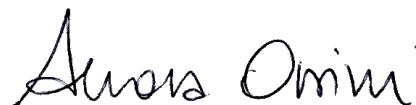
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Document authorisation


Prepared



Approved



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Executive Summary

This report presents the soft interventions proposed at two beaches on St Martin's Island to help protect the dune systems at the rear of the beaches to ensure that the dunes continue to protect the island and its infrastructure from the threat of climate change.

St Martin's Island is a sheltered island to the north of St Mary's and is the location of true dune systems to the south of the island. Two beaches have previously been identified as under possible threat from climate change and HR Wallingford have reviewed the previous proposals at these sites and following a site visit to inspect the existing conditions at each of these beaches, have applied our expertise on the impacts of climate change to propose the solutions to protect these dunes and beaches.

The dunes at both the sites were showing positive signs of self-repair following the 2014 storms that hit the Isles of Scilly and in agreement with previous recommendations no hard coastal defences have been identified as required at these two sites. There are signs of erosion due to human activity from access to the beach and from cabling that has become exposed at the Lower Town Beach and it is recommended that the Council of the Isles of Scilly manage and control access to the beaches through the dunes to ensure that single access points do not get severely eroded and become weak points in the dune defences.

The measures proposed include signage and fencing to be implemented by the Council, and erosion protection surfacing of the beach access point on the Lower Town Beach to help prevent further erosion of the dunes at this key access point.

Contents

Executive Summary

1.	Introduction	1
1.1.	Abbreviations	1
2.	Scope	1
3.	Reference Documents	3
4.	Holds	3
5.	Background	3
6.	Site Visit	6
7.	Design Basis	8
7.1.	Design life	8
7.2.	Coordinate system	8
7.3.	Vertical datum	8
7.4.	Data	8
7.4.1.	Topographic and bathymetric data	8
7.5.	Water Levels	9
7.5.1.	Sea and tidal Levels	9
7.5.2.	Extreme water levels	9
7.6.	Waves	9
8.	Option Development	9
8.1.	Site 27 Lower Town Beach	9
8.1.1.	Recommended option	9
8.1.2.	Efficacy and advantages	10
8.1.3.	Constraints and disadvantages	11
8.2.	Site 28 Upper Town Beach	11
8.2.1.	Recommended option	11
8.2.2.	Efficacy and advantages	11
8.2.3.	Constraints and disadvantages	11
9.	Appraisal	11
10.	Preferred Options	12
	Appendices	13
A.	Drawings	
B.	Supplier information	
	Figures	
	Figure 2.1: Location of sites	2
	Figure 5.1: Defended flood risk - 2067	4

Figure 5.2: Site 27 Middle Town well	5
Figure 5.3: Site 28 Upper Town well.....	6
Figure 6.1: Slipway access to Lower Town beach.....	7
Figure 6.2: Exposed cabling at top of the beach	7
Figure 6.3: Site 28/29 recovering dune.....	7
Figure 7.1: Extreme sea level data	9
Figure 8.1: Ste 27 Lower Beach fencing and main access point erosion control.....	10

Tables

Table 3.1: Reference used for the design.....	3
Table 5.1: OBC preferred options	5
Table 7.1: Tide Tables	9
Table 10.1: St Martins recommended options	12

1. Introduction

The Isles of Scilly have received funding from the European Regional Development Fund and the Environment Agency to complete a range of climate change adaptation works in the Scilly Isles of St Agnes, Bryher and St Martins. These include interventions, such as coastal protection works, renourishment of existing beaches and dunes, upgrade and/or construction of new defences, aiming to reduce the impact of coastal erosion and wave overtopping exacerbated by future climate change scenarios.

The Isles of Scilly are one of the areas in Europe most vulnerable to the effects of climate change, sea level rise and consequent increased risk of inundation, overtopping and coastal erosion.

The council of the Isles of Scilly has commissioned HR Wallingford to undertake this work to evaluate the risk at the sites identified as being most vulnerable and develop designs for the coastal works proposed. The present report describes the approach to the identification, selection, appraisal and development of the schemes for St Martin's Island.

Conceptual options were suggested and were preliminary appraised as part of previous studies (JBA, 2020). These have been qualitatively appraised together with suitable alternatives considered after the site inspection. The preferred schemes will then progress to detailed design as required.

The presented report is a RIBA Stage 3 Design Engineering Report. The measures identified for St Martin's are 'soft' measures and so this report includes option appraisal and selection and development of the preferred option to a suitable level for Planning Application submission.

1.1. Abbreviations

AOD	Above ordnance datum
BMP	Beach management plan
GI	Ground investigation
OBC	Outline business case
RIBA	Royal Institute of British Architects
RFP	Request for Proposal
SPA	Special Protection Area
SSSI	Site of special scientific interest

2. Scope

The scope of the work includes the following key elements for the sites on St Martin's, as identified in the OBC (Ref. 2 in Table 3.1) and in the RFP (Ref. 1 in Table 3.1):

- Review of documents, data and information;
- Review of wave and water level information;

- Site Visit, visual inspection of flood and coastal protection;
- Beach stability desk study;
- Option appraisal, evaluation and selection of preferred option;
- Scheme design RIBA Stage 3;
- Scheme Design RIBA Stage 4;
- Ground Investigation Specifications.

The sites on St Martin's that were examined as part of this study are listed below with the locations of the sites shown in Figure 2.1. Note, Site 26 was not included in the scope of work for this study:

- Site 27 - Lower Town Beach
- Site 28/29 - Higher Town Beach

A more detailed plan of the St Martin's sites, as well as identification of the some of the key features, is included in Appendix A.

