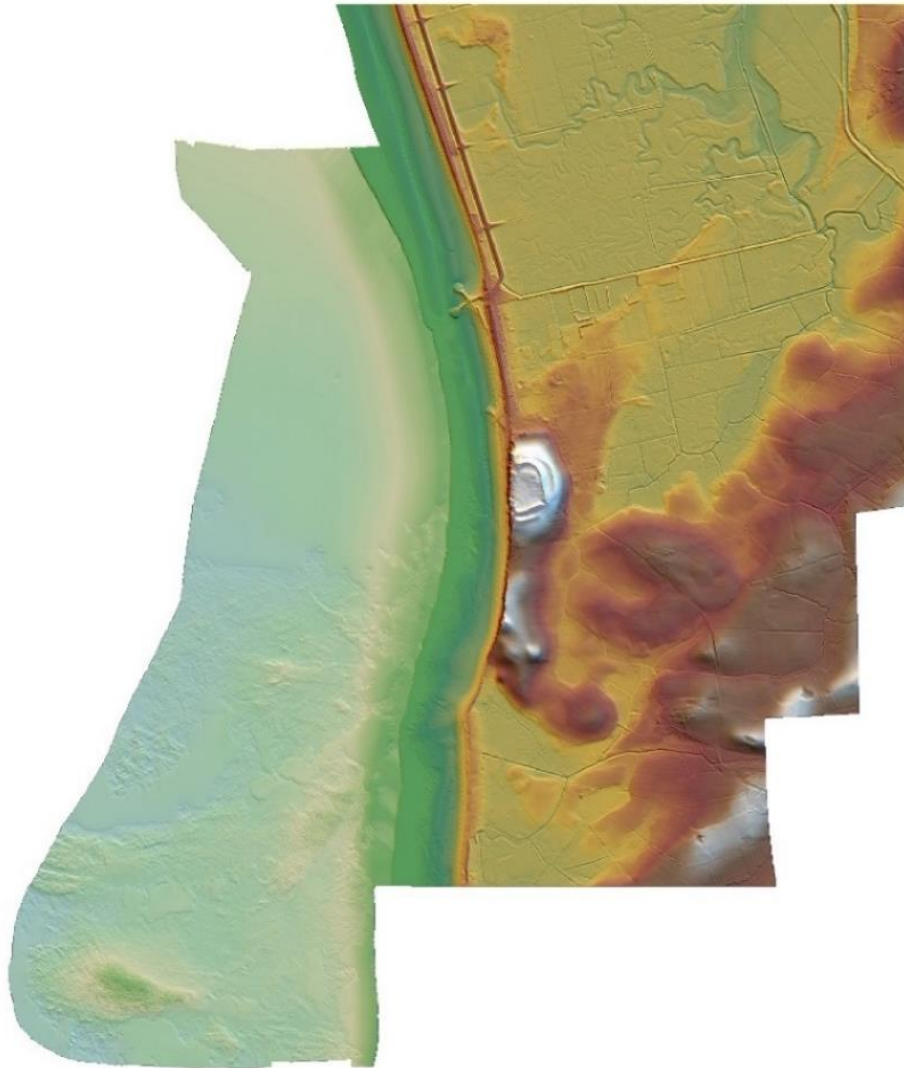
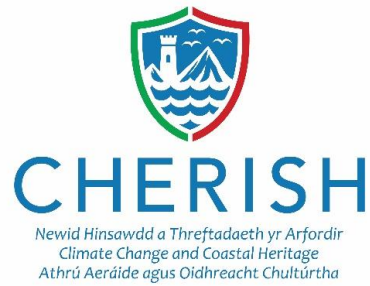




Dinas Dinlle Coastal Hillfort

Coastal Terrain Model.





Dinas Dinlle Coastal Hillfort. Coastal Terrain Model

County:	Gwynedd
Community:	Llandwrog
NGR:	SH43705635
NPRN:	95309
Scheduled Monument No:	CN048
Report No.	CH/RCAHMW-GSI 40
Report Authors:	Kieran Craven (GSI) and Louise Barker (RCAHMW)
Illustrations:	Kieran Craven (GSI) and Louise Barker (RCAHMW)
Date of Investigation:	December 2021
Date of Report:	10 August 2023

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OGL

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1. SUMMARY

As part of CHERISH investigations at Dinas Dinlle hillfort and surrounding environment a seamless offshore-onshore coastal terrain model covering 7.325 kilometres² was produced by CHERISH partner, the Geological Survey of Ireland.

This was created using offshore data collected during the CHERISH project and 2015 0.5 metre resolution Environment Agency Lidar data accessed through DataMap Wales.

<https://datamap.gov.wales/maps/lidar-viewer/>

This report details the data and methodology used to create the coastal terrain model.

2. CHERISH PROJECT BACKGROUND

CHERISH (Climate, Heritage and Environments of Reefs, Islands and Headlands) is a European-funded project led by the [Royal Commission](#) on the Ancient and Historical Monuments of Wales, in partnership with the [Discovery Programme: Centre for Archaeology and Innovation Ireland](#), [Aberystwyth University: Department of Geography and Earth Sciences](#) and [Geological Survey, Ireland](#).

