# GEOTECHNICAL STUDY AREA G5

## WHEELERS BAY, VENTNOR UNDERCLIFF, ISLE OF WIGHT, UK

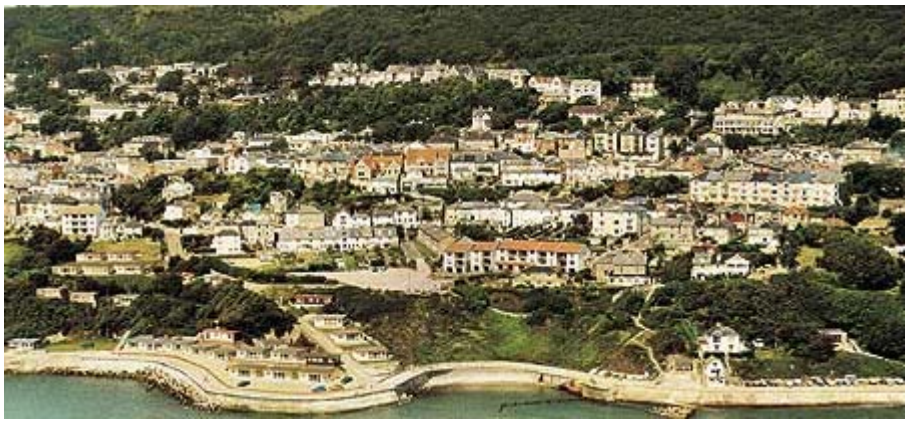

**Plate G5** ***Wheeler's bay, Ventnor Undercliff, isle of Wight, UK***

### 1. BACKGROUND

Wheeler's Bay (Plate G5) is located within the Ventnor Undercliff landslide complex and is situated on the eastern side of Ventnor (see Figure G5.1). A long history of ground movement and slope instability has been the subject of a number of investigations in this area but Wheeler's Bay in particular has, in recent years, become a location of serious concern, principally because ground movements threatened the integrity of assets including residential properties and coastal defences (see Figure G5.2).

Historically Wheeler's Bay itself was caused by a landslip prior to 1862. Recent concerns arose in 1996 when movement was observed affecting a property at the top of the coastal slope behind the Bay. Ground investigations were subsequently carried out on the top of the cliff, on the coastal slope and on the promenade at the foot of the cliff. The results of the geotechnical investigations are illustrated in the cross-section provided (Figure G5.3) and indicate that Wheeler's Bay lies principally within the Gault Clay.

The general geological sequence at Wheeler's Bay comprised Upper Greensand, overlying Gault Clay, Carstone and Sandrock and Ferruginous Sands. Further inland, to the north of Wheeler's Bay the Greensand is overlain by Chalk. As a result of a complex sequence of landsliding, the geological sequence within the coastal slope comprises disturbed Greensand overlying Gault Clay and then undisturbed Sandrock.

To address the increasing problems of ground instability that were raising the potential for a retrogressive failure extending back into the town of Ventnor, a ground investigation was commissioned by the Council.

As the investigations were nearing completion, ongoing piezometric monitoring indicated dramatic rises in groundwater levels within the coastal slope as a result of heavy rain in early 1998. This gave rise to concern for the safety of residents in the area and immediately behind the coastal slope; some property owners were evacuated for the winter period whist others were warned of a potentially worsening situation.

A slope failure would threaten several properties and the coastal defences would be likely to be damaged. More properties further inland would also be threatened by the initial failure. In the

light of this damaging scenario, the Council and its consultants formulated a number of potential solutions aimed at stabilising the slope at Wheeler's Bay. The preferred solution on technical, economic and environmental grounds comprised a combination of toe weighting the slope with rock armour and fill, land drainage and soil nailing. An application to the Ministry of Agriculture, Fisheries and Food for a £1.5m scheme was approved and work was completed in May 2000 (Plates G5a, G5b, G5c, G5d, G5e, G5f). The aim of stabilization of the coastal slope is to prevent further deterioration in ground stability conditions in the area and to help safeguard a large number of properties in the vicinity of Wheeler's Bay.

## 2. MONITORING

In view of the anticipated imminent slope failure, the Isle of Wight Council began implementing measures to provide a degree of early warning. Such measures included provision of 24 hour landslide monitoring equipment and daily measurement of groundwater levels. The Council also put in place a contingency plan for provision of alternative emergency exit routes from certain properties if required. Pending the completion of an engineered solution to the instability problems at Wheeler's Bay, ground movement monitoring equipment was installed. This comprised ten 'in place inclinometers' and five vibrating wire piezometers. Data obtained from these instruments is transmitted to a data logger and thereby transferred to the Isle of Wight Council offices in Newport. Because of the sensitivity of the area, regular visual inspections were also made by members of the Centre for the Coastal Environment from the Isle of Wight Council during the pre-construction phase.