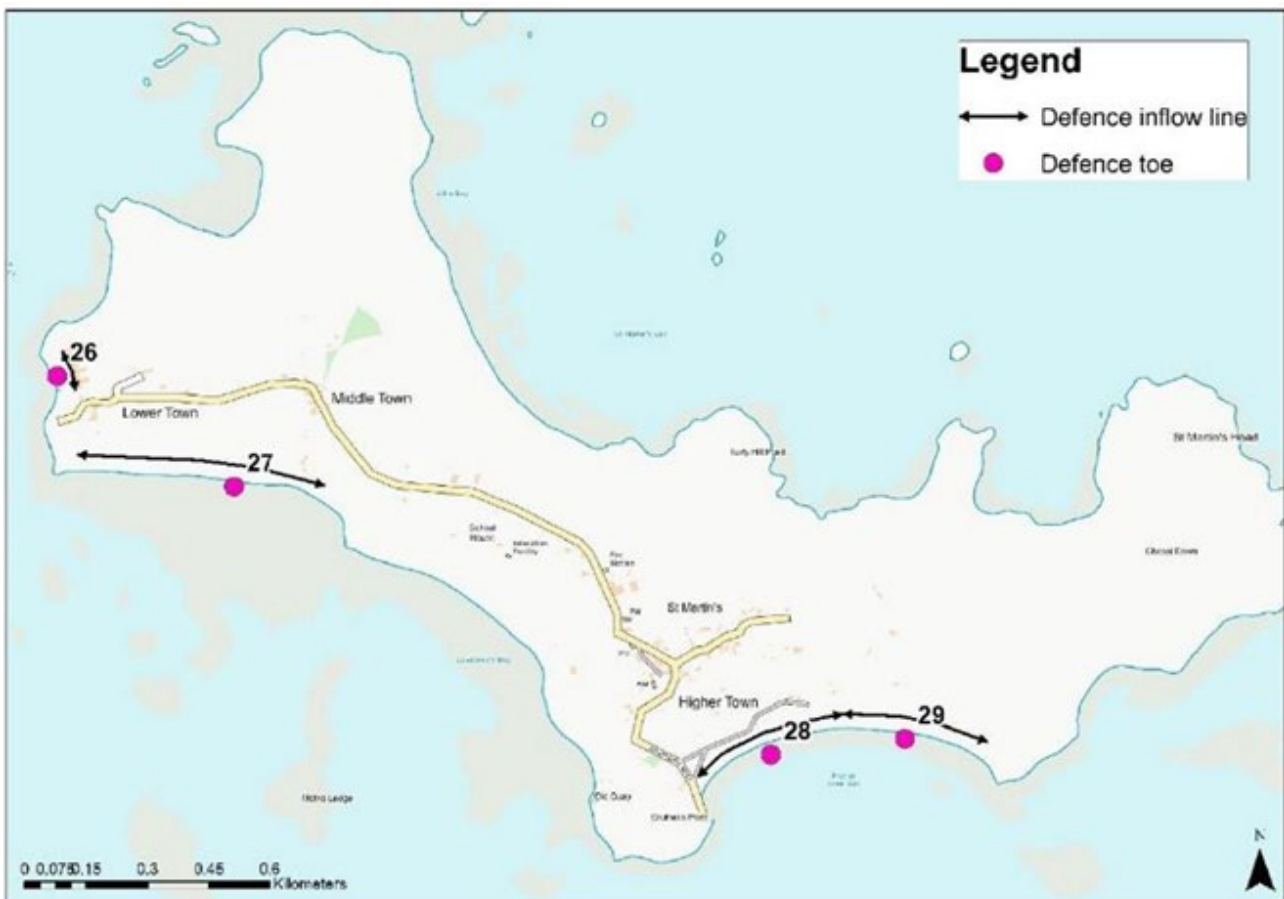


Figure 2.1: Location of sites

Source: Council of Isles of Scilly (OBC, 2020)

3. Reference Documents

Data from the documents/sources described in Table 3.1 below, have been provided by the Council of the Isles of Scilly to be used for the purpose of the design.

Table 3.1: Reference used for the design

Reference Number	Document Title	Published	Provided by
1	Scope of Work- RFP- Annex B_Brief for Off-Island Coastal Defence Works_Final	2021	Council of the Isles of Scilly
2	Adaptive Scillies – Natural Dune Restoration & Flood Resilience – FCERM Outline Business Case	JBA, Arcadis, Council of the Isles of Scilly, April 2020	Council of Isles of Scilly
3	Isles of Scilly – Coastal Flood Modelling – Final Main Report	JBA, Environment Agency, February 2019(a)	Council of Isles of Scilly
4	Isles of Scilly – Coastal Flood Modelling- Model development Report	JBA, Environment Agency, February 2019(b)	
5	DKR6499_RT01-Site Visit Notes	HR Wallingford 2021	HR Wallingford
6	SMP2	2010	Council of the Isles of Scilly
7	SMP2 interim review	2016	Council of the Isles of Scilly

4. Holds

Some HOLDS exist at this preliminary design stage due to insufficient information. The preliminary design can be developed without these data, but these items will need to be addressed before investment decisions and prior to start of construction:

- Detailed Topographic survey (up to low water contour);
- Economic Appraisal, BoQ and detailed costing developed in the OBC;
- Ground Investigation Report.

5. Background

St Martin's is a 3km long island to the north of St Mary's and to the east of Tresco. The island is the most sheltered of the populated islands of the Scilly Isles, especially on the southern side which is evident from the shallow extent of sand that can be seen in aerial imagery, see Appendix A. The island also has what can be classed as sand dunes on its southern coast. This is unlike other islands where what are described as dunes are more typically sand embankments at the rear of beaches. These dunes represent an important

habitat that should be protected against possible climate change as well as protecting properties and infrastructure from wave inundation and potential flooding.