The project commenced on 1st January 2017 and ran for six and a half years to the end of June 2023; it benefits from €4.9 million of European Union (EU) funds through the [Ireland – Wales Co-operation Programme 2014-2020](#), Priority Axis 2 – Adaptation of the Irish Sea and Coastal Communities to Climate Change.

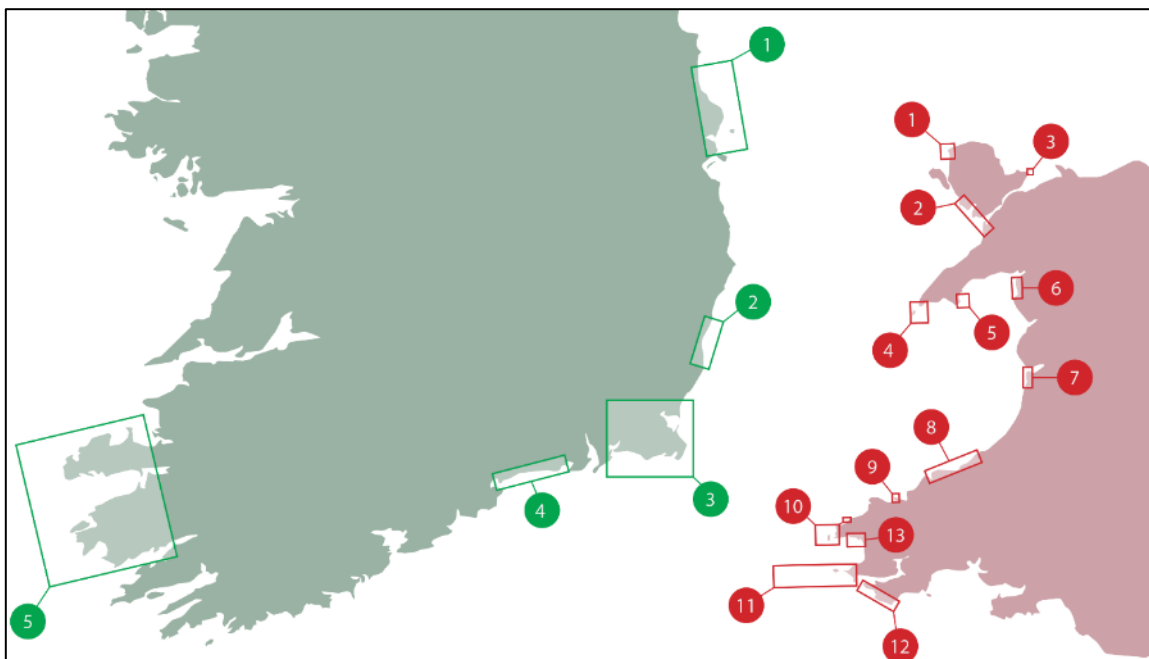


Figure 1: Map of Ireland and Wales showing the 17 principal project areas in both nations. Dinis Dinlle is located in Wales, Area 2 (© Crown: CHERISH Project).

CHERISH is a cross-disciplinary project aimed at raising awareness and understanding of the past, present and near-future impacts of climate change, storminess and extreme weather events on the cultural heritage of reefs, islands and headlands of Wales and Ireland. The project seeks to fill gaps in both data and knowledge for the coastal regions of Ireland and Wales, to develop a greater understanding of climate change impacts on fragile coastal heritage sites and to establish new metrical precision for the rural, coastal landscapes under study.

3. LOCATION AND INTRODUCTION

Dinas Dinlle coastal hillfort (NGR: SH 4370 5635) is located immediately south of the small, low-lying coastal hamlet of Dinas Dinlle in the parish of Llandwrog, some 7 kilometres southwest of Caernarfon in Gwynedd. It is positioned overlooking Caernarfon Bay, close to the southern end of the Menai Strait, and is situated at the western edge of the reclaimed wetlands of the Caernarfonshire coastal plain with Foryd Bay to the northeast (Figure 2).