## 3. CURRENT STATUS AND APPROACH, LESSONS LEARNT

The ground stability situation at Wheelers Bay had deteriorated over the last three years. Since then detailed site investigations aimed at reducing the impact of instability on the local community took place. A change in law arising from a major failure at Scarborough on the North Yorkshire coast meant that landowners had a duty to provide support for properties upslope. However, following an appeal by Scarborough Council the case was reconsidered and the original decision overturned. Owners of land do nevertheless have a duty to prevent nuisance to adjoining landowners. In this respect it is important to be aware of ground conditions on land in one's ownership.

As the owner of the unstable coastal slope at Wheeler's Bay, the Council urgently sought assistance from the Ministry of Agriculture, Fisheries and Food to fund the coast protection scheme. Coast protection had already been identified as one of the key factors that can trigger destabilisation in the Ventnor Undercliff. A failure of the coastal slope at Wheeler's Bay could have resulted in the loss of the seawall and the opening up of the frontage to wave attack. Such action, if unarrested, could result in a rapid retrogressive failure of the landslide system back into the Undercliff into the centre of the town of Ventnor.

The situation would be aggravated by the steep topography with a series of developed landslide benches and terraces separated by a number of high stone walls built in the last century, without due regard to the need for structural strength, or with respect to managing groundwater movements. Due to the potential loss of properties and infrastructure the engineering scheme demonstrated a positive benefit-cost ratio and therefore attracted grant aid from the Government for coast protection and stabilization measures.
Although there was strong support for the coast protection scheme from property owners whose houses were threatened by landsliding, many residents did not believe the potential seriousness of the situation. The Council had to undertake a delicate consultation exercise explaining the vulnerability of the area but without wishing to alarm many property owners or causing blight by insurance companies. Because the landslide at Wheelers Bay had shown only slight signs of movement following reactivation in January 1995, residents did not believe that a large event could take place. This was because the pattern of ground movements in central Ventnor over the past 200 years has been characterised by only slight damage.

The Council has learnt from the Wheelers Bay scheme the difficulty of disseminating information about landsliding in urban locations and also the difficulty in enlisting public support

for essential measures which will inevitably change the appearance of a location. The difficulty of when to advise and/or evacuate property owners for safety reasons was also a key issue. The Council was mindful of both public safety and cost in this respect.

The intertidal area and marine environment at Wheelers Bay and indeed around much of the Isle of Wight coast has been recently designated as a candidate Special Area of Conservation (SAC) under the European Habitats Directive. The approval of English Nature, the Government's nature conservation advisors, is required for engineering works which may impact upon the SAC and a precautionary approach is adopted to new development. As the Habitats Regulations had been recently introduced the consultation was a long and complex process. The presumption against development in such locations can have serious implications for landslide management (see Castlehaven – Study Area G7).