The JBA modelling undertaken for the Environment Agency identified that there were areas of the island at risk of flooding but no residential properties were at risk for the present day, 2067 or even 2117 with the extant defences. The modelled flood extent for 2067 is reproduced in Figure 5.1.



Figure 5.1: Defended flood risk - 2067

Source: JBA (2019)

The OBC (Ref. 2) in 2020 identified that low overtopping and erosion were expected and so the greatest risk to the dune was from human use. It was recommended that the frontages should work with the natural processes and some initial dune restoration and protection would assist in this process. The OBC recommendations for the 2 sites are listed in Table 5.1. Note that there was confusion in the identification of the sites in the OBC and the correct site identifications are included in this table. The freshwater supply identified near the campsite at Site 27 and the cricket pitch at Site 28 are both wells. Both of these are near the potential flood extents, so it will be important to ensure that the dunes in front of these wells retain the current protection level and that lower and wider access points are not created. These locations are shown as *W* in Figure 5.2 and Figure 5.3.

Table 5.1: OBC preferred options

Option	Site	Protecting	Aim	Issue	Activity
1M	Lower Town Site No. 27	Freshwater supply	Prevent overtopping	Low section of dune	Fence off the 25% most damaged, weakest sections front and rear over 100 m to give them the chance to recover.
2M	Higher Town Site No. 28 and No. 29)	Freshwater supply	Prevent overtopping	Low section of dune	Sensitively restore 200 m of dune with in-situ materials, supplemented with planting and transposing to protect the most damaged & compromised 25% of dunes, reroute the important coastal path. Potentially protect beach access tracks from erosion with boardwalks.

