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Fighting bushfires with location-based analytics

ACT Emergency Services Agency

By fusing advanced location-based analytics with innovative laser imagery, ACT Emergency Services Agency automated and standardised the assessment of bushfire risk on Canberra properties.

Project overview

Constantly monitoring landscape changes and the risk of bushfire to nearby structures is crucial to the protection of life, property and the environment in the Australian Capital Territory (ACT).

Canberra is described as the bush capital for good reason, with forest and grassland woven throughout its urban areas. Living in Canberra means living in or near an environment in which bushfire is a natural occurrence.

Site inspections are traditionally used to determine Bushfire Attack Level (BAL) classifications for individual properties. BAL is a standard way of estimating the intensity of the fire that would affect a structure in a bushfire prone area. It is part of Australian Standard AS 3959:2009 that makes recommendations for construction of buildings in bushfire prone areas.

The ACT Emergency Services Agency (ESA) wanted to establish a more consistent and efficient computerised method of analysis which followed the methodology established in AS 3959:2009 to categorise the potential impact of bushfires.

ESA partnered with Esri Australia to develop a tool which uses advanced location-based analytics and LiDAR imagery to calculate the BAL to reflect the level of risk a building has of being impacted by fire.

The model allows ESA to better understand what the effects of a bushfire might be in any given neighbourhood – and ensures an effective management and mitigation strategy can be put in place.

This new assessment tool is helping the ESA assess properties within the ACT at a much faster rate than previously possible.
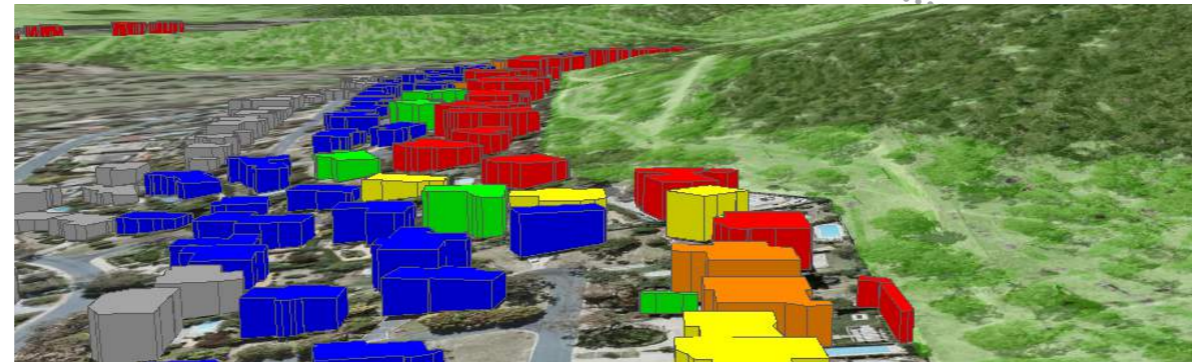
ACT ESA in focus:

With a goal to ensure the ACT remains one of the safest communities in the world, the ACT Government established the Emergency Services Agency in 2004 to combine the Ambulance Service, Fire and Rescue Service, Rural Fire Service and State Emergency Service under one Commissioner.

The agency's dedication to the protection of life, property and the environment is driven by a determination to mitigate a repeat of the devastating 2003 Canberra bushfires that killed four people, injured 490 and destroyed more than 500 homes.

ESA's workforce of 2600 full-time and volunteer personnel employs evidence-based decision-making strategies and cutting-edge technology to preserve more than 23,000 structures within bushfire prone areas.

The agency is a long-term user of location-based analytics technology and supporter of Mapping and Planning Support (MAPS), a network of volunteers who provide Geographic Information System (GIS) support during emergency situations.

> ❝ This model can accurately assess the risk facing thousands of houses in a very short space of time, with the capacity to complete 16,000 property assessments in just a couple of hours. ❞
>
> **Nick Lhuede,** Manager of Emergency Management, Risk, Spatial and Digital Services, ACT Emergency Services Agency

The challenge:

Living in a state dubbed 'the bush capital of Australia' with a history of devastating wildfires, ACT's residents and emergency services personnel keep an ever-vigilant eye on the high-risk farmland, bush and national parks that surround them.

To more effectively achieve its goals, the ESA sought to make its Bushfire Attack Level (BAL) rating process smarter and more precise.

With around 26,000 structures located in bushfire prone areas, a constantly changing landscape and new projects in construction, the ESA wanted to classify each property's BAL in a way that: simplified the effort for both the community and government to capture information, was cost effective, could generate data fast, and created minimal administrative complexity. Site visits to all dwellings were known to be time-consuming and to assess all properties would impose significant costs on the community and government.