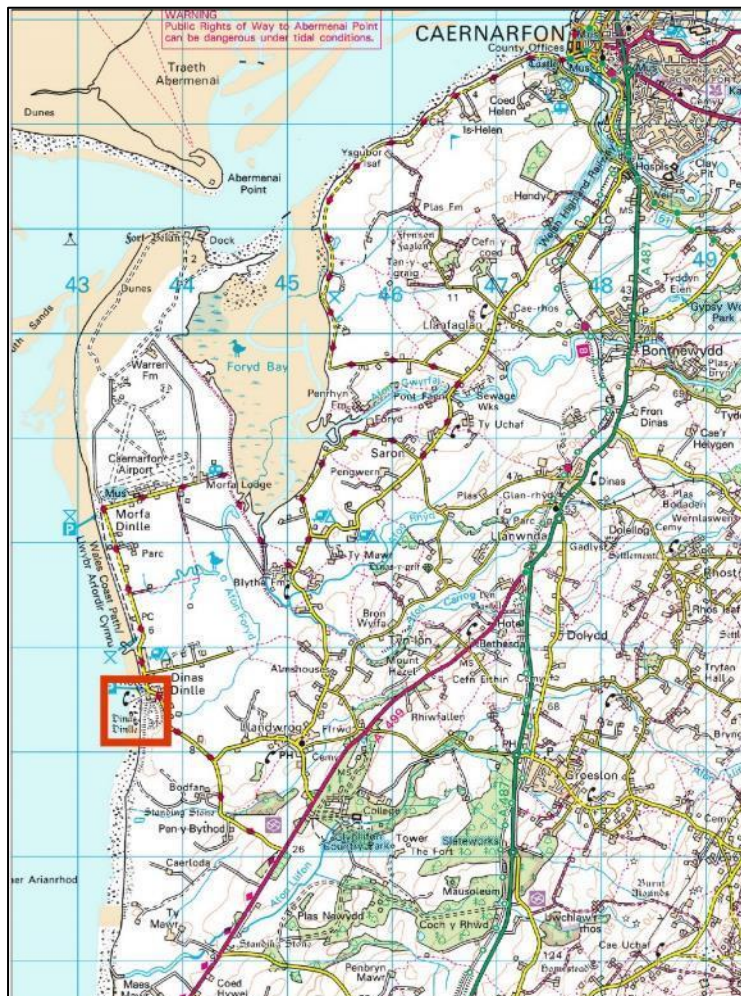


Figure 2: Map showing the location of Dinas Dinlle hillfort within the red box (This map is based upon Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of His Majesty's Stationery Office © Crown copyright, 2023. Licence number: 100022206. Map created using ArcPro).

The hillfort is a substantial earthwork monument (SM: CN048; SSI ID: 616; NPRN: 95309; PRN: 1570) enclosing the summit of a glacial deposit, encompassing an area some 32,000m² (3.2 hectares) in extent. It would originally have enclosed some 4 hectares, but severe erosion has removed the western defences and a small section of the interior (Figure 3).



Figure 3: Dinas Dinlle Hillfort, clearly showing the erosion to the western side of the monument. Crown Copyright: RCAHMW AP_2014_0877.

Based on the morphology and excavation evidence, the hillfort dates from the Iron Age (800 BC – AD 43) and continued in use during the Roman period (AD 43- 410). It also features prominently in early medieval Welsh literature and folklore - it is mentioned in the fourth branch of the Mabinogi - and thus a longer history of use/reuse may be likely. This history stretches to the modern day with the hillfort incorporated into a golf course during the early decades of the twentieth century, and later during the Second World War, defences for the protection of the nearby RAF Llandwrog were constructed into the foot of the fort's northern slopes (SM: CN 396). Excavated features and finds of neolithic, medieval and post medieval date in the field directly to the south of the hillfort also provide a wider chronological and archaeological context.

Beyond the hillfort and glacial hill is a varied landscape consisting of a range of different environmental types. To the west is a long shingle beach which defines the zone between Dinas Dinlle and Caernarfon Bay/ Irish Sea. In the intertidal zone here, small deposits of Mesolithic peat, provide evidence of an earlier freshwater environment.

Surrounding the landward sides of the hillfort are the marshes of the Caernarfonshire plains which have been subject to substantial amounts of reclamation work since the post-medieval period. To the north of the hillfort, at the mouth of the Menai Strait, is the extensive sand and gravel spit of Morfa Dinlle and behind it to the east a large estuary served by two rivers, Afon Rhyd and Afon Gwyrfa (Figure 4).



Figure 4: CHERISH aerial photograph taken in July 2021 showing the landscape and geomorphological context of the hillfort. The view looks north with the hillfort and settlement of Dinas Dinlle near the centre of the image (© Crown: CHERISH Project).

4 DATA COLLECTION

Offshore data were collected during the CHERISH project specifically 2.734 km² of bathymetry data collected using a multibeam echosounder by the RV Keary in September 2019 and September 2020. Data was recorded in UTM 30N relative to Lowest Astronomical Tide (LAT) and gridded to 2m resolution.

Lidar data was collected by Environment Agency on 4 February 2015 to 0.5 m resolution. The data was accessed and downloaded through through DataMap Wales.

<https://datamap.gov.wales/maps/lidar-viewer/>

Total data coverage used is 7.325 km².

5 MAP GENERATION

The seamless coastal terrain model was produced using the following methodology:

Data transformation and gridding

All data sets were transformed to British National Grid projected coordinate system and re-gridded to 2 m resolution. The bathymetry data was transformed in Arcmap 10.7 from WGS 1984 UTM 30N to OSGB16.

A vertical datum transformation of the bathymetry data from LAT (VORF 2.0 model) to OD Newlyn was performed. Three points were selected (Figure 5). The LAT (VORF 2.0 model) offset from the ETRF ellipsoid was calculated at these points. The OD Newlyn offset was also calculated at these points using the Coordinate Transformation Tool (<https://www.ordnancesurvey.co.uk/gps/transformation/>). Based on the offset at these three locations, a mean offset of 2.261m was used for the whole bathymetric dataset (Figure 6 and 7).

