Operational responses to geotechnical asset failures impacting on transportation infrastructure.

BEAR Scotland North West Trunk Road Maintenance – efficient management of geotechnical emergencies.

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Speakers

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Content

• Trunk Road management in Scotland
• Nature of geotechnical assets
• NW unit landslide management plan
• Case studies:
  – Embankment failure supporting A9 at Loch Insh
  – Landslide onto A83 at Rest and Be Thankful
Trunk Road Management in Scotland

- BEAR Scotland is the Operating Company for Trunk Roads in NW and NE of Scotland
- Responsible for the improvement and maintenance of over 2000km of Trunk Roads
- Key routes include A9 (Perth to Scrabster), A83 (Tarbet – Lochgilphead – Kenacraig) – [focus of two case studies]
North West Scotland Trunk Roads

- Scrabster
- Ullapool
- Skye
- A9 – Loch Insh
- A83 Rest and be Thankful
- Glasgow
Nature of geotechnical assets

• Embankments
• Cuttings
• Retaining walls
• Rock slopes
• Debris barriers
• Drainage networks
• *Natural terrain in vicinity of Trunk Roads*
Landslide Management Plan

• August 2004 events
  – A83 Glen Kinglas (Cairndow)
  – A9 (north of Dunkeld)
  – A85 Glen Ogle

• Development of Landslide Management Plan (LMP)

• How LMP is implemented
Embarkment failure supporting A9 at Loch Insh

Key information

• Cause: embankment washout failure
• Date: 22 December 2014
• Scale: failure ~10m high and 10m to 20m wide
• Failed section of embankment 30+ years old
• Quantity of imported material ~5,000t
• Cost of remedial repair ~£80k
A9 Loch Insh – pre and post failure

Pre failure

Post Failure
A9 Loch Insh – remedial works
A9 Loch Insh – temporary construction drainage
A9 Loch Insh - completed remedial works
A83 at Rest and be Thankful (RaBT) Phase 1 Landslide

Key information
• Cause: two significant debris flows
• Date: 5 and 30 December 2015 (storm Frank)
• Scale: initial failure ~60m above A83, second failure ~240m above A83
• Volume of debris flow: 5 Dec ~400m$^3$ (intercepted by barrier), 30 Dec ~100m$^3$ (breached temporary barrier)
• Barrier design capacity: 600m$^3$
• Cost of repair ~£140k
A83 RaBT – hillside prior to events of Dec 2015

Source of first failure
5 December 2015

Source of second failure
30 December 2015

A83 Trunk Road

Old Military Road (temporary diversion route)

Note: photo predates failures and shows earlier failures on hillside
A83 RaBT – 5 December failure
A83 RaBT – consequence of 30 December failure
A83 RaBT – 30 December failure source

150t boulder

Images courtesy of Geo-Rope
A83 RaBT – reducing risk posed by 150t boulder
A83 RaBT – boulder post remediation
A83 RaBT – conclusions

• Dynamic nature of hillside
• Inspect hillside from opposite side of glen
• Exposed boulder inspection following debris flows
• Catch pits considered to augment barriers
• Alternate solutions have been explored:
  – Viaduct
  – Debris flow shelter
  – Road at bottom of glen (along OMR alignment) and tunnel
  – Alternative routes
Concluding remarks

• Safety of road users is the key consideration in geotechnical decisions
• The uniqueness of parts of the Scottish Trunk Road Network requires a pragmatic approach to dealing with geotechnical asset failures
• Solution is typically to remediate, i.e. as good as before or better (not necessarily to code)
• By combining the strengths of various organisations, cost effective and timely solutions can be delivered to benefit road users
• Lessons used on design of new infrastructure
Thank You.