

Understanding London's underground railway infrastructure: how the past explains the present, and the future

Presented by:
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At 55 Broadway, London,
on 19 November 2018,

as part of the
TfL Corporate Archives Lunchtime series of talks.



**Demolition as part of construction for the Circle line, to the rear of Leinster
Gardens, Bayswater**

Source: The Sun, undated.

Who am I?

- An historical geographer
- Systems Integration Coordinator for the BLE project
- Part time - PhD student at the University of Aberdeen
- Visiting lecturer at the University of Aberdeen
(Undergraduate '*Fearsome Engines*' course)
- Guest lecturer at the London South Bank University
(MSc in '*Transport Engineering and Asset Management*' – 'Railway Asset Management' module)

Who am I?

- 18 years working full time in public transport in London:
 - 2 years bus driving in Twickenham; Kingston; and Hammersmith areas;
 - 5 years tram driving in Croydon;
 - 11 years within London Underground/TfL;
 - Reviewing and responding to asset location enquiries
 - Reviewing and commenting on planning applications
 - Undertaking research in to the legal; historical; and engineering interfaces of transport infrastructure and its environment
 - Advising the business and stakeholders on asset ownership, rights and responsibilities
 - Creating and managing data for the Bakerloo Line Extension
- Graduate Certificate – *Railway Studies and Transport History*.
 - *University of York (Distance Learning), Sep 2007 – Sep 2009.*
- *Master of Arts - Railway Studies by research.*
 - *University of York (Part Time), Sep 2010 – Sep 2012.*
- *Doctor of Philosophy - Transport Studies.*
 - *University of Aberdeen (Part Time), 2014 – 2019.*

Why is historical geography important to the understanding of an urban metro system?

“If you’re going underground,...why bother with geography?”

Source: Henry (Harry) Beck, quoted in Ackroyd, P., 2012. pp.131-132.

“Historical geography is a sub-discipline of human geography concerned with the geographies of the past and with the influence of the past in shaping the geographies of the present and the future”.

Source: Heffernan, M., 2008.

Populations are urbanizing and cities are densifying, globally.



Sau Paulo, Brazil



New York, US



Paris, France



London, UK

Metro systems are a beneficial means of mass transportation within urban environments.

“Metros are of critical importance to our cities for mobility and urbanisation - with new statistics showing that 168 million passengers use metros in 182 cities within 56 countries every day”.

“World metro ridership has increased by 19.5% over the past six years. The highest growth has been in the MENA region - with an increase of 58% Nineteen new cities are equipped with metros since the end of 2014. The world’s longest system is in Shanghai at 639km”.

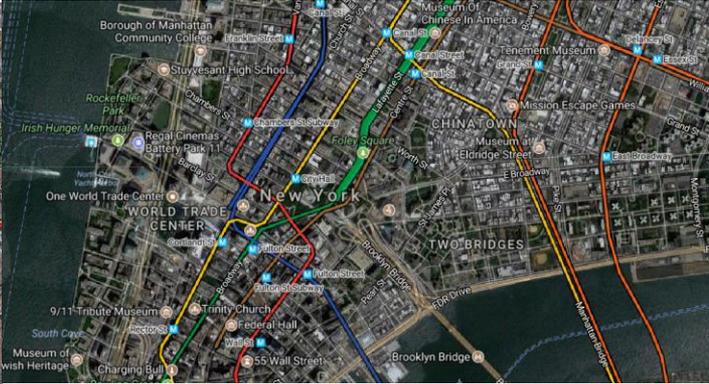
“New metro developments have never been as intense as in the last five years, with the opening of no less than 103 new lines. On average, 1,400km of new metros will enter revenue service each year over the next five years. This, together with brownfield modernisation projects, offer robust business opportunities for a supply chain in deep reorganisation.”

Laurent Dauby UITP Director of Rail
Source: UITP, 2014.

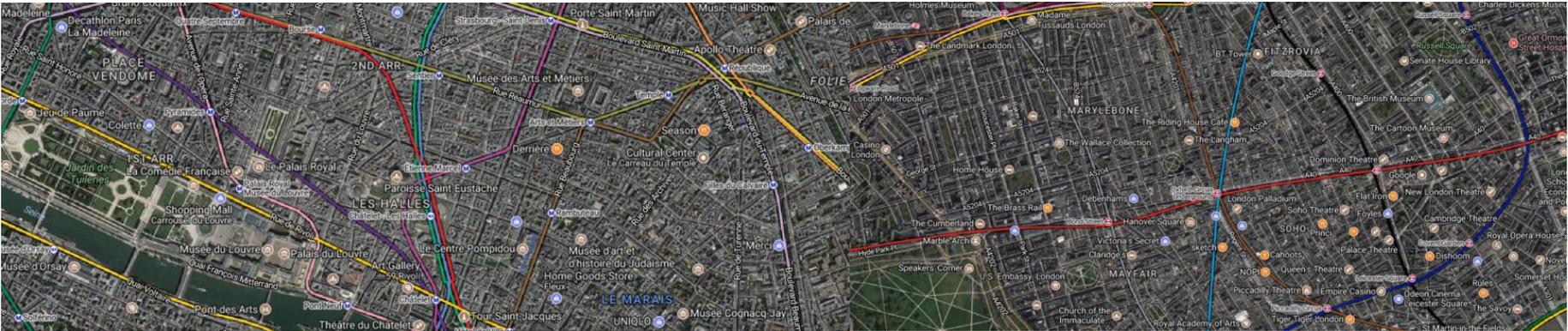
The construction and presence of urban metro infrastructure creates hundreds of thousands of interfaces within its urban environment.



