Multi-Disciplinary Activity Group for Use of Underground Space
C/O Urben

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London & Northern Evidence
National Infrastructure Commission
1 Horse Guards Road
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RE: Call for Evidence

The Multi-Disciplinary Activity Group for Use of Underground Space (MAG2US) is a recently formed group of professionals aiming to improve subsurface resource management and spatial development. In response to a call for evidence by the Infrastructure Commission we would like to submit evidence and views in response to the following questions:

- Connecting northern cities – potential needs and delivery constraints (question 4)
- London's transport infrastructure – opportunities to reduce the costs of London's transport infrastructure (question 3)
- London's transport infrastructure – opportunities for delivery of large-scale transport infrastructure improvements in London, including Crossrail 2 (question 4)
- London's transport infrastructure – international lessons (question 5)

Background

Underground space is a complex, scarce and valuable resource, particularly in urban areas where we are more reliant on using the subsurface for physical infrastructure such as utilities and transport, containment of resources (energy & water), and storage of waste. A lack of integrated above and below ground spatial planning is currently leading to increased pressures on the subsurface. Where optimal use of the space is not pursued, resource functions are not protected and land for future infrastructure is not safeguarded. Subsurface planning is therefore vital to ensure a coordinated approach is taken to the development of above and below ground spaces in our cities, particularly in order to support the needs of Nationally Significant Infrastructure Projects.

Given large-scale infrastructure projects have both a surface and subsurface expression, they provide the opportunity to demonstrate the benefits of new city data management tools, infrastructure mapping and integrated city modelling (e.g. Building Information Models - BIM). Integrating these approaches at an early stage, through demonstrator projects could act as a catalyst for more strategic use of the subsurface and more sophisticated spatial planning of our urban areas and making it nationally consistent.

Potential delivery constraints to new transport infrastructure

Mapping potential project constraints

Late stage awareness of physical constraints to planned infrastructure can be costly. In order to better understand what lies beneath the surface of cities better coordination is needed between utility providers, transport operators, property owners, land use planning authorities and other government institutions. The risk of large infrastructure projects needing to undertake physical detours to avoid constraints such as building foundations could be partly reduced by creating a shared database of geological conditions, existing public assets, planned infrastructure projects, and development opportunity sites in cities. The alignment of Crossrail was influenced by the need to avoid over 200 existing obstructions including building foundations and other underground rail lines. Meanwhile Crossrail2 is likely to be re-routed via Balham rather than Tooting because of geological concerns.

Safeguarding Directions are an important tool in helping to deliver major infrastructure projects, however they are not able to address existing, unknown subsurface conditions or take a holistic approach to management of underground spaces. Although some data pertaining to critical national infrastructure might need to be omitted from a public register of subsurface assets, an appropriately managed central resource of underground data could help avoid late stage amendments to infrastructure projects. One example is the amendment to the draft Thames Tideway Tunnel Development Consent Order, needed to reposition the proposed replacement Blackfriars Millennium Pier. Integrated infrastructure mapping by the Future Cities Catapult with the city of Manchester successfully demonstrates the benefits of partnership working across the utilities sector for more robust planning for infrastructure growth.

Current resources available through the British Geological Survey (BGS)

NERC's British Geological Survey (BGS) and the National Geoscience Data Centre offers a digital data platform and a national geological model to help identify potential risks to delivery of infrastructure and other development projects. This data includes geological maps, 3D models and borehole logs which are used to inform infrastructure planning and design. These data, include geological maps, 3D models and borehole logs which are used to inform infrastructure planning and design. Since 2009, the collection of over 1.3 million UK onshore borehole logs have been released in digital form free of charge through the BGS web site[1], with over 750,000 downloads in 2015. For geotechnical data a new platform has also been developed which allows online submission of digital data from new ground investigations to enhance national data holdings[2]. Several governmental and infrastructure organisations (e.g. Environment Agency, Scottish Water, TfL, ARUP) have made a commitment to use these new digital services and submit geotechnical data collected as part of development works and infrastructure projects.

Adoption of these open-data protocols, whereby existing data is re-used and new data is submitted centrally, maximises past investments in ground works, reduces site investigation costs and de-risks future investments and should be a standard, contractual requirement for all infrastructure projects.