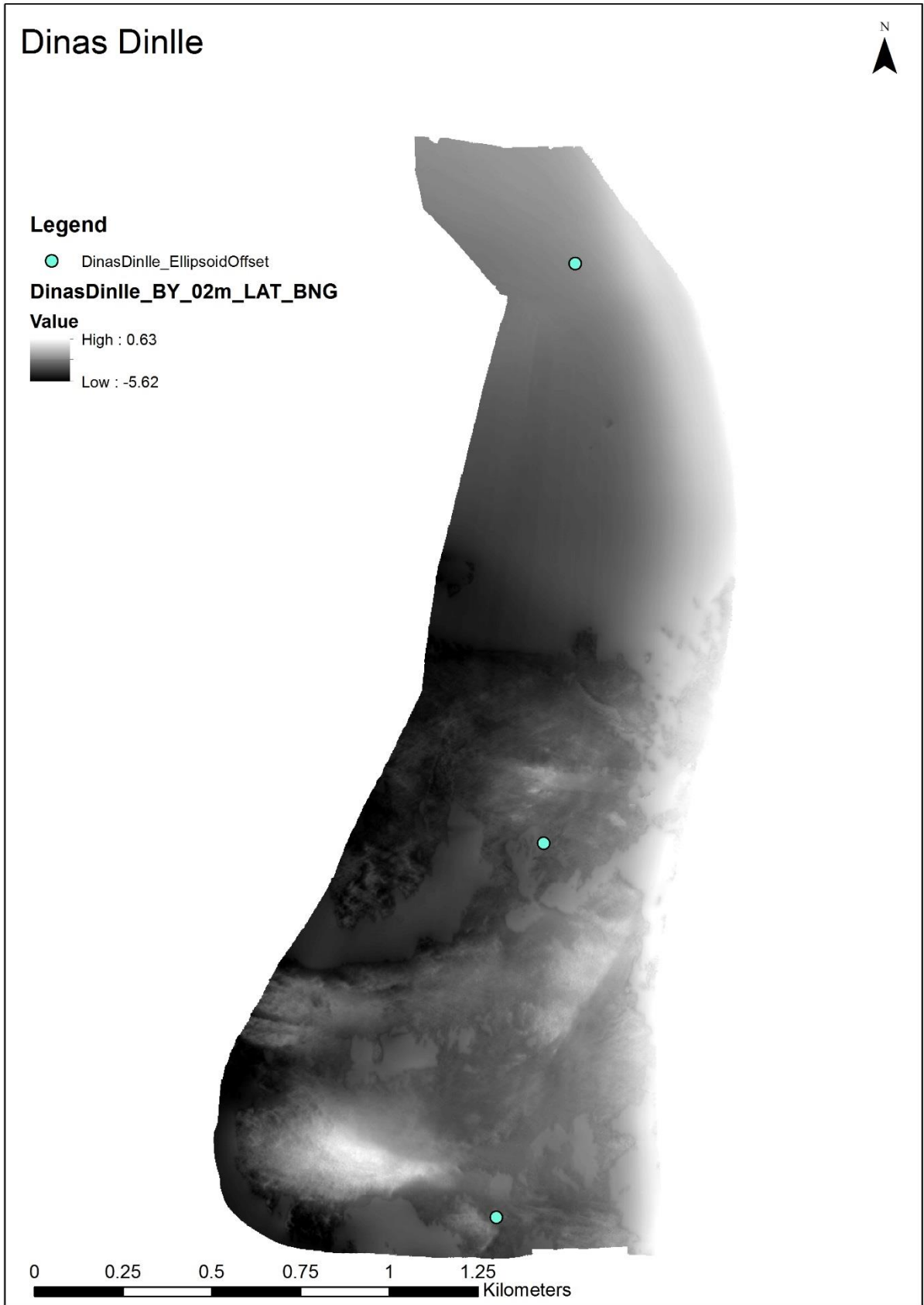


Figure 5: Location of Datum Conversion Points (© Crown: CHERISH Project).

Table 1: Selected points for offset. Mean LAT is calculated at 2.642 m below OD Newlyn in the area.

Point	Latitude	Longitude	LAT Elipsoid Height	OD Newlyn Elipsoid Height	Offset
1	53.08839	-4.345382	51.905722	54.570	2.664
2	53.07371	-4.345911	51.918509	54.561	2.642
3	53.06420	-4.347384	51.935831	54.556	2.620