Source: From RFP – provided by Council of Isles of Scilly

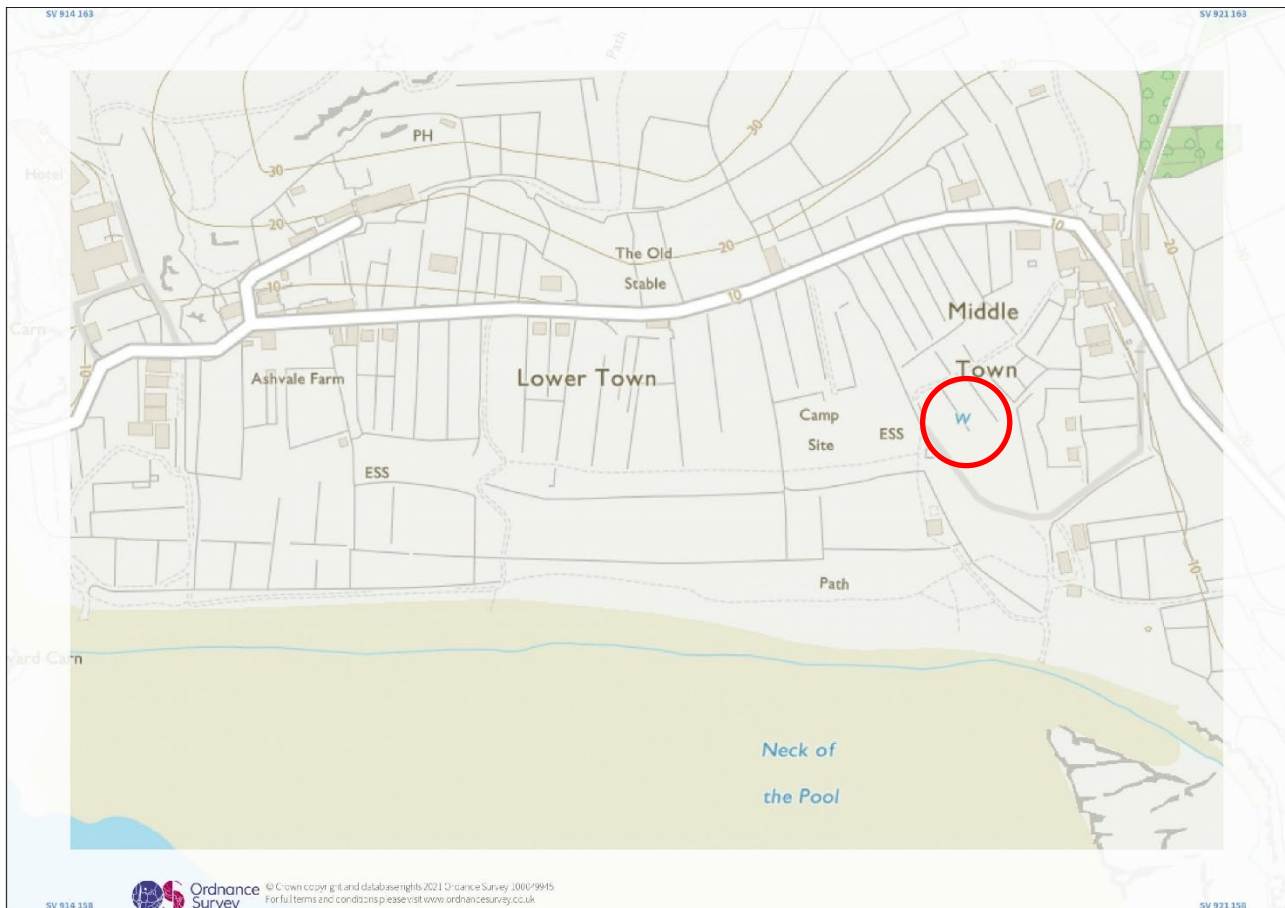


Figure 5.2: Site 27 Middle Town well

Source: Ordnance Survey

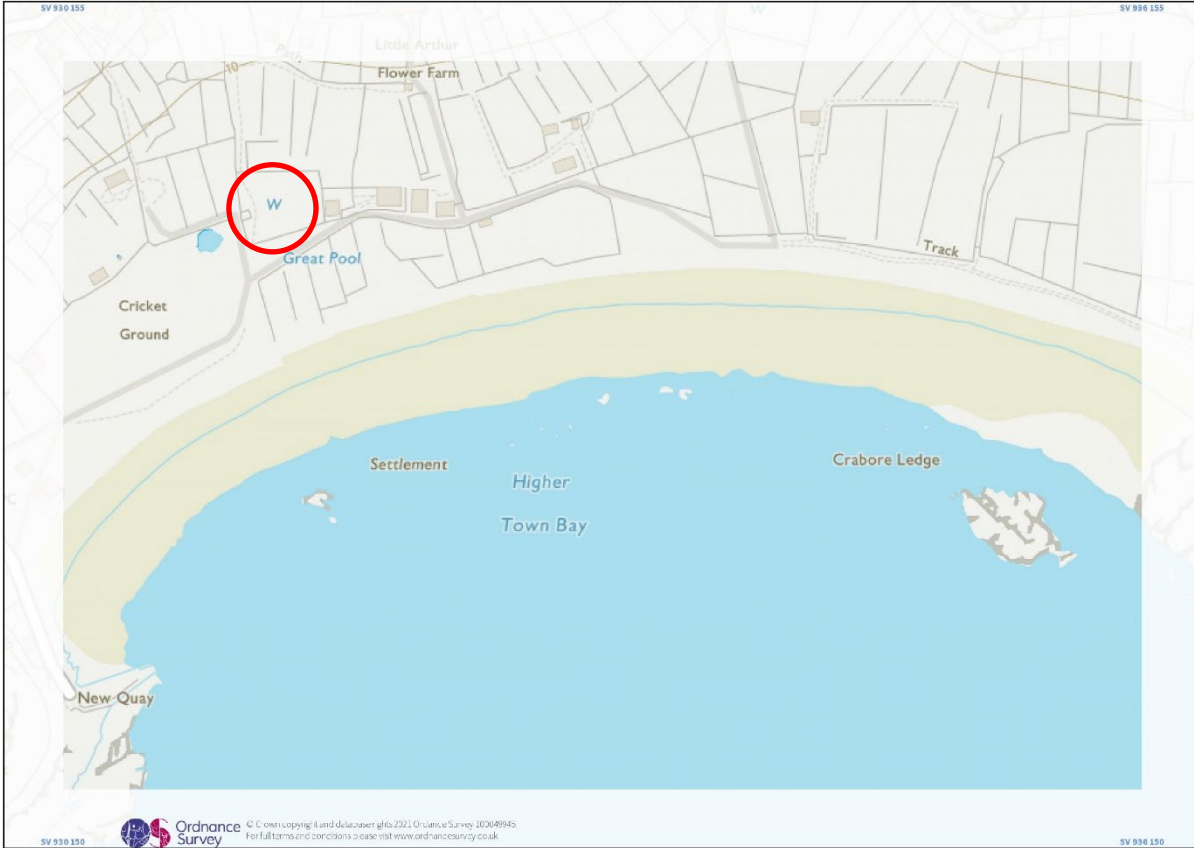


Figure 5.3: Site 28 Upper Town well

Source: Ordnance Survey

6. Site Visit

A site visit was attended on 17th June and each of the sites was walked in their entirety. The preliminary assessment agreed with the JBA recommendations that human use was the principal cause of some local erosion which is generally around access points to the beach. Some evidence of the 2014 storms could be seen but the dunes seem to be recovering well with increasing successional grass coverage.

At Site 27 the two main locations highlighted as requiring some intervention were the beach access slipway at the west of the beach, Figure 6.1, and an approximate 80 m stretch of the top of the beach immediately to the east of the slipway where utility cabling has become exposed, Figure 6.2.



Figure 6.1: Slipway access to Lower Town beach



Figure 6.2: Exposed cabling at top of the beach

There are several other access points to the beach which are informal, including several in the vicinity of the well. These do have the potential to widen and deepen thereby damaging the dunes and increasing flood risk, however current erosion was not significant.

At Site 28 there was also evidence of some erosion due to the 2014 storms, but again the dunes indicated good natural recovery as shown in Figure 6.3. There were several informal access points along the beach that were leading to some erosion, but again this is not currently significant.



Figure 6.3: Site 28/29 recovering dune

7. Design Basis

The basic design basis for the schemes proposed for St Martin's are summarised in this section. The proposed works are for erosion control and not any coastal protection works. The design basis is therefore focused on design life for the proposals.

7.1. Design life

The design life for the coastal scheme is 25 years.

7.2. Coordinate system

National Grid for plane coordinates.

7.3. Vertical datum

All levels are shown in m OD.

7.4. Data

7.4.1. Topographic and bathymetric data

The following topographic data was used:

- LiDAR downloaded from: <https://environment.data.gov.uk/DefraDataDownload/?Mode=survey>:
 - Digital Surface Model (DSM) - this LiDAR data type was chosen for consistency and better understanding when displaying data in Excel plots. Generally a DTM would be preferable but in this case, not available for all years of interest.
 - Years used: 2011, 2014, 2018 and 2020.

