Proactive Management of Slope Hazards in the Transport Industry - Waioeka Gorge Pilot Study
Overview

Introduction
Pilot Study
Proposal
Next Steps
Acknowledgement
Questions
Our State Highways
Waioeka Gorge SH2

6hr detour
Current Practice

• Contractors located on both ends of gorge
• NZ National Annual Rockfall Study
• NZ Transport Agency Risk Register
• Twice daily patrols
Waioeka Gorge Slip History

- Case Study (at least 10,000m³)
- Rock fall (OPUS)
- Sandy Slip
Sandy Slip (March 2012)

- 4 week Road Closure
- 1 lane operational till March 2013
- 100,000m³ of slip debris
- $8M to Agency
- $4.2m to NZ economy
Pilot Study

Purpose

1. Was Sandy Slip a one off event?
2. Explore the ability of remote monitoring systems to enable a more proactive risk management system dealing with large scale slip risks
Pilot Study

Staged approach

Stage 1
50km Waioeka Gorge

Stage 2
16 High to Very High Risk Sites

Stage 3
3 -6 Key sites
2 Critical Sites
Stage 1 - High Level Screening

Estimated Slope Stability Rating (0 to 100 pts)
  + Vegetation Cover Rating (-20 to 20 points)
  + Adjacent Geometry Rating (-20 to 30 points)
  + Adjacent Hydrology Rating (0 to 30 points)
  + Failure History Rating (0 to 50 points)
  + Future Instability Indicators Rating (0 to 30 points)
## Stage 2 – Moderation Phase

<table>
<thead>
<tr>
<th>Site location (SH-RS/RP-RP)</th>
<th>Site #</th>
<th>NZ National Annual Rockfall Hazard Rating</th>
<th>Waioeka Gorge Pilot Study Stage 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Site #</td>
<td>Ranking</td>
</tr>
<tr>
<td>2-318/10.2</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2-334/0.4</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-334/6.45 – 6.55</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-345/1.72 – 2.32</td>
<td>4</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2-334/3.99 – 4.09</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-334/8.50 – 10.5</td>
<td>6</td>
<td>12,14,16</td>
<td></td>
</tr>
</tbody>
</table>
Stage 3 – Case Study

- LiDAR (10Km)
- Helicopter flyover
- Site visit
- Historical Arial photos
Stage 3 – Case Study

Risk $\propto$ Pot. Slip Volume + Debris Cap. Road
10,000 to 50,000 m³ + each
Proposal
Monitoring system

Monitoring Instruments
Installation and operation

Alarm/Alert System
Road level and Office

Action
Customer safety

Threshold
Alert level

New Zealand Government
Monitoring Instruments

- Laser Target (EDM)
- Tiltmeter
- Extensometer
Management system

<table>
<thead>
<tr>
<th>Alert Level</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Do Nothing</td>
</tr>
<tr>
<td>1</td>
<td>VMS Warning/ Social Media</td>
</tr>
<tr>
<td>2</td>
<td>No stopping for *Km</td>
</tr>
<tr>
<td>3</td>
<td>Bring down in controlled manner (road closed)</td>
</tr>
</tbody>
</table>
Case for Change

• Deliver early warning of slope failure
• Not New
• Goes Beyond Waioeka
Next Steps

Propose monitoring system as an operation research to develop and prove a process; a system that is

• Repeatable
• Scalable and
• Low cost
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