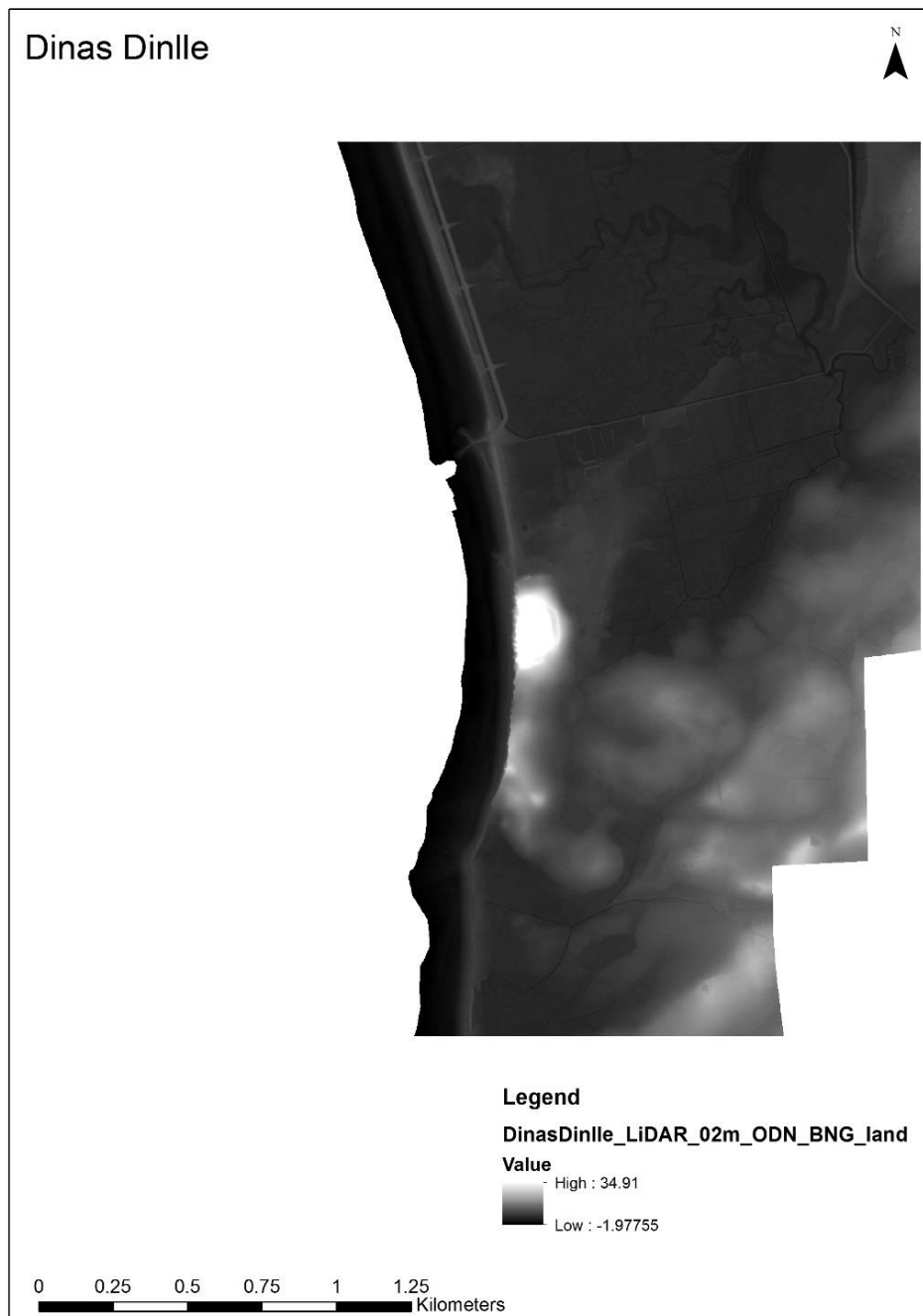


Figure 6: Elevation (m) relative to OD Newlyn and 4.590 km² extent of terrestrial LiDAR data acquisition. Data acquired over water was omitted (© Crown: CHERISH Project).