During the analysis of the LiDAR data, 'discrepancies' were apparent between surveys regarding elevation ('z' values). To address this issue, an additional elevation check was carried out using profile data from the Channel Coastal Observatory (CCO). The CCO data provided topographical coastline profiles using the same vertical datum (m ODN) as the LiDAR, therefore a local comparison could be made against the LiDAR datasets. This allowed an informed decision to be made regarding what was a 'realistic' elevation for a particular match of survey year. Following on from this, it was decided that the 2011 LiDAR (earliest year) values should be used as the baseline to adjust the other LiDAR survey to, thus making all the datasets nominally comparable. Hard point elevation values (roads surfaces, concrete slipways) were extracted from the same positions in all LiDAR datasets in order to work out an average difference (adjustment) between a baseline year and the other years of interest. The average adjustment values were applied to the 2014/18/20 datasets so these could be brought in line with the 2011 baseline LiDAR.

7.5. Water Levels

7.5.1. Sea and tidal Levels

Table 7.1: Tide Tables

Level	Elevation (m CD) -	Elevation (m OD) -
MHWS	5.68	2.77
MHWN	4.35	1.44
MLWN	2.04	-0.87
MLWS	0.73	-2.18
LAT	0.09	-2.82

Source: HR Wallingford

7.5.2. Extreme water levels

Extreme sea levels were based on predictions published in the Environment Agency's Coastal Flood Boundaries report, Environment Agency (2018). These were updated to the present (2021) to account for likely rises on sea levels since 2017, the base date for these levels, University of Colorado (2021), and estimated changes in land levels since this date, Bradley *et. al.* (2008).

Site CFB Chainage	Extreme still water level for the year 2017 per AEP (mODK)										
	50%	20%	10%	5%	4%	3.33%	2%	1.33%	1%	0.5%	0.1%
ESL 0	3.51	3.59	3.64	3.69	3.71	3.72	3.75	3.78	3.80	3.84	3.95

Figure 7.1: Extreme sea level data

Source: JBA (2019)

7.6. Waves

No coastal defence improvements against wave action are proposed on St Martin's and instead dune management was identified in the OBC as the most appropriate to provide protection for the 75 design year return period under the do something scenario. Extreme waves and water level combinations have not been run as they have been for St. Agnes and Bryher.

8. Option Development

8.1. Site 27 Lower Town Beach

8.1.1. Recommended option

The OBC preferred option for Site 27 was for fencing off the most sensitive area of dunes at the rear of beach to help recovery by limiting access to this area and encouraging accretion of sand at the foot of the dunes. Following the site visit, the recommendations of this study concur with the OBC option, and the area

to the east of the access track where cabling has become exposed is recommended for this protection. Investigations into what type of cabling and the routing are underway, but based on the signage it is assumed that these are telecommunication cables. Additional erosion protection for the beach access at the west of the beach is also recommended. This is to be an open grid product appropriate for vehicle loading that will fill with sand to match the existing appearance whilst providing erosion protection to this area limiting any further lowering of the crest level. Literature on an example product, X-Grid by Ketel, is included in Appendix B.

The approximate areas identified for fencing and the beach access extent of erosion protection are indicated in Figure 8.1.



Figure 8.1: Ste 27 Lower Beach fencing and main access point erosion control

General pedestrian footpath management is recommended to limit and control access to the beach. This should be a proactive process of signage and short sections of fencing to allow access locations through the dunes along the beach time to recover, whilst still providing different access points through the dunes, without the need for any restoration or other intervention.

No wider coastal protection works are proposed for the beach as the dunes appear to be recovering naturally following the 2014 storms, and so with some management of access to the beach and protecting the most vulnerable areas, the existing dune system can be maintained to continue to protect the island and its infrastructure, including the well, beyond the 25 year design life required.

8.1.2. Efficacy and advantages

- The beach dunes are showing signs of self-repair from previous storms so no costly civil works are recommended here.

- Dune management with signage and fencing will prevent erosion in particular locations and alternating access points will give the dunes a chance to recover naturally.

8.1.3. Constraints and disadvantages

- The dunes will still remain at risk from large storms and erosion may occur as was seen in 2014.
- Active management of the access to the dunes will be needed with regular scheduled inspections and moving of signs and fencing.

8.2. Site 28 Upper Town Beach

8.2.1. Recommended option

A 200m stretch of beach was recommended to be sensitively restored as described in the OBC recommendation. This report was written in 2019 and whilst the principle of the recommendation remains true, the condition of the dunes at the rear of the beach in 2021 is good and showing indications of recovery and plant recolonisation following the 2014 storms, as can be seen in Figure 6.3. It is now, therefore, not recommended that any restoration works are required and the dunes should be left to recover naturally.

The presence of numerous informal access points to the beach was noted during the site visit, and as with Site 27 it is recommended that active management of access to the dunes is undertaken and a system of signage, short sections of fencing and potential access stairways for some steeper sections could be used to protect the dunes from any concentrated erosion at particular points.

Some management of beach access will enable the dunes to continue to recover and maintain the high level of protection that they already offer to the local properties and infrastructure.

8.2.2. Efficacy and advantages

The advantages for the proposed approach are the same as for Site 27:

- The beach dunes are showing signs of self-repair from previous storms so no costly civil works are recommended here.
- Dune management with signage and fencing will prevent erosion in particular locations and alternating access points will give the dunes a chance to recover naturally.

8.2.3. Constraints and disadvantages

The disadvantages for the proposed approach are the same as for Site 27:

- The dunes will still remain at risk from large storms and erosion may occur as was seen in 2014.
- Active management of the access to the dunes will be needed with regular scheduled inspections and moving of signs and fencing.

