10. Recommendations for Further Works

The following section provides recommendations for further works to continue assessing the landslip and immediate area at Wade Street, Portland.

The further works which we believe are required have been summarised as part of a 12 month future works program presented in Appendix AD. We have assumed that the 12 month future works program would commence in March 2009. Indicative costings have been provided but these will need to be confirmed before commencing any works.

The sub-sections below provide the rationale behind the need to conduct these further tasks and describes the tasks required.

10.1 Immediate site visit/meeting

As discussed, Glenelg Shire Council advised PB in early December 2008 that there had been intrusion into the restricted zone at Portland resulting in damage to fencing and possibly interference with one of the extensometers. In addition, we were informed that the Port Authority needs to secure access on the beach to repair a break/hole in the sand pipe which has caused a blowout on the beach.

PB recommends an urgent site visit to check the errant extensometer (repair if necessary), undertake further inclinometer readings, carry out full visual inspection and provide advice to GSC on how to facilitate the repair of the sand pipe on the beach. The blowout has the potential to undermine the landslip debris slope on the beach.

10.2 Revised site monitoring program

A significant site observation and monitoring program has been in place at the site for some months. This program includes weekly surveying of a number of points at the site and the production of a series of graphs showing magnitude of movement from the initial baseline. In addition, regular inclinometer readings have been taken since June 2008 in 4 locations above the cliff edge to assess any potential for slope movement including creep and deep seated movement. An assessment of groundwater levels within various strata at the site including (within the upper Basalt, the Maretimo Clays and the underlying Portland Limestone) has been undertaken both manually and automatically.

During January 2009 a near real time automatically monitored data logging system recording rainfall levels, groundwater pressures and extension across the tension crack in the metastable slopes above the Anderson Point stairs was commissioned.

Due to the availability of continuous monitoring utilising the automatic data logging system It is recommended that a revised monitoring program be implemented which includes a modified survey program incorporating a series of new survey point located along Clifton Court. We believe the frequency of survey monitoring, the regular inclinometer readings and site observations can be reduced to quarterly with the provision of additional monitoring runs if heavy or prolonged rainfall is experienced or significant movement is detected by the data logging system.

Regular ongoing review and assessment of monitoring should be undertaken as soon as possible after each quarterly or additional monitoring run with results assessed and analysed and a monitoring report forwarded to the appropriate stakeholders as soon as practical .

Operation of the near real time monitoring data logging system should be secured for at least two years with access for all major stakeholders so as to allow regular and as required review of the monitoring data. An ongoing monthly fee, to be paid to DGSI P/L, is required to maintain on-line access and management of the site monitoring station data.

Trigger levels for data logging system alarms need to be set in accordance with the below recommendations (to be discussed and agreed with DSE):

- Vibrating wire piezometer readings exceeding the 'Moderate Potential for Failure', Threshold 4 values (see Section 7.5.3)
- Isolated extensometer increases equal to or greater than 10mm

It is recommended that protocols for the review of this ongoing monitoring system be developed and implemented. Whilst alarms will provide automated updates to significant movement or groundwater pressure variations, periodic manual checking of data should also occur.

10.3 Site management plan

A comprehensive site management plan is required to manage the Wade Street landslip and immediate area in the medium to long term. The site management plan would need to include a revised emergency response plan and provide specific measures to control all current and proposed site activities.

The commissioning of the on-line monitoring station has also introduced the need to understand the roles and responsibilities of all stakeholders. It is recommended that protocols for the review of this on-line monitoring system be developed and implemented. Whilst alarms will provide automated updates to significant movement or groundwater pressure variations, periodic manual checking of data should also occur.

In summary, the site management plan is proposed to include measures which address, but are not limited to:

- protocols for review of the on-line monitoring system
- maintenance of site monitoring station
- protocols for conducting site inspections, including potential safety harness training
- pedestrian and vehicle traffic, including beach use
- fences and signs, including maintenance
- Conduct asset manager stakeholder workshop to discuss and finalize remedial options

As discussed throughout this report PB was commissioned to provide a number of conceptual remedial options based on the overall assessment and investigation of failures at the site. The concepts have been provided for consideration by DSE and potentially other stakeholders and it is recommended that a workshop be convened to discuss the merits of each option.

It is expected that factors relating to issues such as cost, amenity, public disruption, complexity of construction, timeframes etc would be fully debated and that a final consensus taking account of all issues could then be arrived at as to which option should be pursued through a more detailed design and documentation phase.

PB also recommends that an additional provision be made for involving a specialist geotechnical contractor through the workshop process. PB visited the site with Geovert during September 2008. Geovert has experience working on difficult landslip projects and is familiar with the sites characteristics.

10.4 Public consultation meeting to present results

It is recommended that DSE consider extending the current public consultation program to include a public presentation of results obtained thus far from this investigation. A number of the options presented may have impact on various sections of the public and the dissemination of information can prove to be an effective method of understanding concerns and gaining support for the final preferred option.

10.5 Consider obtaining site profiles using LiDAR technology

One of the enduring information gaps throughout this assessment has been the lack of detailed site contours and profiles. This has been largely due to restrictions with site access and OH and S considerations especially when working in close proximity to failed slopes and cliff edges.

Any final design will require detailed site profiles and one safe option to emerge in order to obtain detailed survey information is the use of remote sensing technology such as helicopter based oblique LiDAR. Given the importance of this information to the final design it is recommended that further investigations be undertaken to assess the suitability and availability of this application at the site.

10.6 Consider reviewing assessments once better data is available

Once additional profile data is available it is recommended that a review of the overall site profiles be undertaken. In addition it is recommended that a limited number of stability analyses be re-run to assess the overall implications for the previous slope stability analyses which were restricted to data obtained from limited site observations and previous less detailed survey information for the site.

10.7 Detailed design of remedial works

Detailed design work and documentation is required if protection is selected as the preferred strategy. Detailed design work could commence once a particular engineering remedial solution has been selected.

The design of permanent fencing and other site safety works would be required if either of the adaption or retreat strategies are selected.

10.8 Consider repeating coastal risk study

The previous coastal study conducted in 2000 identified a number of significant coastal stability issues along the coast extending north from the harbour to Dutton Way. The recent significant landslip at Wade Street, the metastable slope now located above the closed off Anderson Point stairs and the occurrence of at least two other significant slides north of Hanlon Parade suggest it is an appropriate time to review this study.

We believe the LiDAR information will also provide extremely useful information in assessing coastal stability issues along the Portland coast. The LiDAR data is likely to provide high definition contour information which can be used to highlight boundaries of historic landslips, recent landslips and/or potential future landslips.

Risks are very rarely static and the coastal processes along this coastline have proven to be dynamic. Knowledge and understanding gained during the current investigation and assessment can now be reapplied to the overall coast and a reassessment of hazards and associated risks undertaken to assist with forward planning by the responsible authorities.