Sao Paulo, Brazil



New York, US

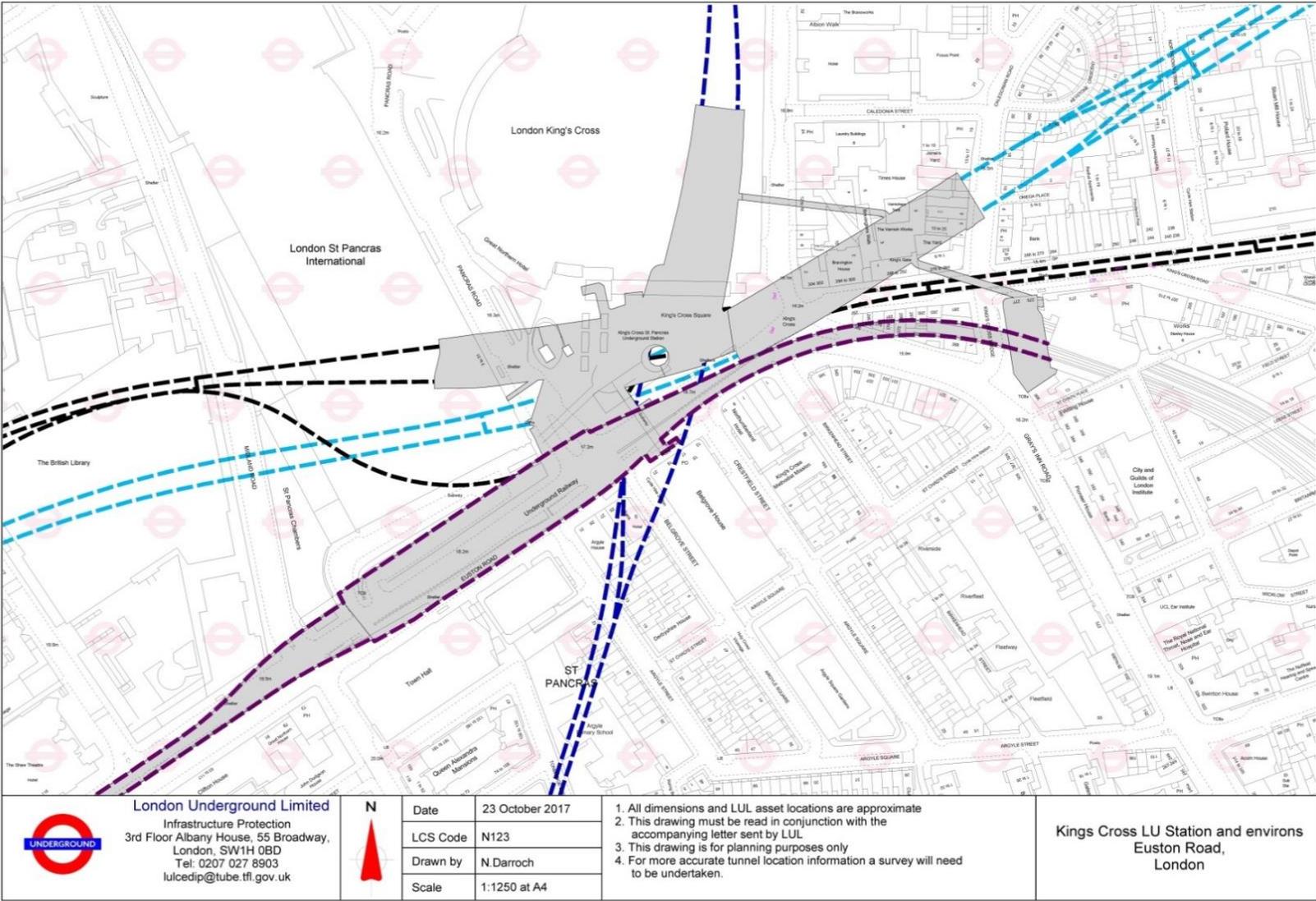


Paris, France

London, UK

Satellite image source: Google Maps, 2017.

These interfaces last for decades and even centuries...