9. Appraisal

None of the OBC or this study's recommendations for the two St Martin's beaches are formal coastal protection measures. The recommendations focus on maintaining the ability of the existing dunes to protect

the land behind as it can be seen that they are capable of self-healing. Therefore an option appraisal, with a long list of soft and hard options, has not been undertaken as the recommendations are for soft measures only, with no coastal defence works proposed to increase the level of protection. In addition the only feasible soft option which can be considered at this site is the dune self-repair, through management, rather than any imported beach recharge.

This is the Do Something approach defined in the OBC so more that Do Minimum, with active dune management to be done by the Council of the Isles of Scilly to manage access to the beach to prevent local areas of erosion whilst helping the dunes to recover naturally.

10. Preferred Options

The recommended approach as summarised in Section 8 is listed below. There is no detailed design beyond the beach access resurfacing at Site 27. The extent and detail for this green paving will be developed, together with the extent of fencing to be provided, and this will be presented in the detailed design that follows this preliminary phase.

The locations and details of dune signage, fencing or barriers and any stair access are beyond the scope of this study and are to be developed by the Council of the Isles of Scilly separately.




Table 10.1: St Martins recommended options

Site	Recommended options
27 – Lower Town Beach	<ul style="list-style-type: none"> ■ Beach access erosion protection surfacing; ■ Fencing of ~85m section of dune to help natural recovery; ■ Signage, fencing to manage access along the beach through the dunes.
28 – Upper Town Beach	<ul style="list-style-type: none"> ■ Signage, fencing to manage access along the beach through the dunes.

Appendices

A. Drawings



-  BEACH CROSS SECTION PROFILE
-  CREST ELEVATION PROFILE
-  DEFENCE ID

Isles of Scilly – Design Services
for Off Islands Coastal Erosion

Climate Adaptation Schemes -Preliminary
Design - St Martins

PROFILE LOCATIONS



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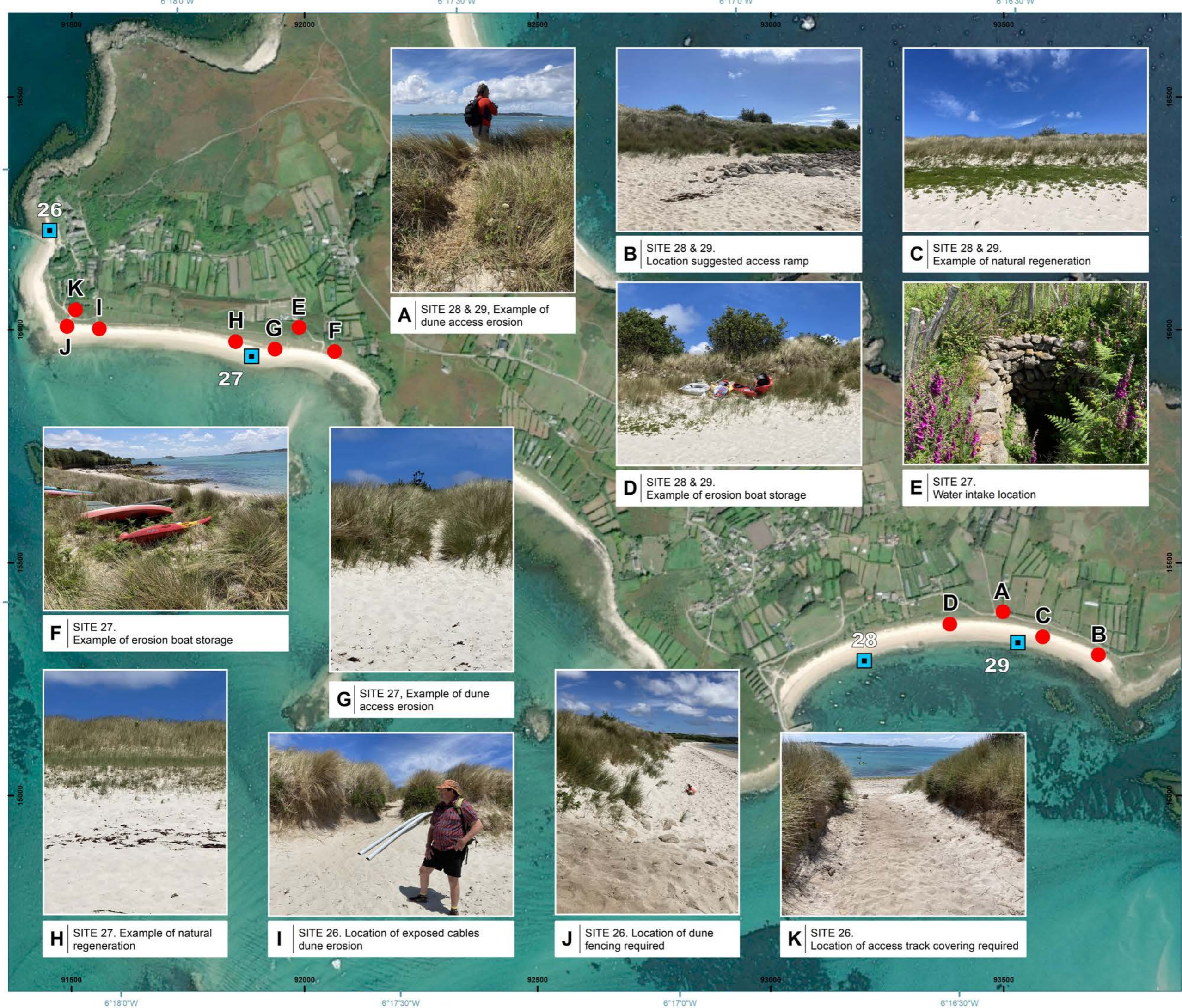
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 Central Meridian: -2.0000
 Scale Factor: 0.9996
 Latitude Of Origin: 49.0000