The BGS has also redirected its UK geological survey programme to develop the National Geological Model (NGM)[3] an integrated set of 3D geological models at various resolutions that is

[1] http://mapapps2.bgs.ac.uk/geoindex/home.html
[2] http://transfer.bgs.ac.uk/ingestion
[3] http://www.bgs.ac.uk/research/ukgeology/nationalGeologicalModel/home.html

the primary spatial knowledge-base on the UK's geology. The BGS are adopting a digital approach to facilitate effective opening-up and sharing of the national geological model and underpinning datasets that is efficient and economically viable[4]. All outputs from the National Geological Model are compatible with BIM software[5] and digital-services have been developed for the collation, display, filtering and editing of a range of data relevant to infrastructure projects. The NGM and supporting web-services, provide access to nationally consistent, expert geological understanding to support initial infrastructure feasibility and design and de-risk investment.

Opportunities for reducing the cost of transport infrastructure projects

Land acquisition & sub-surface development

One of the most significant costs associated with the delivery of major infrastructure projects is for the compulsory purchase of land. Although a £50 flat rate has been accepted as the nominal value payable for acquisition of subsoil earth needed for tunneling, increasing property prices, particularly in London are influencing the perceiving value of subsurface space. The High Speed 2 project recently faced challenges from 204 parties who claimed that £50 was an insufficient payment for the subsoil, a number of respondents also sought confirmation of whether or not this policy would restrict their own subsurface developments, such as basement developments. The London Borough of Camden noted this as a particular issue in their area. Although the London Borough of Camden and several other London boroughs are developing planning policies to address the phenomena of large scale basement development, these generally represent reactionary, localised attempts to manage the construction impacts of developing subsurface space, rather than addressing hydrological impacts or broader strategic urban needs[6]. With residential basement depths of up to 15m and commercial developments such as the Edwardian Hotel Leicester Square with five basement levels, there is a concern that the physical cost of acquiring or insuring against damage to private subsurface developments could add unnecessary costs to the delivery of infrastructure projects.

Value versus cost

However, it is not just about reducing costs on large scale transport initiatives, but also recognising the wider benefits associated with infrastructure development. Currently the Cost Benefit Ratio used to value infrastructure projects adopts a prescribed formula which is too narrow. In January 1997 the Parliamentary Office of Science and Technology released the Tunnel Vision report, which concluded that:

"*tunnel proposals have to overcome a number of hurdles to be accepted, and often must rely more on public and political pressure than the 'objective' appraisal system of the DoT. A useful future policy option might be to seek a greater social consensus on what aspects of the environment and quality of life should be protected from the adverse effects of new infrastructure, and from here, identify cost-effective solutions*".

Major changes in the business case framework rules for infrastructure projects should be encouraged. Health benefits, carbon emissions and international city competitiveness are also important measures of the benefits associated with mass public transport infrastructure. Where projects are deemed viable, city governments and infrastructure providers also need to become better at capturing the resulting value. Upgrades to the London Underground and the

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4 http://www.bgs.ac.uk/research/environmentalModelling/groundhogDesktop.html

5 http://www.keynetix.com/bimforthesubsurface/

6 https://www.rbkc.gov.uk/pdf/Final Basements Policy Jan 2015 adopted web.pdf

construction of Crossrail have acted as strong drivers for real estate development, but despite the recent introduction of a Crossrail Levy and Community Infrastructure Levy, there are too few mechanisms for harnessing the uplift in property values to help fund further necessary infrastructure development.

Opportunities for improving delivery of large-scale transport infrastructure improvements

Strategic planning and proactive governance of subsurface resources is needed in cities, particularly London, where competition for underground space and resources is most pressing. Such a plan would allow a more strategic approach to benefits, such as locations of housing developments, commercial or residential developments around new or upgraded stations, etc.

One of the key advantages of strategic planning is that it requires involvement of all relevant stakeholders. This opens the way for seeking new innovative solutions. Rather than using the subsurface either for transport or energy solutions, it could lead to a combined solution serving both. The same holds true for the question of how to develop public spaces below the surface. To really create a new urban tissue below the surface, public connectors need to be created. Planning also stimulates thinking about future uses. Creating space below the surface has to be appraised against a much longer time scale than surface development given the long life span of these spaces.