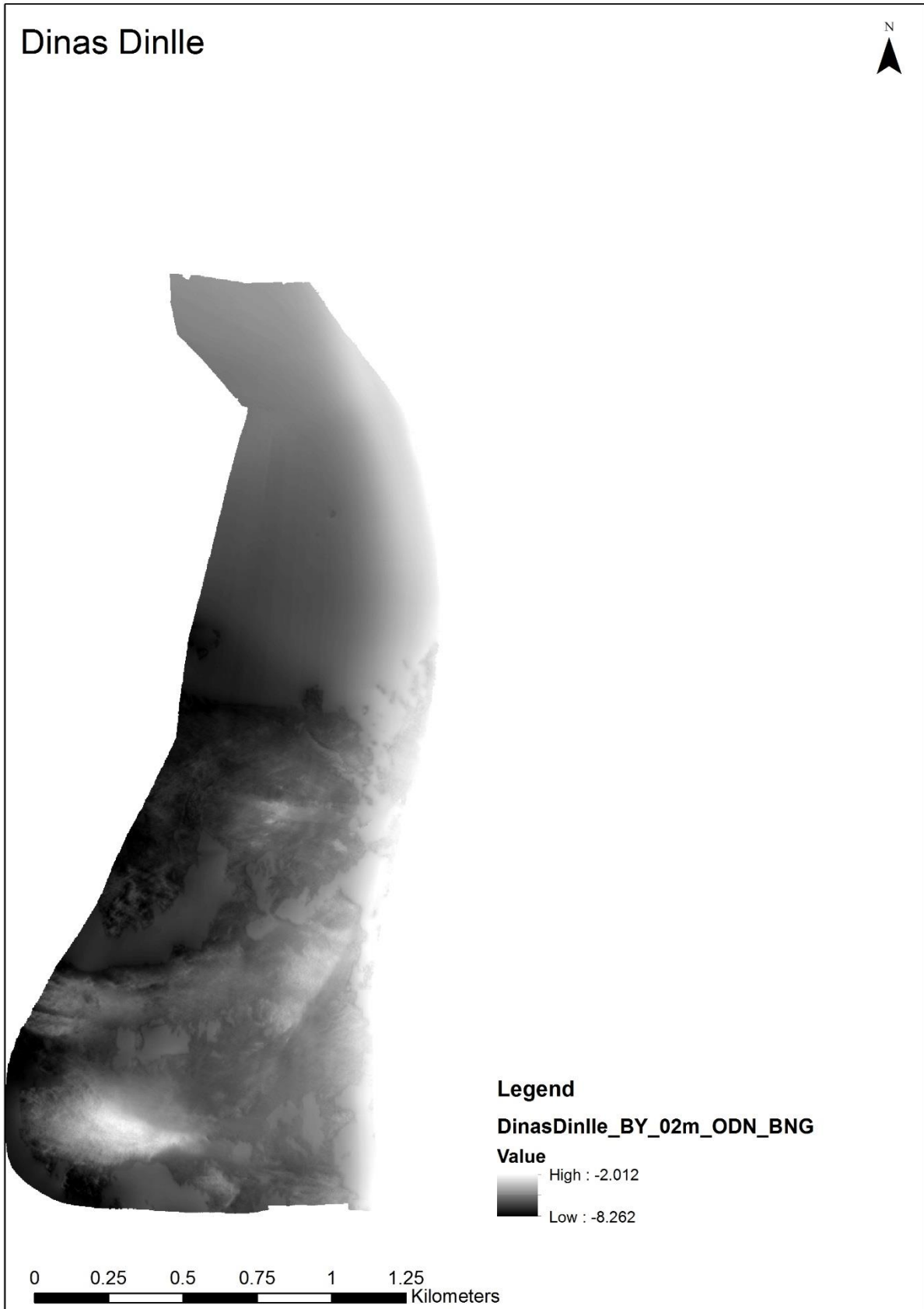


Figure 7: Elevation (m) relative to OD Newlyn and 2.734 km² extent of Dinas Dinlle bathymetry data used in coastal terrain model (© Crown: CHERISH Project).

Merging and product development

Both datasets acquired (LiDAR and bathymetry) have constraints on their useable extent by the presence of water. LiDAR's lowest usable elevation is constrained by the occurrence of water, with the laser incapable of penetrating the water column. To ensure the minimum occurrence of water, the waterline was digitised from a multi-hillshade map (16 direction, sun angle of 35 degrees) derived from the LiDAR data, retaining the terrestrial data. The bathymetry is constrained during acquisition by water elevation, with the vessel unable to acquire data in shallow water. Datasets were merged using Mosaic to New Raster Tool in ArcMap. There was no overlap (Figure 8).

Following merging, a white ribbon around the coast persists as the two datasets do not overlap. The horizontal difference between datasets ranges from 30 m to 200 m in the north. This white ribbon area is 0.242 km² comprising 3.2% of the survey area. In the absence of further data acquisition during suitable spring low tides, it is not possible to correct for this.

As there are currently no plans for CHERISH to re-survey the area, the data gap was interpolated in ArcGIS applying the mean cell value of a 20 m by 20 m rectangle to cells with no data. This was repeated until all the cells contained data. This resulted in a total area of 7.567 km² (Figures 9 and 10)

The final product was exported as a geotiff, with a multi-hillshade image (16 directions, sun elevation at 35 degrees) produced using the Relief Visualization Toolbox (RVT) 2.2.1.