PROJECT REF: DKR6499
 DRAWING: DKR6499-005-01-DDE
 DATE: 06/08/2021 DRAWN: DDE CHECKED: TAP



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DEFENCE ID (Blue square icon)

PHOTO LOCATION (Red circle icon)

Isles of Scilly – Design Services for Off Islands Coastal Erosion

Climate Adaptation Schemes -Preliminary Design - St Martins

SITE INVESTIGATIONS



A SITE 28 & 29, Example of dune access erosion



B SITE 28 & 29. Location suggested access ramp



C SITE 28 & 29. Example of natural regeneration



D SITE 28 & 29. Example of erosion boat storage



E SITE 27. Water intake location



F SITE 27. Example of erosion boat storage



G SITE 27, Example of dune access erosion



H SITE 27. Example of natural regeneration



I SITE 26. Location of exposed cables dune erosion



J SITE 26. Location of dune fencing required



K SITE 26. Location of access track covering required

0 0.1 0.2
KILOMETRES

SCALE: 1:7,500 PAPER SIZE: A3 (42 x 29.7 cm)

GEODETTIC INFORMATION

CRS: British National Grid
 Projection: Transverse Mercator
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B. Supplier information

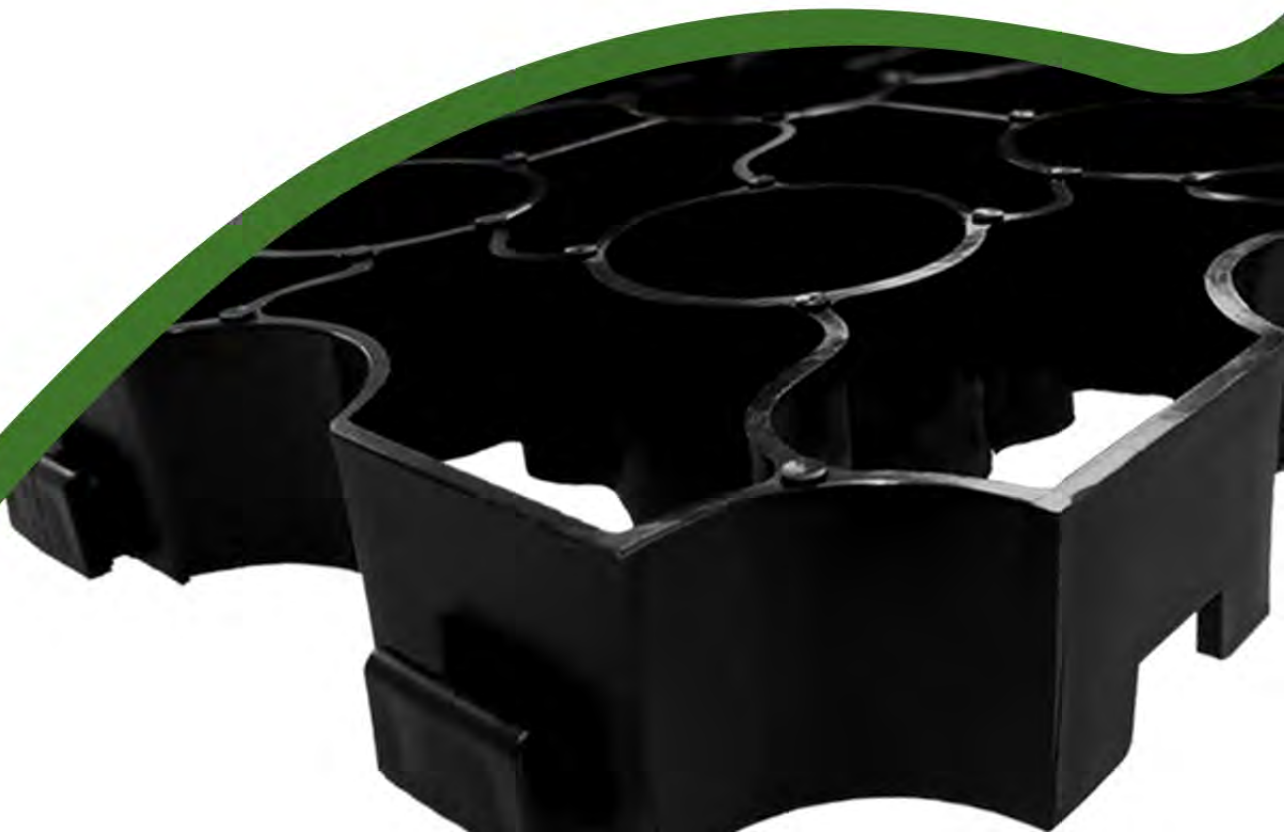
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Product Guide



X-Grid® is a versatile, SuDS compliant ground reinforcement and gravel retention grid which is suitable for use in a huge number of different applications.

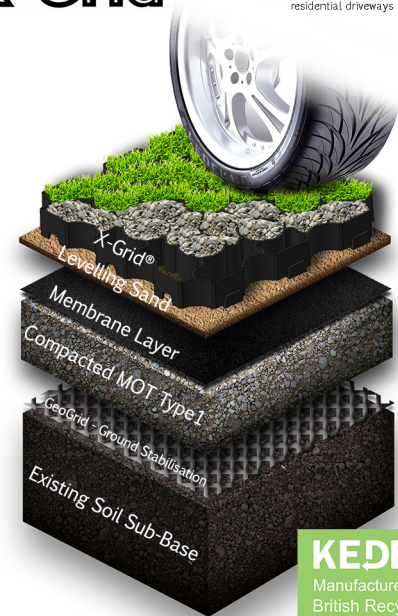
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The easy-to-handle nature of X-Grid® means that a single person can lay up to **100m² per hour!** With its 330mm x 330mm x 40mm dimension, connecting nine panels together forms a nominal square metre. Due to the modular nature of the grid, many different shapes can be created specifically for your project with minimal product wastage.

