



# Land Governance in an Interconnected World

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY  
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## HARNESSING LAND INFORMATION THROUGH CLOUD-BASED PLATFORMS FOR A RESILIENT SOCIETY

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## **Abstract**

In many countries land is a scarce and valuable resource which critically underpins the wellbeing of citizens, as well as being a pillar of economic activity.

Availability of accurate geospatial data which provides a range of valuable information about land has been proven to increase the resilience of communities dealing with events such as flooding, industrial hazards, climate change, disease outbreaks etc. In all cases, access to current, high quality geospatial data is a critical component, underpinning effective planning, response and recovery to these often-unforeseen crises and emergencies. A Spatial Data Infrastructure (SDI) in which geospatial information about land can be shared between government organizations, emergency responders, critical infrastructure providers and citizens, prepares for these scenarios by identifying, aggregating, harmonizing and making accessible, valuable land information to enable the best decisions to be made.

This paper will give an example of a closed and tightly managed Spatial Data Infrastructure which was developed to strengthen national resilience and put information at the fingertips of decision makers in the United Kingdom.

## **Key Words:**

Collaboration, Geospatial, Land, Resilience, Response



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## **Harnessing Land Information Through Cloud-Based Platforms For A Resilient Society**

Andy Wilson, John Kedar, Neil Dewfield, Fredrik Zetterquist, Dan Schirren, David Stowe and Peter Hedlund

### **Definition of a resilient society**

Resilience takes many forms. Today's resilient societies are safe, economically strong and rich in citizen well-being, engagement and quality of life. Accurate and dependable information about land and geography underpins the creation, maintenance and growth of these resilient communities. Looking at the long-term variables we risk tipping points with irreversible consequences in a number of planetary systems (environmental, social etc). We need also to care about long-term impacts and foster an understanding of the complexity and adaptation we have to deal with. The use of qualitative, consistent and comprehensive geospatial data is fundamental to ensure this long-term sustainability of resilience preparedness.

### **Value of land information**

In many countries land is a scarce and valuable resource which critically underpins the wellbeing of citizens, as well as being a pillar of economic activity and governance.

Availability of accurate geospatial data which provides information about land has been proven to increase the resilience of communities dealing with events such as flooding, industrial hazards, climate change, disease outbreaks etc. In all cases, access to current, high quality geospatial data is a critical component, underpinning effective planning, response and recovery to these often-unforeseen crises and emergencies. A Spatial Data Infrastructure in which geospatial information about land can be shared between government organizations, emergency responders, critical infrastructure providers and citizens, prepares for these scenarios by identifying, aggregating, harmonizing and making accessible, valuable land information to make the best decisions.

Geospatial data also enables monitoring of land use change, enabling governments to quickly understand and visualize the amount of change in any given area and to identify communities at risk due to changes in land occupation (for example construction of new industrial/energy installations within close proximity of conurbations).



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Having information about the amount and location of land which is changing also enables effective management of both rural and urban development at national, regional and local levels. This information can be used to derive valuable information on:

- Percentage and location of housing developments in areas which are subject to flooding, subsidence or extreme weather events
- Percentage and location of housing close to high risk industrial installations
- New developments at risk of being impacted by pollutants
- Changes in land use in terms of agriculture and farming

By combining different geospatial datasets including property addressing, Ordnance Survey has created a highly-detailed map showing land and property use across England. This has provided a baseline of the 'current state' of land use across the country down to individual dwelling level.

Every year, 'snapshots' in time are taken using Ordnance Survey's large-scale mapping and a comparator undertaken to identify areas of change and new land use classifications. This annual land use classification process provides an insightful view of the way in which rural and urban land usage is changing and to be able to identify 'at risk' communities.

Figure 1 shows the inferred land use classification attributed to each polygon at one of the annual 'snapshots.'