Ideas and lessons learnt from international case studies

British expertise in property, law, engineering, environmental management and construction is some of the best in the world and our expertise in delivering complex infrastructure projects is highly regarded, however lessons can still be learnt.

International case studies

It is our strong suggestion that major UK cities adopt a three dimensional approach to spatial planning. Internationally there are a number of initiatives to better understand, manage and develop the subsurface, including:

- Helsinki - Although it's geology and land tenure is very different to London's, Helsinki has a three dimensional spatial plan that coordinates, connects, safeguards and provides a framework for the use of 600 underground spaces for mostly public infrastructure. Planned and existing land uses of the subsurface range from public swimming pools to data centres (where less energy is needed to cool the equipment and the surplus heat generated is then used for residential heating).
- Kuala Lumpur - In 2007 The Stormwater Management and Road Tunnel (SMART) infrastructure project in Kuala Lumpur, Malaysia introduced an 9.7km long, underground roadway and storm water retention tunnel that is divided into three sections that can be collated to absorb urban flood waters.
- Tokyo - In 2007 Japan introduced the Deep Space Utilization Law to legalise the development of spaces at least 40 metres below ground level for public utility infrastructure. The most significant attribute of this law is that when a road, railway or water utility company for example wishes to build a tunnel at 40 meters or more under the

ground, they are not required to receive the consent of parties owning or renting the land above the tunnel, nor are they required to pay them any compensation.

- Singapore - the Urban Redevelopment Authority (URA) has proposed 29km of underground links to improve pedestrian access and reduce congestion at ground level. At 20 designated locations private developers can receive cash grants from the URA to reimburse the cost of constructing pedestrian walkways beneath their properties, with the spaces also being exempt from the usual caps on Gross Floor Area (GFA).
- Tianjin - Since 2004 Tianjin in China has carried out extensive research on the development and utilisation of underground space. This has resulted in a series of documents, including the 'Utilization of Underground Space Planning in Tianjin Central City (2011-2020)'. Research undertaken to inform the 2011 and other earlier plans included a comprehensive survey of existing underground spaces in Tianjin city central and the aim now primarily is to construct under-ground nodes to link primary subway stations and public centres for commercial and parking purposes.
- Montreal - Montreal's underground RESO network is a set of city-enabled, privately-developed underground connections that ties much of the city centre into a climate-protected, traffic-free and vibrant pedestrian zone.
- Arnhem & Zwolle - In the Netherlands, a new model of analysis has been introduced for urban and land planning in Arnhem. The plan consists of three layers: occupation (plot oriented developments e.g. housing and offices); network (functions such as road and rail infrastructure); and the underground (consisting of all subsurface functions e.g. storage of water). The City of Zwolle has created a 'Vision on the Underground of Zwolle'. This document comprises a complete analysis of the underground space beneath the city.

In May 2015 'Think Deep: Planning, development and use of underground space in cities'[7], was published by the International Tunnelling and Underground Space Association Committee on Underground Space (ITACUS) and International Society of City and Regional Planners - the book contains five detailed international case studies.

Sub-Urban research project

In 2012, the British Geological Survey together with other geological surveys in northern Europe, put forward a proposal to the Transport and Urban theme of the European Cooperation in Science and Technology (COST). The proposal advocated for greater interaction and networking between experts who develop urban subsurface knowledge and those who can benefit most from it. One product of this research cooperation is the creation of 'Sub-Urban'[8]. Sub-Urban is a European network of Geological Surveys, Cities and Research Partners working together to improve how we manage the ground beneath our cities. Glasgow is the UK's representative city in Sub-Urban and as such is already undertaking a number of applied research projects to investigate how their subsurface resources might be better used and managed. Initiatives include city subsurface spatial planning, integrated above-below ground BIM and heat extraction and storage through disused mines.

[7] ISBN: 978-94-90354-34-3
[8] http://sub-urban.squarespace.com

Conclusion
In summary, MAG2US would encourage the Infrastructure Commission to work with city governments to promote the importance of strategic planning and safeguarding of subsurface resources, in order to reduce risks to the cost and delivery of future infrastructure projects. Should the Infrastructure Commission or other government agencies require further advice or support regarding subsurface issues we would be happy to contribute our expertise where possible.

With Regards,

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