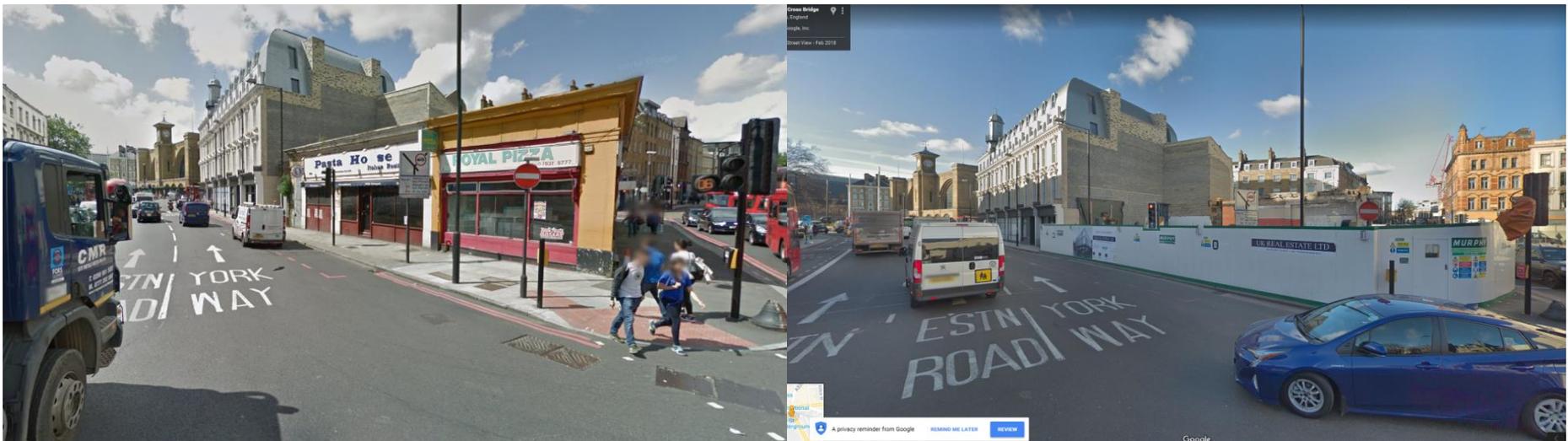
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Grey shaded areas represent some of the London Underground metro infrastructure in the kings Cross/St Pancras area
Source: London Underground

...within changing urban environments.

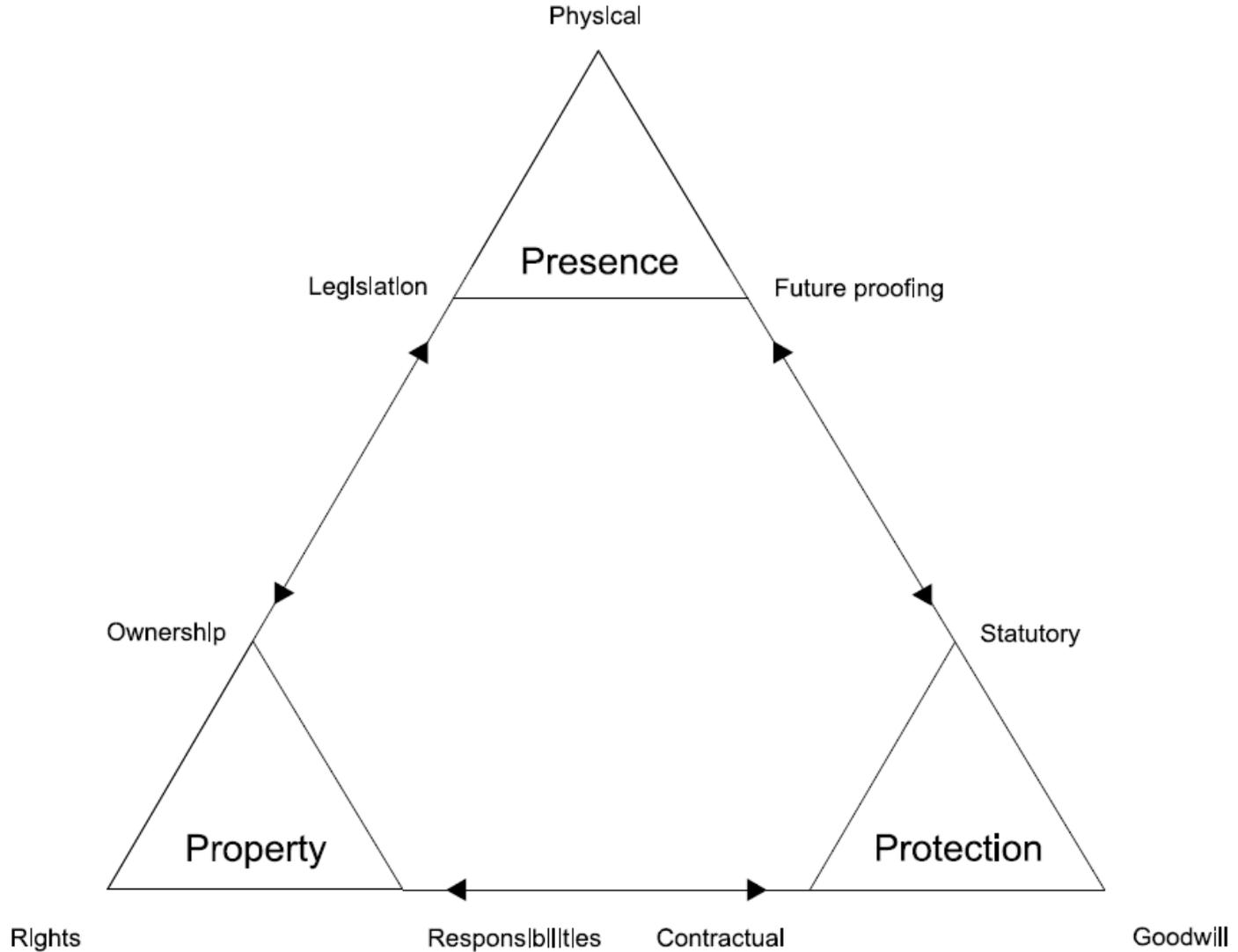


Junction of Gray's Inn Road and Kings Cross Bridge, London, 1861-2018



Historic diagram source: The Illustrated London News , 1861. Other Sources: Bing Maps, 2017; Google Maps, 2018.