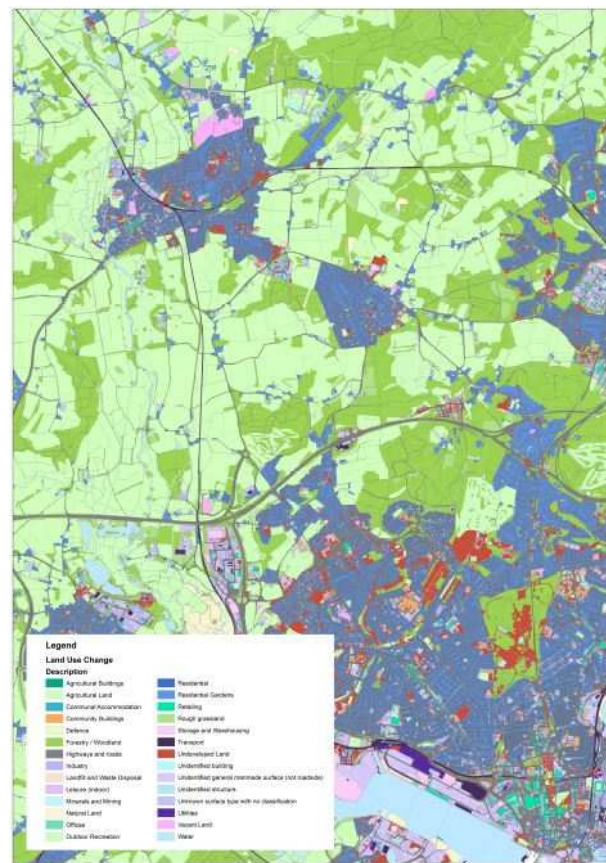


Figure 1: Inferred land use classification attributed to each polygon at one of the annual 'snapshots'.

Source: Ordnance Survey.



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## Drivers for investment in land administration capability

We see four key drivers for investment in national and regional land administration capability.



Figure 2: Post conflict countries.  
Source: Ordnance Survey.

In post conflict countries (Figure 2) to:

- Return land to its rightful owner
- Create a transparent inclusive economy for regrowth

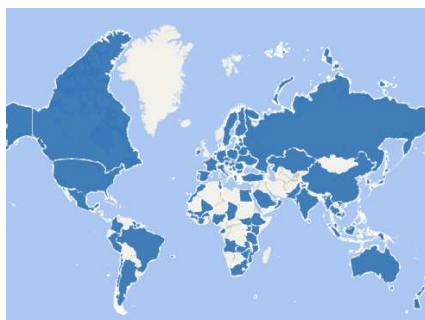


Figure 3: Countries with Smart Cities.  
Source: Ordnance Survey.

To meet the challenge of increasing urbanization and the rise of ‘Smart’ cities (Figure 3) to:

- Effectively and transparently manage rapid growth in land and property transactions
- Manage the complexity of growing numbers of high rise buildings with multiple owners



Figure 4: Economic growth countries.  
Source: Ordnance Survey.

In support of economic growth (Figure 4) to:

- Provide surety to encourage and attract foreign direct investment
- Establish a critical building block for robust taxation systems
- Enable confidence land tenure for all



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In the face of natural and man-made crises (Figure 5) to:

- Ensure clear ownership of land and property to aid post-crises recovery
- Support the control and management of disease outbreak
- Enable safer cities in the face of terror attacks

*Figure 5: Natural and manmade crisis countries  
Source: Ordnance Survey.*

Geospatial data and land information are close allies, with geography providing the map on which all land and property activity occurs. When combined, they provide a powerful decision-making tool for government, private business, and citizens. Knowing what is happening ‘where’ and ‘when’ – and what might occur – enables the protection and security of citizen communities in the face of the four key challenges described above. When this information is combined, and made available to multiple users as a ‘single version of the truth’, we can start to hardwire resilience into our communities at national, regional and local levels.





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## **RESILIENCE DIRECT – MAKING GEOSPATIAL AND LAND INFORMATION AVAILABLE ON A SECURE CLOUD BASED PLATFORM.**

### **Context**

The United Kingdom Civil Contingencies Act 2004 establishes a legislative framework for civil protection in the United Kingdom. It imposes a clear set of roles and responsibilities on those organizations with a role to play in preparing for, and responding to, emergencies. The Act is separated into two parts: local arrangements for civil protection (Part 1) and emergency powers (Part 2).

