

Improving safety and efficiency whilst investigating landslide-prone terrains

AECOM

The Challenge

- Survey a hillside notorious for landslips and identify need for mitigative solutions to reduce number of road closures

The Benefits

- Improved health and safety at a hazardous location
- Fivefold acceleration in field surveys
- Reduced potential for under-design or over-design of landslide mitigation measures
- Effective collaboration throughout the project

Transport Scotland tasked infrastructure consulting firm AECOM with investigating landslide hazards across a remote Scottish hillside notorious for landslide-related road closures. AECOM used Esri's ArcGIS to reduce the number of site visits required during the assessment and to better understand landslide behaviour in 2D and 3D.

The Challenge

In 2020, two major landslides caused the closure of the A83 Trunk Road in rural Scotland at a location known as The Rest and Be Thankful where the Trunk Road traverses a steep, southwest facing hillside along Glen Croe. Hillside stability after these major landslides was cause for concern.

Transport Scotland appointed AECOM to assess landslide potential and estimate landslide pathways and scale along Glen Croe. Well aware of the urgency of the project and the potential hazards faced when surveying unstable land in remote locations, AECOM needed to find a way to undertake the project as efficiently and safely as possible.

The Solution

AECOM had been using Esri's ArcGIS for many years on this project and therefore decided to harness the 3D modelling and analytical capabilities of ArcGIS to help its Ground Engineering Team better understand the geography of the hillside.

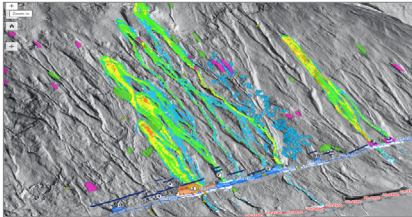
First, the company used ArcGIS Pro to analyse the terrain in 2D and 3D to understand slope angle variation across the hillside, identify boulders, map historical debris source areas and locate tension cracks. It imported high resolution imagery of past landslip events to make comparisons and reveal patterns. Then it used the Esri Hydrology toolset in ArcGIS Pro to model watershed and flow paths to improve understanding of the terrain before site visits and 3D landslide modelling began.

In parallel, AECOM used ArcGIS Online to create a 3D web scene of the entire site, enabling the project team to visualise and virtually navigate the hillside. Specialist third party Rapid Mass Movement Simulation (RAMMS) landslide modelling software outputs presenting projected landslide trajectories, landslide velocities, landslide flow heights, rockfall bounce heights and rockfall energies, were also draped onto the ArcGIS Online map, allowing everyone to see the model calculations in context with surrounding features and terrain in 2D and 3D.

To support geologists working at the site, AECOM created a mobile data capture solution using ArcGIS Survey123. Several digital survey forms were built enabling geologists to record information such as boulder, rock outcrop and channel features, ground surface soil types and vegetation coverage. The geologists could add photographs as well as observations to their survey forms and record accurate, consistent, geospatially-referenced data. All the information collected in the field was uploaded directly to ArcGIS Online, making it instantly available to the whole project team. All ArcGIS project data was accessible electronically on tablets, allowing efficient cross referencing during the survey and avoiding the need to carry multiple drawings.

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Beth Mennie, Associate Director, Data, Geospatial and Analytics, AECOM



ArcGIS 3D Scene showing some of the potential landslide flow paths and rock boulder locations identified during the assessment

The Benefits

Improved health and safety at a hazardous location

ArcGIS contributed to improved health and safety by enabling geologists to better understand hillside conditions, identify potential ground stability issues before going out on site and take necessary precautions to avoid areas of highest risk. Furthermore, the use of desktop surveys significantly reduced the need for repeat site visits and minimised the amount of time geologists needed to spend on site. “Reducing the number of field visits is an important aspect of improving health and safety and reducing travel-related carbon footprint,” explains Beth Mennie, Associate Director, Data, Geospatial and Analytics, at AECOM. “We estimate that our use of ArcGIS reduced the number of site visits by at least 50%, which significantly reduced the risks from working at a remote, unstable site, as well as travel-related risks traveling to and from site.”

Fivefold acceleration in field surveys

By using ArcGIS Survey123 for data collection, AECOM was able to dramatically improve the efficiency of its field-based operations by as much as 400%. It took advantage of smart editor tools to enable data collection to be undertaken consistently and created drop-down fields to speed up the process of surveying the hillside. “Doing surveys with ArcGIS Survey123 is around five times faster than doing surveys on paper,” Mennie says. “What is more, the data collected using ArcGIS Survey123 is more consistent, more detailed and more accurate which really makes a difference in the design and build phases.”

Well-engineered designs to mitigate risks

ArcGIS played a pivotal role in helping AECOM and Transport Scotland to identify sections of carriageway at risk of future landslide activity, estimate landslide scale and assess operational impact with less uncertainty. Landslide risk reduction measures designed to capture and retain debris, such as catch pits and catch fences, can therefore be designed more efficiently, reducing potential for under-design (where mitigations are not resilient enough to capture debris) and over-design (where mitigations are oversized offering poor cost efficiency). “The optimised design of catch pits and catch fences will reduce the number of road closures needed in future and minimise road user disruption,” Mennie says.

Effective collaboration throughout the project

The use of ArcGIS Online web maps gave the project team a better understanding of the site from the outset and enabled everyone to more easily visualise the site and share information. All survey data was visible in ArcGIS Online as soon as it was uploaded, and models from separate specialist systems were integrated into ArcGIS, creating a single place for all project information. This created a highly collaborative project within AECOM and, as Mennie says, “contributed to a good working relationship with our client, Transport Scotland, during project delivery too.”

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