These interfaces can be defined as...



Source: Darroch, N., Beecroft, M., & Nelson, J., 2016.

The *presence* interface is what most people consider. It can be obvious...



Metropolitan and Thameslink lines north of Farringdon Stn.



Elephant & Castle LU Bakerloo line Stn.



Canary Wharf LU Jubilee line Stn.

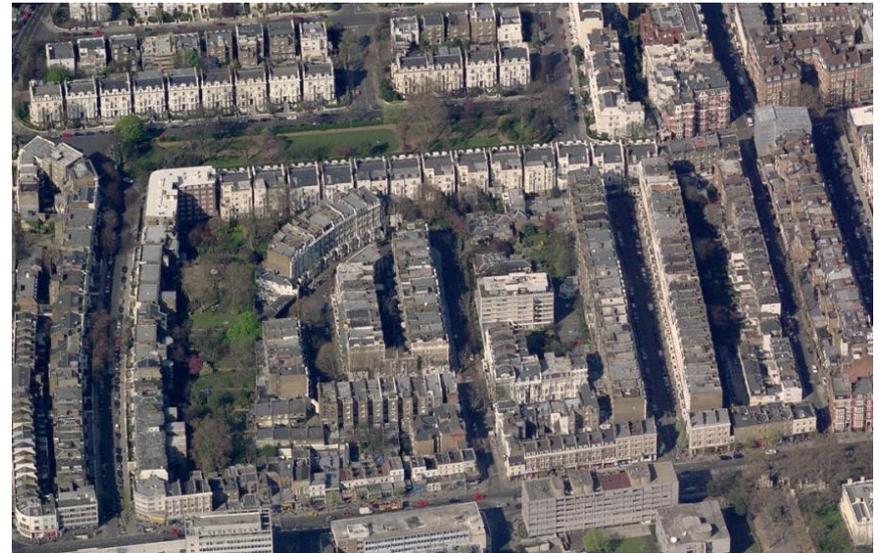


Piccadilly Circus LU Piccadilly and Bakerloo lines Stn.

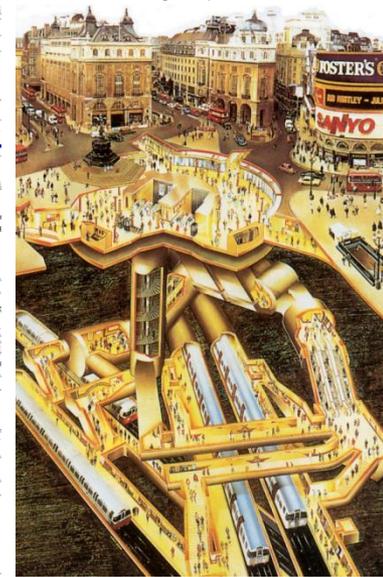
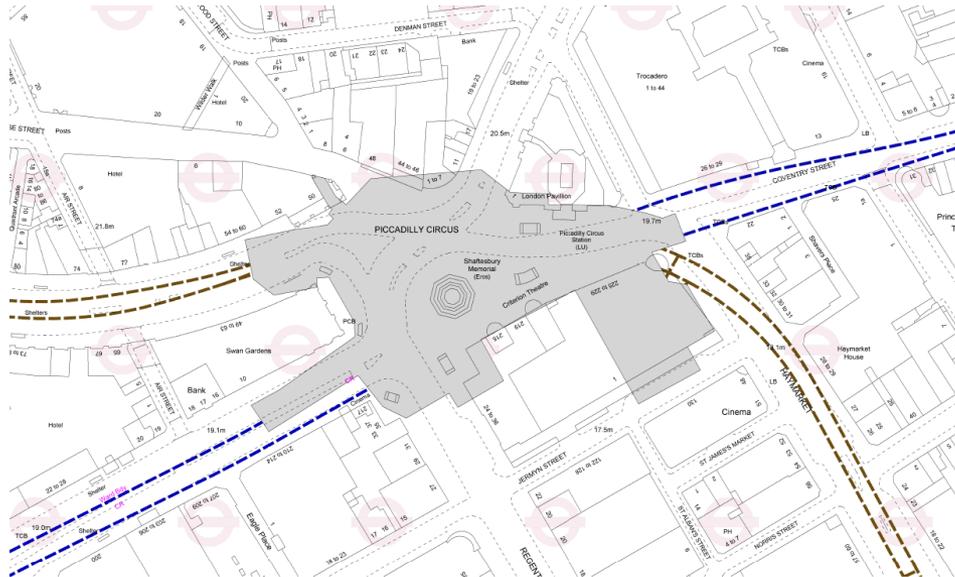
...and not so obvious.



A river passing through the crown of a sub-surface tunnel
Source: London Underground.



Linden Gardens, Notting Hill
Source: Bing Maps, 2017.