Part 1 of the Act, establishes a clear set of roles and responsibilities for those involved in emergency preparation and response at local levels. Whilst there is no reference in the Act to the use and sharing of geospatial data, there are specific duties that require response agencies to:

- Assess the risk of emergencies occurring and use this to inform contingency planning in the form of a Community Risk Register;
- Share information with other local responders to enhance co-ordination.

### **Challenge**

Crisis situations are dynamic – change occurs by the minute and emergency situations are impacted by many different influences both man-made and natural. Emergency services need to be ready to deal with these crises and disruptive events, ranging from natural disasters to deliberate attacks. To make critical decisions quickly, responders need to work collaboratively using information from a range of diverse sources. In the absence of an accessible common operating picture which integrates a range of different information, decision making becomes siloed and ill-informed leading to ineffective response planning, management and recovery. This can result in exposed, unsupported and vulnerable citizen communities.

Typically, some of the challenges faced by emergency responders are;

- Responders can't find each other
- Responders can't share information
- Responders can't understand each other
- Information is systematically undervalued



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- Risks are not properly understood
- Situational awareness is not shared
- Objectives, capabilities & activities do not cohere
- Vulnerable lives are further endangered

## **Solution**

Using Ordnance Survey's national mapping datasets, ResilienceDirect™ was launched by Ordnance Survey and the UK Cabinet Office in April 2014 in response to a need for rapid access to information from a range of sources. This national crisis management tool provides a secure common operating platform which brings together emergency response stakeholders and government agencies from across the country, enabling the creation of a single operating picture when needed.

The service enables data sharing and is used by many diverse organizations when planning and responding to emergencies. This common operating picture using Ordnance Survey detailed mapping enables stakeholders to maintain shared situational awareness and underpins effective decision-making at both tactical and strategic levels. Users include emergency services, local authorities and utilities partners with the service enabling real-time sharing and visualization of accurate data and information.

ResilienceDirect has strengthened national resilience by bringing together stakeholders from across the country to enable the deployment of effective incident planning, response and recovery through the provision of:

- A Single platform for collaborative and dynamic engagement, enabling informed and rapid responses in the face of fast changing and unpredictable situations
- Facility for online documentation and information sharing through a data repository
- Ability to rapidly create, edit and share maps online which integrate data from different sources
- A hard-wired work flow enabling central command and control centers to provide instruction and share information with agencies and responders irrespective of their location





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In this way, this secure web-based platform enables true collaboration across different emergency responders and agencies in real-time to underpin the development and deployment of effective, responsive and holistic response plans.

For example, real-time forecast Meteorological Office precipitation can be integrated and easily visualized within the ResilienceDirect tool (Figure 6):