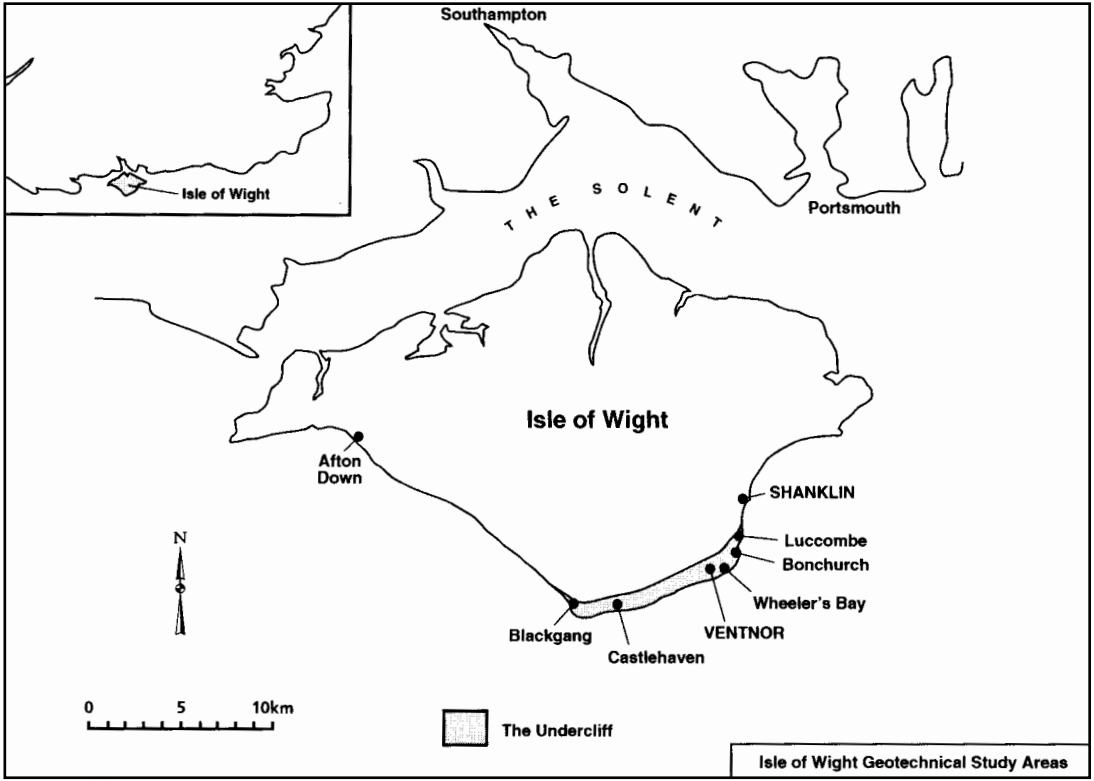


**Figure G5.1 Wheeler's Bay location map.**

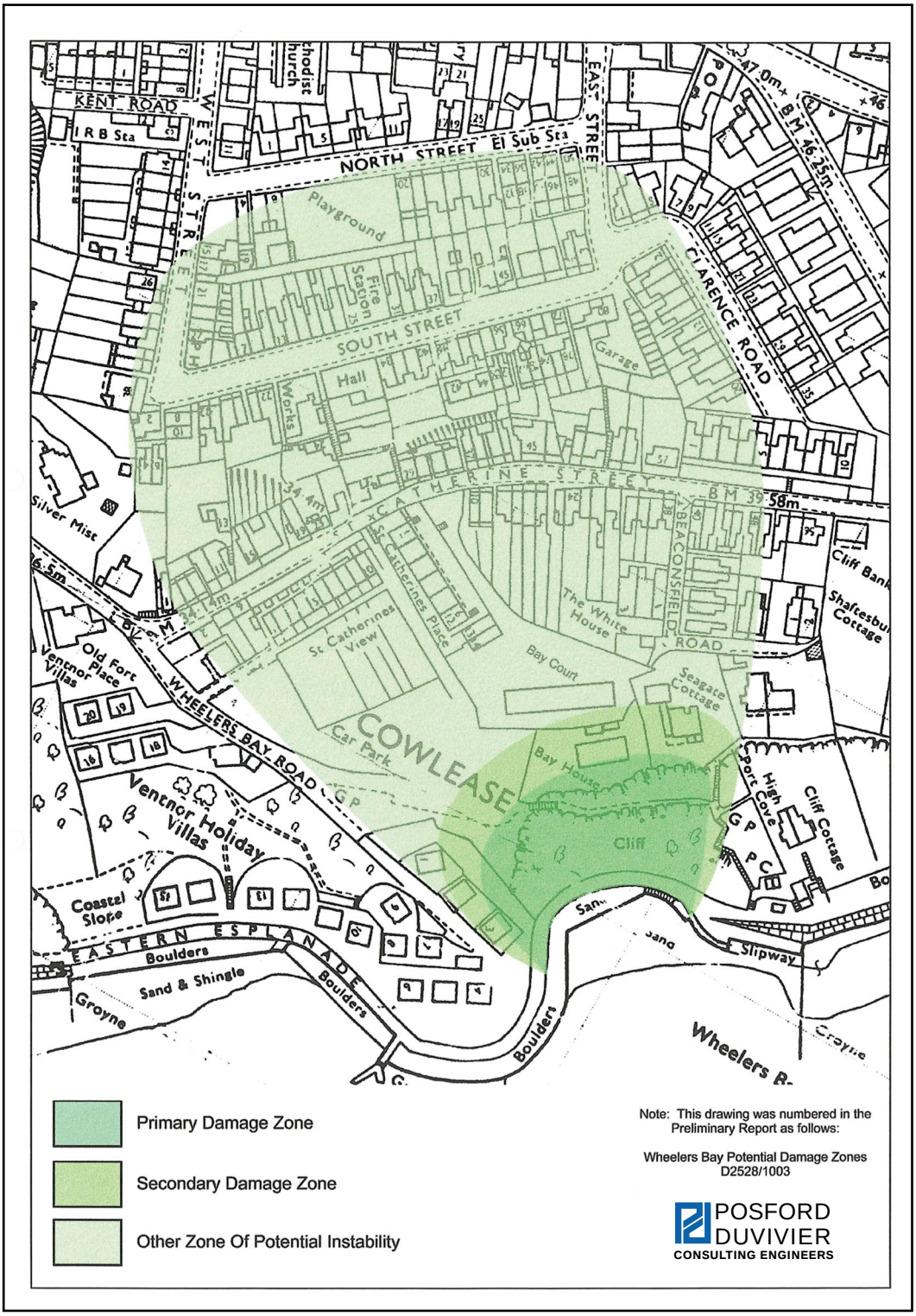


**Figure G5.2 Landslide hazard map.**

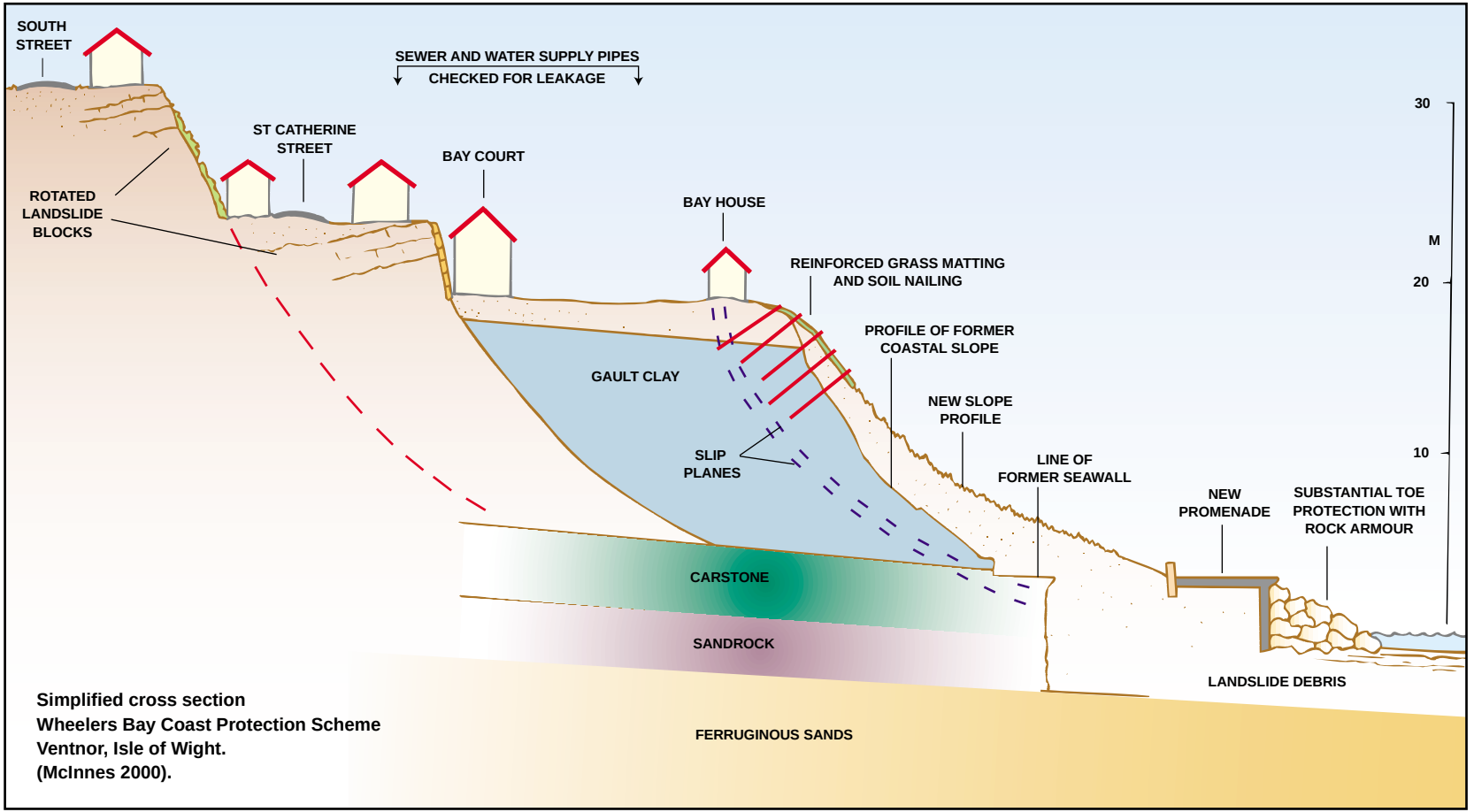


**Figure G5.3 Diagrammatic cross-section through Wheeler's Bay coast protection scheme.**

**Plate 5a** ***Coast protection and slope stabilization works in progress, 1999 (courtesy:D.Bowie Photography)***

**Plate 5b** ***Coast protection and slope stabilization works in progress, 1999 (Courtesy D.Bowie Photography)***

**Plate G5c** ***Soil nailing on the upper slope, 1999***

**Plate G5d** ***Bonchurch Undercliff looking west towards Wheeler's Bay (Courtesy: Elaine David Studio)***

**Plate G5e** ***The completed coast protection and slope stabilisation scheme, April 2000***


**Plat G5f** ***The completed coast protection and slope stabilization scheme after a successful growth of grass, August 2000***