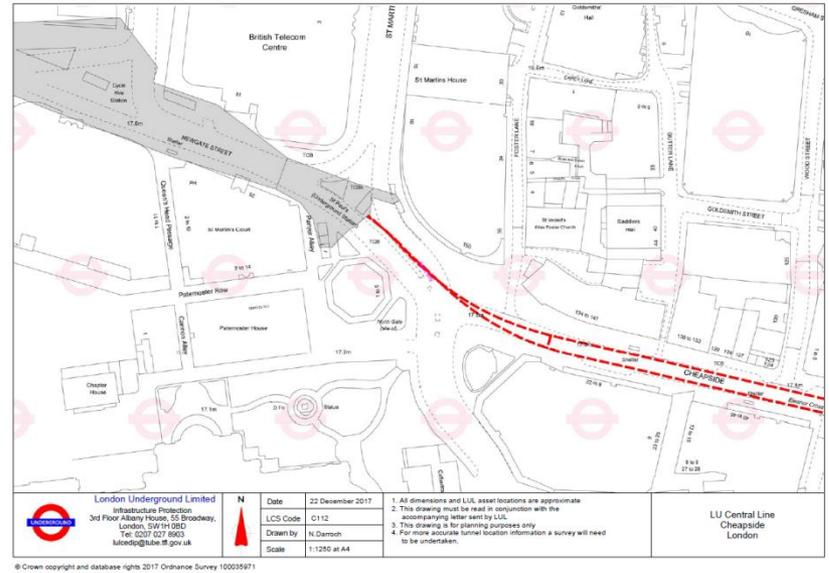


Plan showing the underground areas of Piccadilly Circus station, shaded grey; a cross section drawing through the station
Sources: London Underground; London Transport Museum, undated.

Physical interfaces affect and are affected by their environment.



Circle line, Porchester Terrace, Bayswater



Plan showing the Central line under Cheapside
Source: London Underground

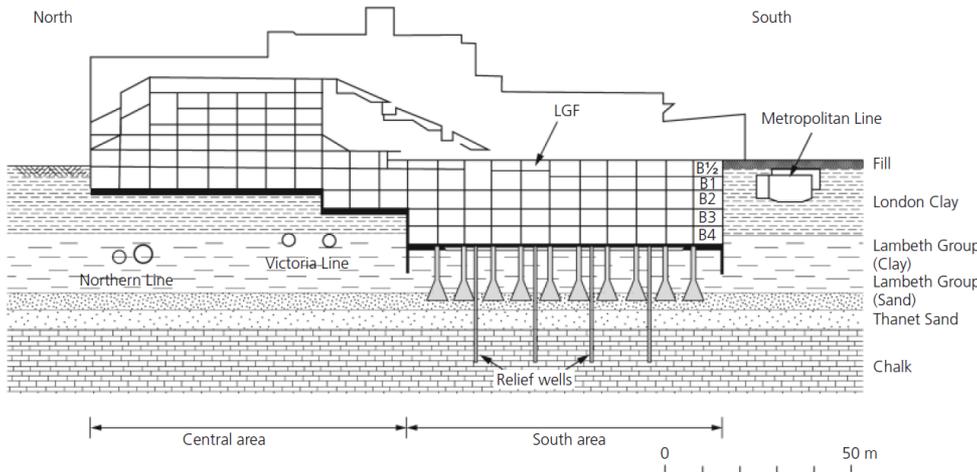
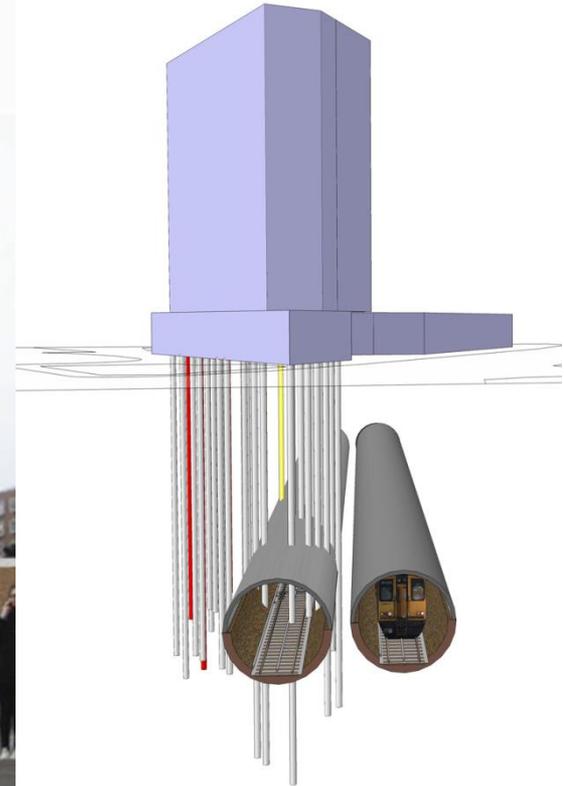


Diagram showing the design of the British Library
Source: Simpson, B., and Vardanega, P., 2014.



Building over District & Circle lines, St James's Park

Failure to *identify* the physical interfaces between metro infrastructure and its environment poses *potential* risk to metro infrastructure.



Artist's impression of proposed development from 2011 planning application (looking north); Scale diagram showing proposed foundation layout and extent of interaction with railway tunnel

Source: RAIB, 2014.