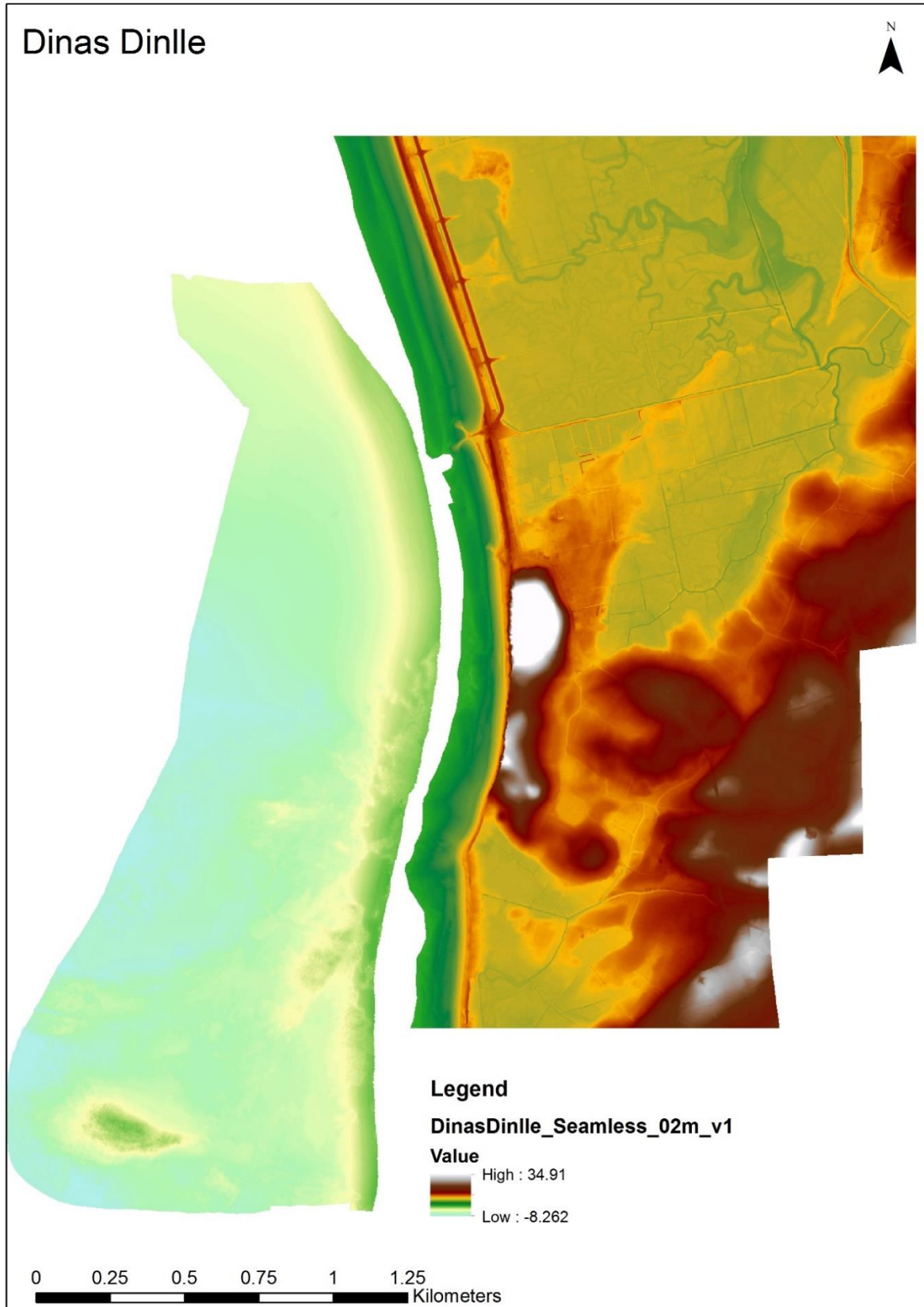


Figure 8: Merged Coastal Terrain Model including remaining white ribbon of 0.242 km². This is where seabed surface is not recorded by either LiDAR or Multibeam (© Crown: CHERISH Project).