Automating the assessments had not been considered, because using imagery such as Landsat and aerial imagery, which does include accurate 3-dimensional capture, required advanced modelling.

Specifically, the ESA needed a solution that would:

✛ Assist property owners by providing a more up-to-date definition of bushfire prone areas

✛ Save time and money by automating the classification system, providing an ACT-wide complement to visual inspections and manual measurements

✛ Ensure property classifications remained up-to-date and consistent by the efficient monitoring of landscape and construction changes.

The solution:

Through the ACT government's program to provide high-quality LiDAR covering the entire territory, and the ability to take this data and generate a range of high-resolution, spatially accurate 3D products, the concept of automating Bushfire Attack Level (BAL) assessment was born.

Already at the forefront of the use of location-based analytics for emergency management, ESA again partnered with the Esri Australia Professional Services team to develop a first-of-its-kind solution.

Drawing on the LiDAR imagery, a 3D model of bushfire prone areas was created which included derived vegetation density, building footprints and slope data. This allowed a comprehensive assessment of BAL consistent with the field processes detailed in the Australian Standard.

Using spatial analytics functions in the Esri technology suite, the distances between features can be determined, and by referring to the Australian Standard, the BAL calculation is then made.

The categories, from 12.5 KW/m2 through to 'the flame zone' – an area subject to direct flame impingement – are modelled on radiant heat in kilowatts per metre squared, and the results are displayed with different colours representing the five BAL risk categories.

Having a comprehensive, consistent assessment allows the ESA better understand where levels of higher risk occur.

The innovations:

Laser sharp imagery:

✛ ESA and Esri Australia created a world-first prototype for the use of LiDAR imagery in the classification of BAL. The remote sensing method that uses a pulsed laser from an aircraft to measure variable distances to Earth, can generate precise, 3D information about the shape of the landscape and its surface characteristics.

✛ In the ESA's case, LiDAR imagery produces eight points per metre which is ideal for emergency services risk assessment, clearly identifying rooflines and tree canopies.

✛ When combined with location-based analytics technology, the 3D model generated by the millions of LiDAR points taken over the ACT, provides a perfect foundation to determine the layers of additional data required to determine the final BAL.

A multi-layered analysis of risk factors

Location-based analytics technology combines the 3D LiDAR modelling with additional layers of the following information:

✛ Existing vegetation maps, along with the categories defined in Australian Standard AS 3959:2009, are matched against the LiDAR-derived vegetation model and aerial photography to validate vegetation density

✛ Buildings are categorised and their footprints enhanced to outline hard edges and heights and their distance from vegetation

✛ The slope of the land, a critical factor in generating greater bushfire intensity, is measured and applied to the model

The resulting matrix of distance, slope and vegetation type facilitates a straightforward and easily automated process that assigns different BAL ratings to every property.

The outcomes:

+ **Large-scale assessments.** The ESA can now undertake large-scale assessments in much less time and at lower cost. The automated solution enables the agency to make estimations and judgements across the whole ACT. Instead of time consuming individual and manual assessments, the new tool processes 16,000 assessments in one hour. Importantly, ESA can potentially quantify the impact of policy changes by quickly calculating the number of properties that might be affected, simply by modelling different options and assumptions.

+ **Consistent classifications.** The automated tool empowers ESA to deliver a uniform assessment of BAL across the entire ACT.

+ **Mitigation advice for new constructions.** The accuracy the new tool provides may assist in how people build new houses in bushfire prone areas. By assessing vacant land, planners can ensure structures are positioned in a way that minimises the risk of damage in a fire. This makes the BAL tool not just a useful assessment device but also an essential guide in the planning and approval process.

+ **Community education.** Aided by the easy-to-understand 3D maps and colour-coded fire risk categories, the information delivered through the tool can guide community awareness and the development of bushfire prevention activities.

Solution mix:

+ Esri Professional Services
+ ArcGIS for Desktop
+ Spatial Analyst Extension
+ Python 2.7

The new automated Bushfire Attack Levels rating system has enabled the ACT Emergency Services Agency to reclassify properties in the territory more consistently and at a much faster rate than previously possible.

> For the first time, we are able to quantify the level of bushfire risk for properties street by street throughout Canberra. This will be invaluable in guiding targeted community education and engagement to reduce the impacts of fire.

Nick Lhuede, Manager of Emergency Management, Risk, Spatial and Digital Services, ACT Emergency Services Agency

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Discover the value Esri Australia's GIS technology solutions will deliver to your organisation.
Call us on 1300 635 196 today.