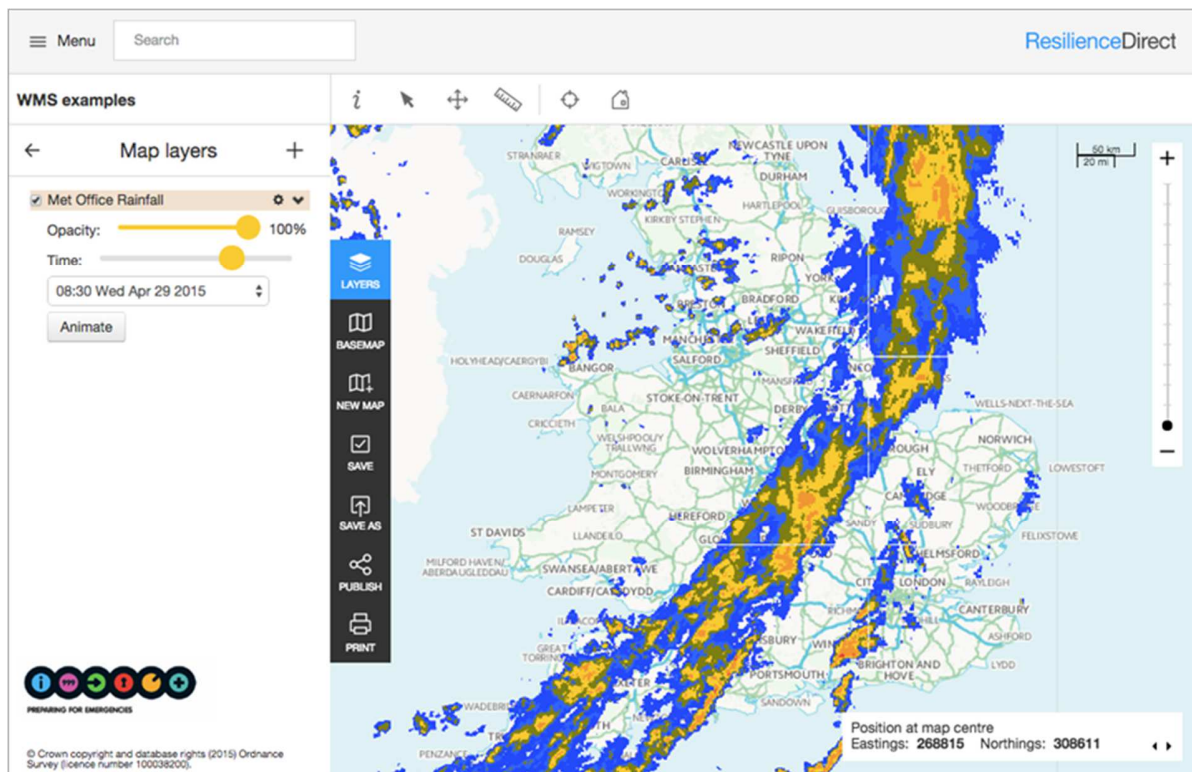


Figure 6: Precipitation visualised within the ResilienceDirect tool  
Source: Ordnance Survey.

This information was critical to emergency responders in December 2015 when Storm Desmond brought 13.5 inches of rain in 24 hours to Cumbria in the north west of England, leaving over 60,000 homes without power due to the devastating impact of the flooding.

The ResilienceDirect tool was deployed to help responders, including the military, to respond to the sudden and widespread flooding which swept across the country leaving farmland, towns, homes and businesses underwater (Figure 7).



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*Figure 7: Cumbria flooding 2015.*

*Source: UK Met Office*

The availability of information about properties and ownership within the flood-hit areas enabled responders to quickly identify the most vulnerable members of the community and to prioritize their evacuation.

## **Open source and open standards**

The ResilienceDirect online mapping capability has been developed using open source technologies and designed to support the integration of OGC® compliant web services. The open-source development approach was considered preferable to Commercial Off The Shelf (COTS) options by the Cabinet Office client. Open source was also seen as an opportunity to design and build a solution for users entirely from the ground up and to provide them with greater flexibility in terms of scaling and deploying the solution to an ever-growing user community without the constraints of commercial licensing models.

The tool brings together over 2,000 geospatial datasets, many of which are land-related and include the Environment Agency (e.g. live flood alerts), British Geological Survey (e.g. landslide susceptibility), Met Office (e.g. live rainfall prediction) and Health & Safety Labs (e.g. population density) plus live feeds from traffic cameras, river gauges and other sensors. The service can digest a variety of data formats, enabling users to add their own layers to maps, reflecting accurate local detail.



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## **Business model**

To ensure widespread buy-in to ResilienceDirect, a decision was made to remove as many barriers to adoption as possible. One such barrier was the previous subscription-based model which saw Category 1 and 2 responders paying to access the service that ResilienceDirect eventually replaced. Detailed base mapping layers and property addressing information is provided free at point of use to all users under the terms of the Public Sector Mapping Agreement between Ordnance Survey and the UK Government. This 10-year agreement, signed in April 2011, enables public sector organizations to access and use Ordnance Survey mapping products and fosters collaboration across the public sector.

## **Accreditation and Security**

The ResilienceDirect service is accredited by the UK Government's National Technical Authority for Information Assurance and hosted in a secure cloud infrastructure, allowing situational reports, documents, site plans, mapping layers and other information to be shared completely securely between authorized individuals, groups and organizations. This ensures that sensitive personal or critical national infrastructure information remains secure and is visible only to those agencies that require it.

A major concern was raised by stakeholders at the beginning of the project as to whether a cloud-based service could be secured sufficiently to protect the sensitive information being created and shared within the system. The challenge was to find the right balance between information security protection and ease of access. Significant engagement with the user community and the National Cyber Security Centre (formally CESG) resulted in final agreement to a suitable classification level and the appropriate accreditation required for the cloud environment.