X-Grid®

Typical build-up for an X-Grid® system, suitable for grass or loose gravel car parking, hardstanding or residential driveways



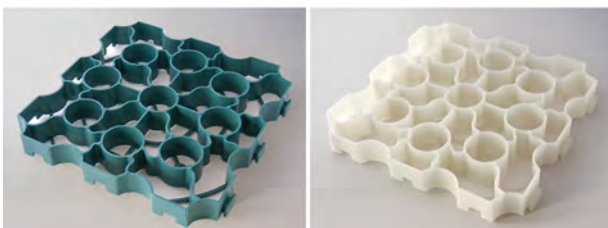
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Manufacturers of
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The **unique** cell design means that gravel is retained much more effectively and prevents the fill from migrating to surrounding areas, causing unnecessary maintenance such as raking or sweeping.

The **permeable** nature of the grid allows water to pass through the structure into the sub-base below and helps to reduce surface water run-off. This helps to mitigate the effects of severe and/or sudden rainfall by locking groundwater into the sub-base for it to gradually soak away, diverting water from the sewer system.

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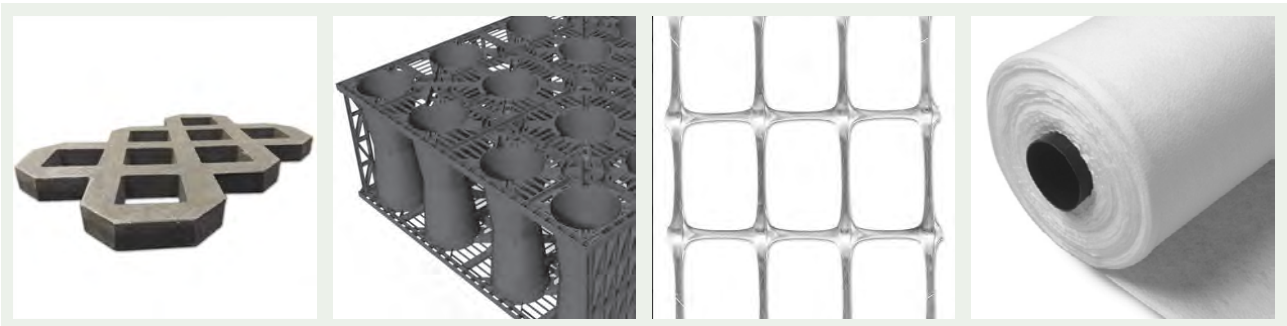


Product Highlights

- Quick & Easy Installation
- Lightweight & Easy To Handle
- High Compressive Strength
- Tight Slot & Peg Connection
- Reduces Surface Water Run-off
- Minimal ongoing maintenance
- Can Be Used As Non-Slip Surface
- Weatherproof, Rotproof, UV Stable
- Can Be Cut To Size
- Prevents Gravel Migration
- Can Last Up To 25 Years
- Can Be Cut To Shape

Our business mission is to become the UK's leading supplier of groundwork, civil and landscaping products. Over the last few years, our company has grown to become one of the UK's most reputable suppliers to these demanding specialist markets.

The extensive range of products we stock is tailored to cater for the needs of our clients, which we complement with unrivalled customer service and friendly, knowledgeable staff. We strive to build long-term working relationships with each of our customers to provide the best value for money without compromising on quality or service.

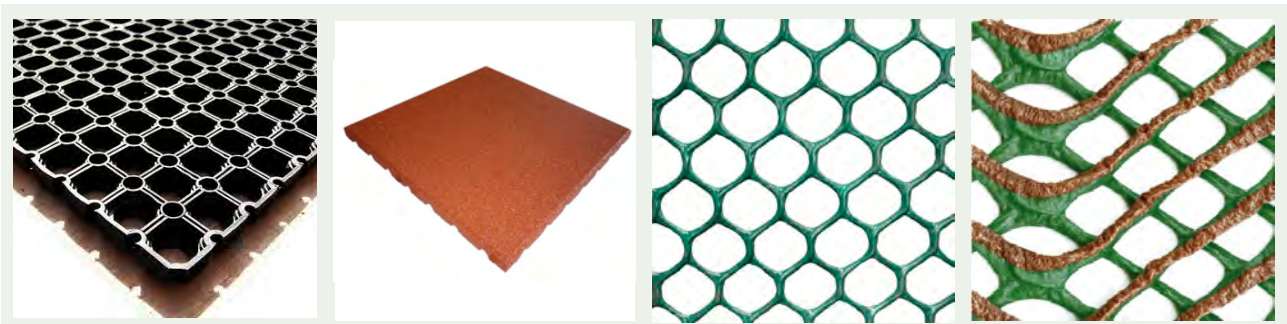


TruckPave

Attenuation Crates

Stabilisation Mesh

GeoTextile



Rubber Grass Mats

Rubber Play Tiles

GrassMesh

TurfMesh



uPins

jPins

X-Grid® Anchor Pegs

TurfMesh Anchor Pegs



HR Wallingford is an independent engineering and environmental hydraulics organisation. We deliver practical solutions to the complex water-related challenges faced by our international clients. A dynamic research programme underpins all that we do and keeps us at the leading edge. Our unique mix of know-how, assets and facilities includes state of the art physical modelling laboratories, a full range of numerical modelling tools and, above all, enthusiastic people with world-renowned skills and expertise.

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