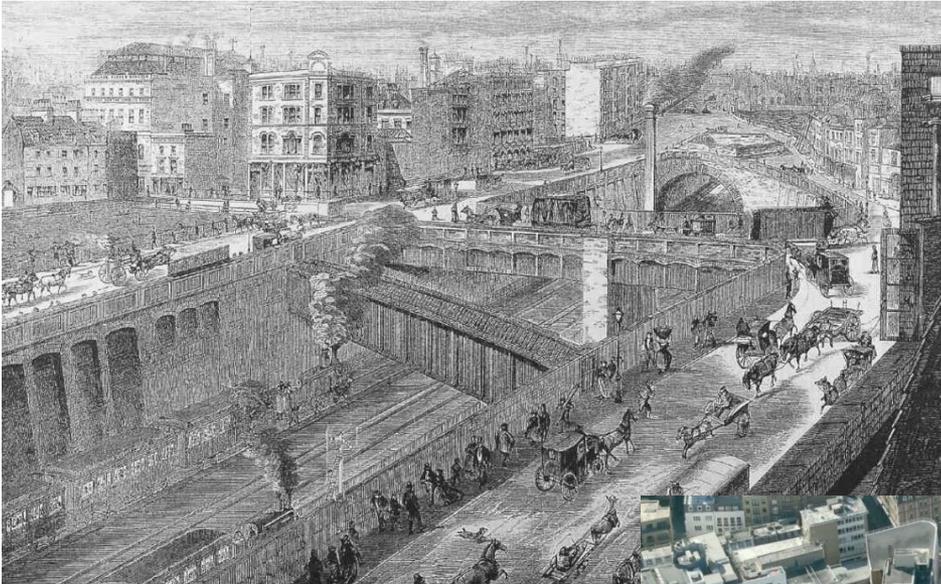
But failure to *clarify* the physical **and** property **and** protection interfaces poses *real* risk to metro infrastructure.



Penetration of tunnel lining and auger sections and debris on the track

Source: RAIB, 2014 (photograph courtesy of Network Rail).

Archival research enables effective *identification* and *clarification* of all of the infrastructure interfaces (*the 3Ps*).

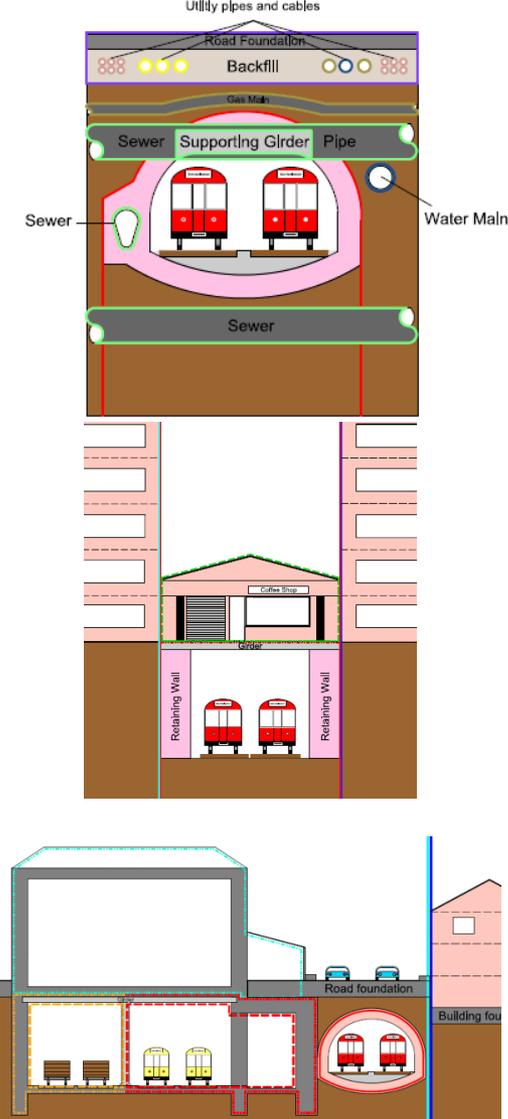


**Drawing showing the site of
Clerkenwell Bridge in 1868**
Source: British History Online, 2017.

**Satellite image showing the site of
Clerkenwell Bridge in 2017**
Source: Bing Maps, 2017.



My research has identified over 40 different *physical* interfaces within TfL Fare Zone 1 alone. Each has *property* and *protection* interfaces.



Physical Interface	Location	Physical Interface	Location
Sub-surface railway		Tube Railway & stations	
Tunnel under highway (highway pre-existing)	Craven Road, Bayswater	Tunnel under highway (highway pre-existing)	Charring Cross Road
Tunnel under highway (contemporary)	Charterhouse Street, Smithfield	Tunnels staggered under highway (different depths) (pre-existing; post)	Cheapside, City of London
Utilities interfaces with metro infrastructure (pre-existing; contemporary; post)	Aldgate East	Tunnels under building affecting building design (post)	British Library
Tunnel under building (contemporary)	Pembridge Square/Moscow Road, Bayswater	Station building with development over; and redevelopment of site (post)	Brompton Road Disused station
Railway within basement of building (contemporary)	Smithfield Meat Market, Farringdon	Escalator shaft from remote station building under building to platforms (pre-existing; post)	Angel, Islington
Railway within basement of building (post)	Westminster Station	Utilities subway within station infrastructure (contemporary)	Bank Station
Railway in cutting (buildings adjacent: pre-railway; post)	Campden Street, Kensington	Key to terms: <i>Pre-existing</i> - The urban asset was present before the railway. <i>Contemporary</i> - the urban asset was provided with or about the same time as the railway. <i>Post</i> - the urban asset was provided/changed post railway construction.	
Railway in cutting: bridge over (contemporary)	Campden Street, Kensington		
Railway in cutting with bridge over (contemporary; separate span owners)	Leeke Street, Islington		
Railway in cutting with bridge over (post)	St Botolph Street, Aldgate		
Railway in cutting with building over (post)	Palmer Street, Westminster		
LU railway in cutting adjacent to Network Rail in tunnel (contemporary)	Swinton Street, Islington		
Road, over railway, over railway (contemporary)	Ray Street, Farringdon		
Bus station over railway (post)	Aldgate Bus Station		

