



# **Aberdeen Donmouth Coastal Embankment**

Phase 2 Recommendations Report

21 July 2017



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# Issue and Revision Record

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# 1 Introduction

## 1.1 Background and Scope

This recommendations report follows on from the MML Risk Assessment Report for the Donmouth coastal embankment site in Aberdeen, which is experiencing ongoing erosion and has previously experienced slope failure.

The risk assessment report identified areas of high risk to Donmouth Road along the embankment slopes with evidence of current erosion at the toe of the slope and historic slope instability. Remediation measures have been constructed to stabilise a recent slip adjacent to the Bridge of Don. Aberdeen City Council (ACC) have commissioned MML to consider appropriate survey and site investigation activities to inform remedial option selection, and outline possible remediation options for the site.

The coastal embankment is located between the mouth of the River Don and the Bridge of Don, herein referred to as the site. The site location is shown in Figure 1.1.

**Figure 1.1: Indicative Site Boundary**



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The objectives of this Phase 2 Recommendations report are to:

- Outline any further investigation activities required, intrusive and non-intrusive.
- Propose possible remediation options for the site.
- Provide approximate costs for investigation and design activities.

## 1.2 Sources of Information

The following sources of information summarised below have been used to compile this report.

- MML Donmouth Desk Study (Ref. 1)
- MML Donmouth Risk Assessment Report (Ref. 2)
- ACC Tender Information (Ref. 3)
- A guide to managing coastal erosion in beach/dune systems, SNH (Ref. 4)



## 2 Site Investigation and Design Process Recommendations

### 2.1 Possible Remediation Options

The slope stability risk assessment report identified a moderate to high risk to Donmouth Road from slope instability and toe erosion, and recommended remedial measures be adopted for the high risk areas.

The risk categories allow prioritisation of monitoring and remedial works. During the optioneering / preliminary design stage the potential impact of remediating parts of the slope and not others should be considered. For example, this approach may focus erosion and scour to areas that have not experienced it before and surface water to slopes that may become unstable as a result.

The following sections outline potential remediation measures that could be considered.

#### 2.1.1 Slope Instability

A number of possible remediation measures may be appropriate, including:

- Extension of the coarse rock fill placed on the slope at the western end of the site.
- Regrading of the slope, reducing the road to one carriageway to create extra space. Potentially including soil nailing.
- Construction of a concrete retaining wall along the length of the slope.
- Localised placement of rock armour at the toe of the slope.

It is considered that the most appropriate option will need to be chosen based on a preliminary design exercise, consultation with residents and stakeholders, and consideration of long-term plans for the area.

#### 2.1.2 Immediate Monitoring and Works

Immediate actions that may be undertaken at the site include setting up fixed monitoring points on the slope and road to monitor movement. It is recommended that visual inspection is undertaken regularly i.e. every month and after periods of extended rainfall. This monitoring will allow the slopes to be properly assessed and managed while an informed decision is made as to the nature and extent of remedial works.

ACC may wish to install signage along the road to warn people of the risk of road subsidence and slope instability, and consider the long-term suitability of parking at the crest of the slope.

### 2.2 Proposed Site Investigation and Surveys

To determine the most appropriate response to the ongoing issues, undertaking the following site investigation / surveys should be considered.

#### 2.2.1 Non-intrusive

A detailed topographic survey of the site is required, potentially with fixed survey points to allow measurement, i.e. at the crest of the embankment. This would:

- Allow monitoring in the interim of a decision being made about the most appropriate solution.

- Act as a baseline to determine movement of the slopes.
- Inform the design of remedial measures.

This survey could take the form of either a traditional topographic survey, i.e. using total station and staff, or a point cloud survey and photogrammetry using an Unmanned Aerial Vehicle (UAV). MML has moved to the use of UAV surveys recently due to speed of data acquisition, associated potential cost savings and health and safety aspects, as well as ease of comparison of subsequent surveys. It is recommended that this be undertaken at a lowest tide, to ensure partially underwater slopes are included.

ACC may also wish to commission an environmental survey to inform the decision.

### 2.2.2 Intrusive

To better understand the potential and historical failure mechanism of the slopes and to inform the design of remedial measures a site investigation and associated testing should be undertaken. This could take the form of boreholes along the crest of the slope, and boreholes / trial pits at the base of the slope, dependant on access.

## 2.3 Proposed Design Processes

Prior to remedial works design a preliminary design exercise should be undertaken. This would consider available data including the proposed topographical survey, historical lidar, charts, aerial photography, flooding and environmental data.

As part of the this preliminary design exercise, initial slope stability modelling would indicate the feasibility of discussed possible remediation measures. This would allow an informed decision to be made as to the most suitable remediation approach across the slope.

Developing the detailed design for a remedial works would involve the following:

- Slope stability analysis using intrusive investigation results and topographic survey.
- Design of remediation engineering solutions, i.e. placement of coarse fill, retaining wall, regraded slope.
- Production of design drawings, plan and section, using the topographic survey as a background.

## 2.4 Estimated Costs

Included in Table 1 below is an estimate of costs associated with the site investigation / surveys and design processes outlined.

**Table 1: Approximate Costs**

Aspect	Estimated Costs	Assumptions
Non-intrusive Investigation	£8,000	<ul style="list-style-type: none"> <li>• Point cloud survey across an area of 2 hectares.</li> <li>• Undertaking of an environmental survey</li> </ul>
Intrusive Investigation	£25,000	<ul style="list-style-type: none"> <li>• Borehole site investigation, assuming 2 no. along crest and 2 no. along base of embankment slopes. 2 no. days trial pitting.</li> <li>• Site supervision.</li> <li>• Scheduling of laboratory testing.</li> </ul>

Aspect	Estimated Costs	Assumptions
Optioneering / Preliminary Design	£5,000	<ul style="list-style-type: none"><li>• Review of freely available data and preliminary slope stability assessment.</li></ul>
Detailed Design	£25,000	<ul style="list-style-type: none"><li>• Costs are dependant on option.</li><li>• Costs are indicative and include estimate of detailed design, construction drawings..</li></ul>

Additionally, ACC should be aware of other potential associated costs including licensing (marine, environmental).

## 3 References

1. MML Desk Study, 378926 Donmouth Road Phase I Desk Study, Rev B, March 2017
2. MML Risk Assessment Report, 378926 Donmouth Risk Assessment Report, Rev D, April 2017
3. ACC, Tender Information 'Volume 2.2, Work Package 2 – Scoping Document, Aberdeen Donmouth Road Coastal Embankment' ref. 3097260/CS-ACE/2.2 Rev.T00, dated October 2016
4. SNH, 'A guide to managing coastal erosion in beach/dune systems', dated October 2000.  
[online- <http://www.snh.org.uk/publications/on-line/heritagemanagement/erosion/index.shtml>]