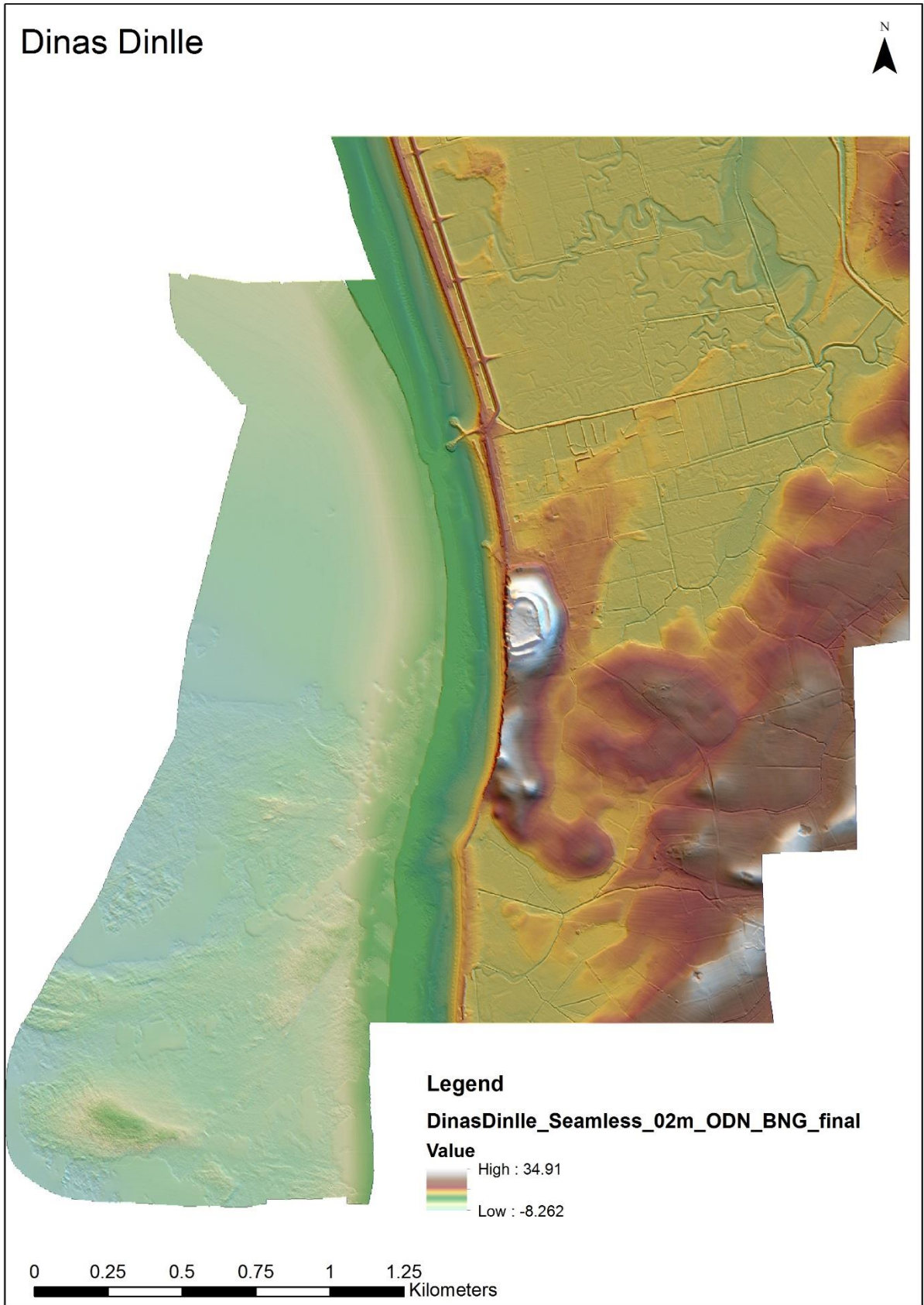


Figure 9: Interpolated DSM to fill white ribbon around Dinas Dinlle (© Crown: CHERISH Project).

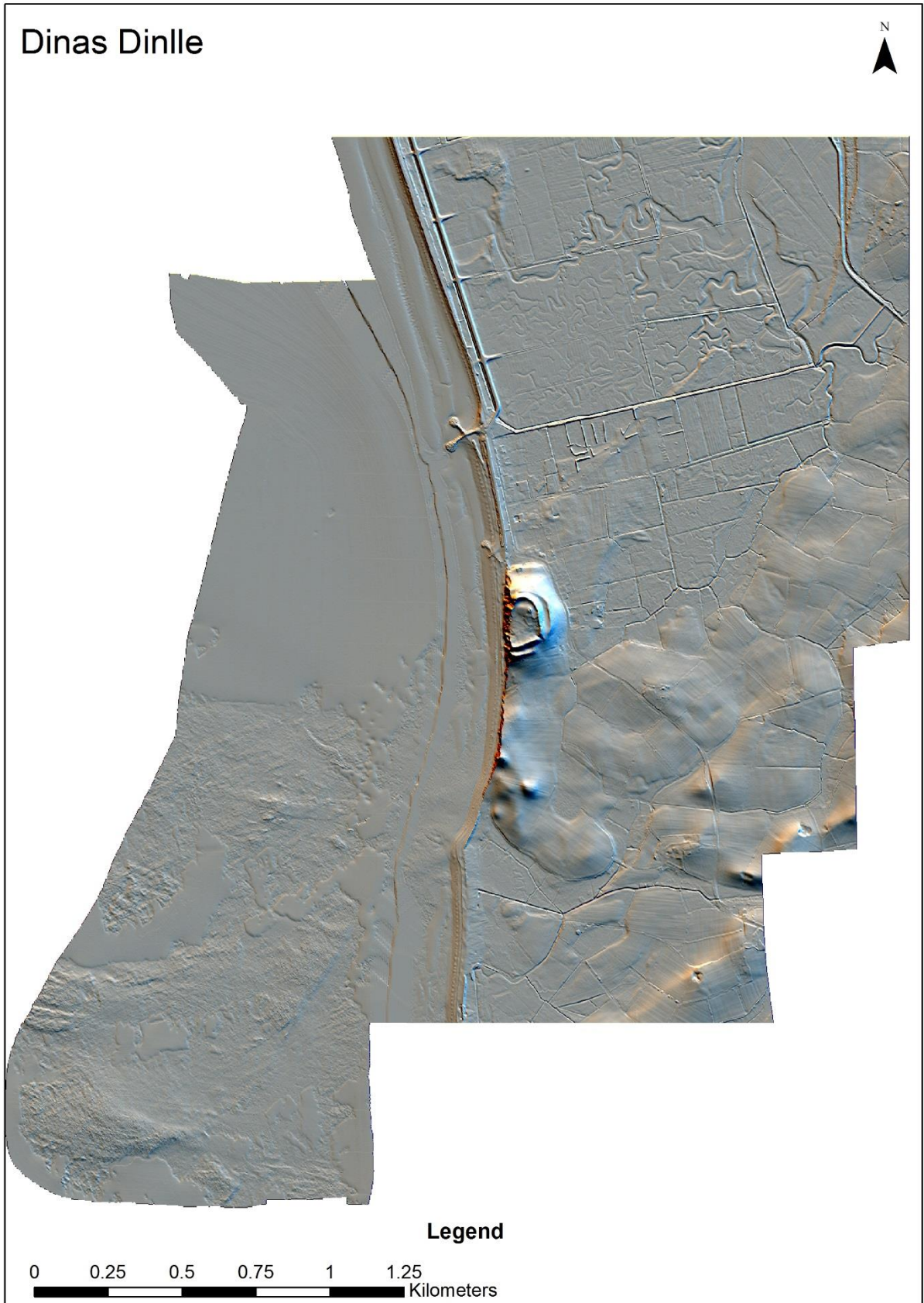


Figure 10: Multi Hillshade (D16H35) of seamless coastal terrain map of Dinas Dinlle (© Crown: CHERISH Project).