## **Stakeholder engagement**

Working closely through a short discovery phase, Ordnance Survey worked with Cabinet Office and stakeholders from the emergency response community to identify and prioritize business requirements. Core to the success of the project was this bringing together of multiple agencies to create a common operating view and to capture a wide range of requirements. It was recognized that to ensure buy in to the new solution, feedback should be sought from stakeholders throughout the development cycle. By deploying an Agile approach to development, each 2-week sprint provided an opportunity for the stakeholder community to steer development, have visibility of the incremental value being built and have transparency of all development activities.



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The chart below (Figure 8) illustrates the breadth and depth of the ResilienceDirect landscape and the many groups and stakeholders with an active interest in the tool. As can be seen, stakeholders are diverse and complex but the objective remains the same – to combine information and data from different sources into one operating picture to enable the deployment of effective response and recovery plans.

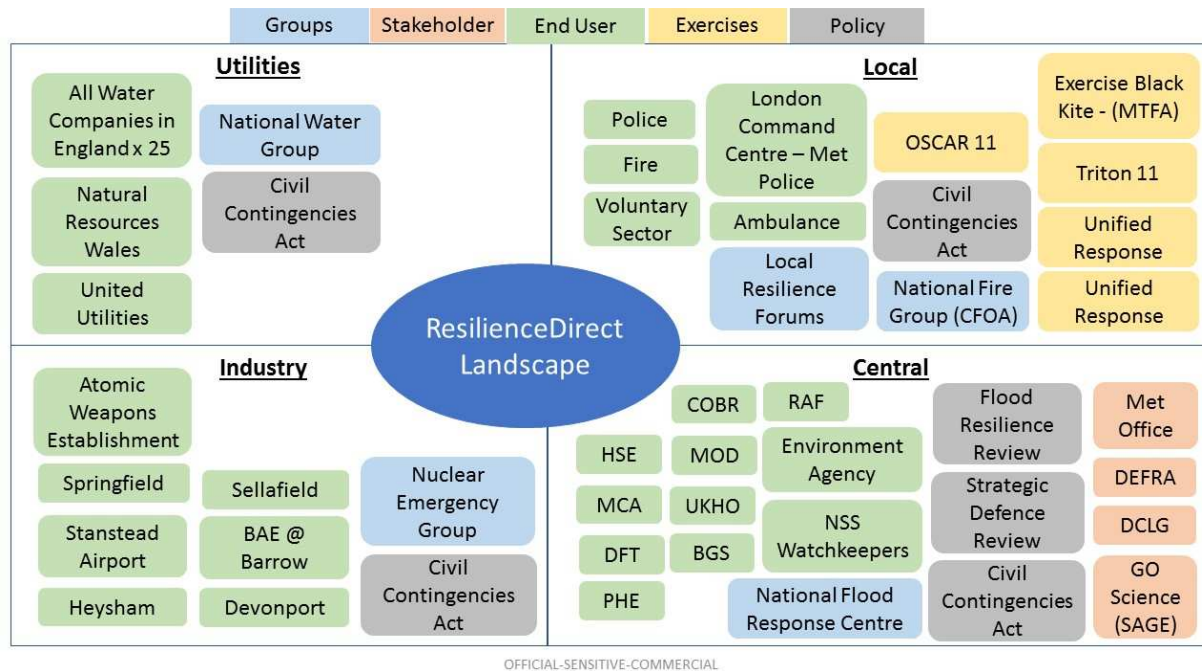


Figure 8: Chart details the groups and stakeholders with an active interest in ResilienceDirect.  
Source: Ordnance Survey.

## Conclusion

Accurate, detailed and accessible information about land underpins a nation’s decision making and its ability to build, enhance and maintain fit-for-the-future resilient communities. Integrating geospatial and land information from different sources into a single, unified and shared operating picture enables best decisions to be made in the face of man-made or naturally occurring critical events. Collaboration, access to real-time accurate data and a common objective enables emergency services to make best use of deployed resources in the face of dynamic and fast-changing critical situations.





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