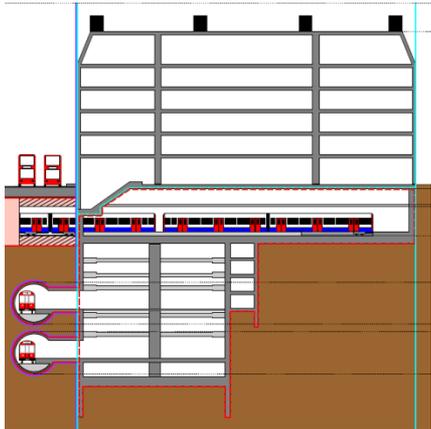
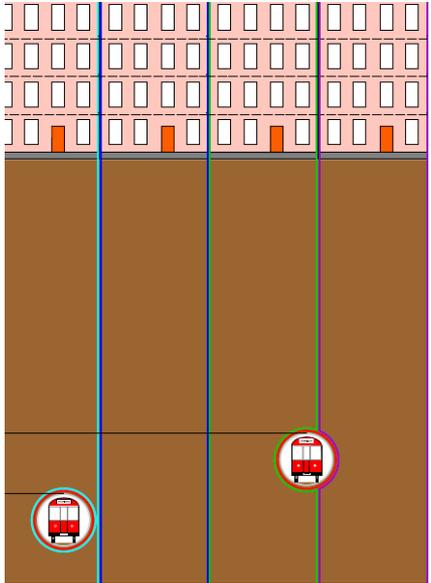
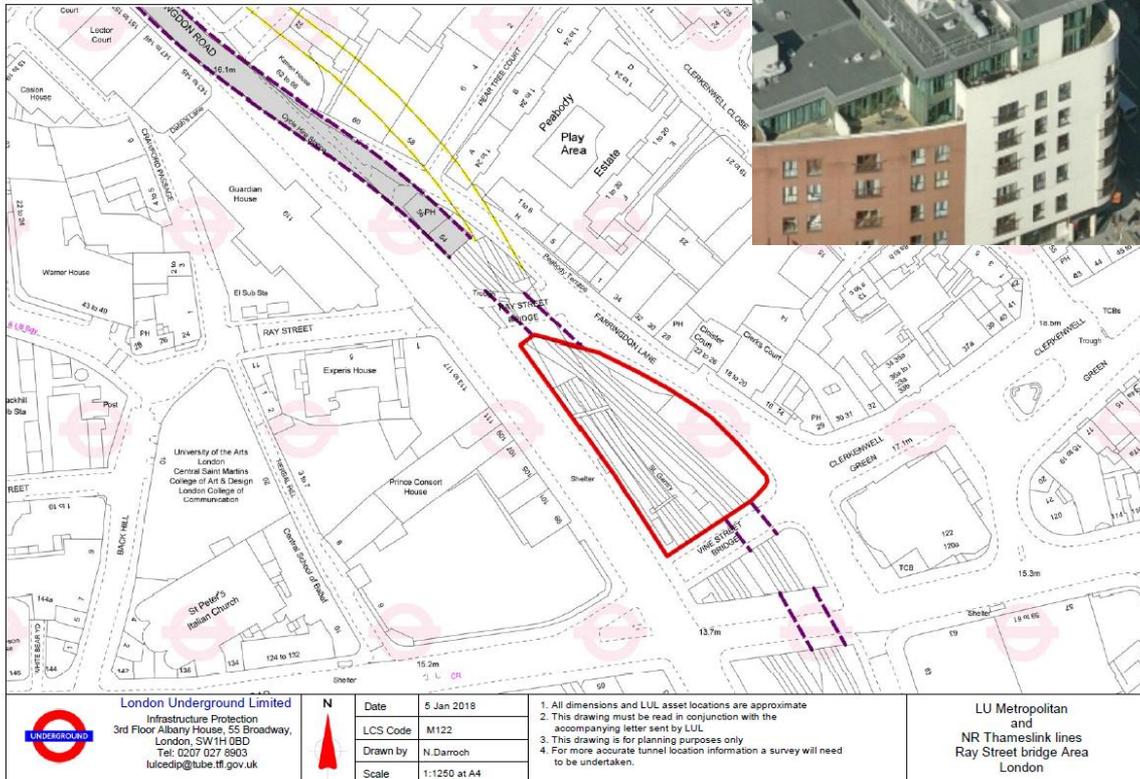
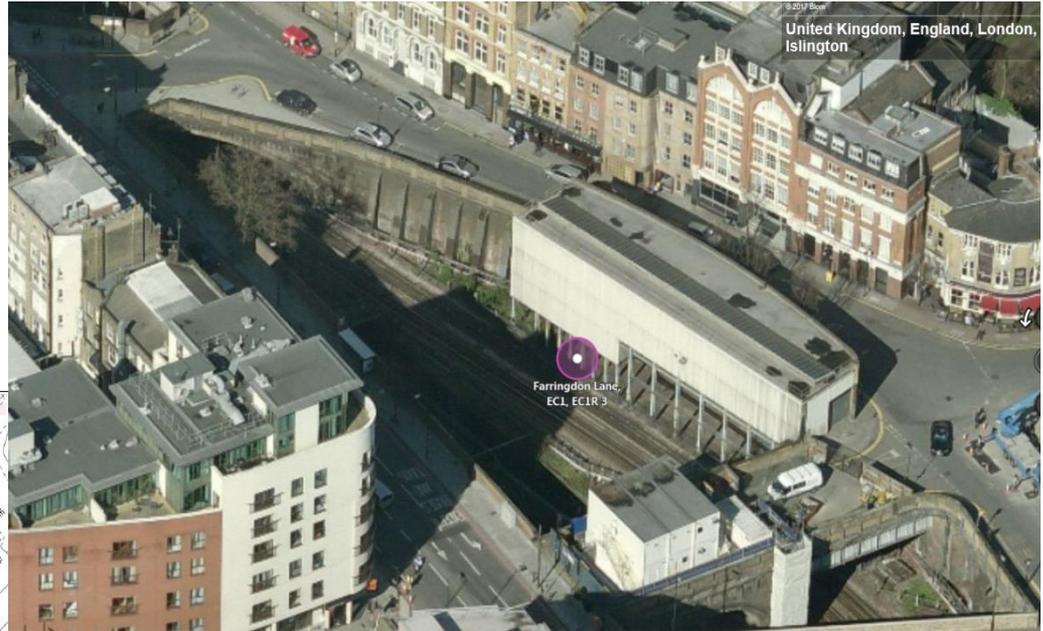


Table showing 20 scenarios of the physical interface between Urban Metro Infrastructure and its environment, in London

Source: RAIB, 2014 (photograph courtesy of Network Rail).

Ray Street Bridge – holistic analysis - a highway over a cutting over a fly under.

Satellite image showing Ray Street bridge and environs
source: Bing Maps, 2017.



Plan showing Ray Street bridge and environs
source: London Underground.

Ray Street Bridge – *macro analysis* - presence.



Photograph showing Ray Street bridge and some of its physical interfaces

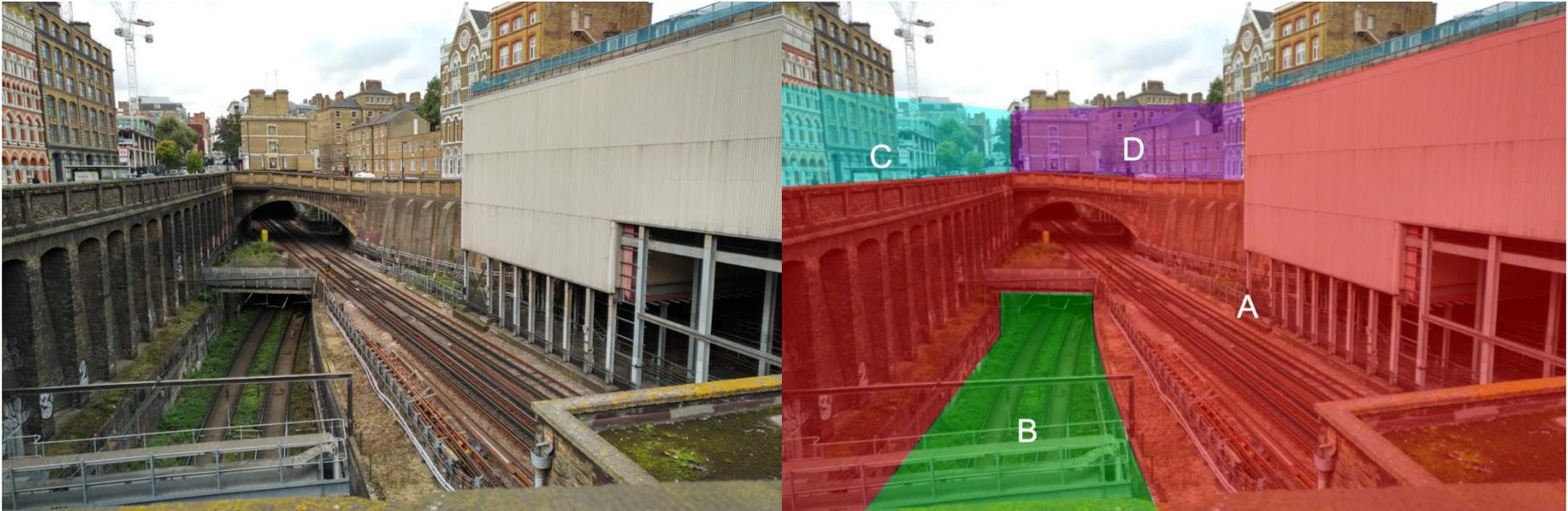
Ray Street pre-existed the railways;

The Metropolitan railway opened in 1863;

The widened line was completed in 1867;

All are still in use today.

Ray Street Bridge – macro analysis - property.

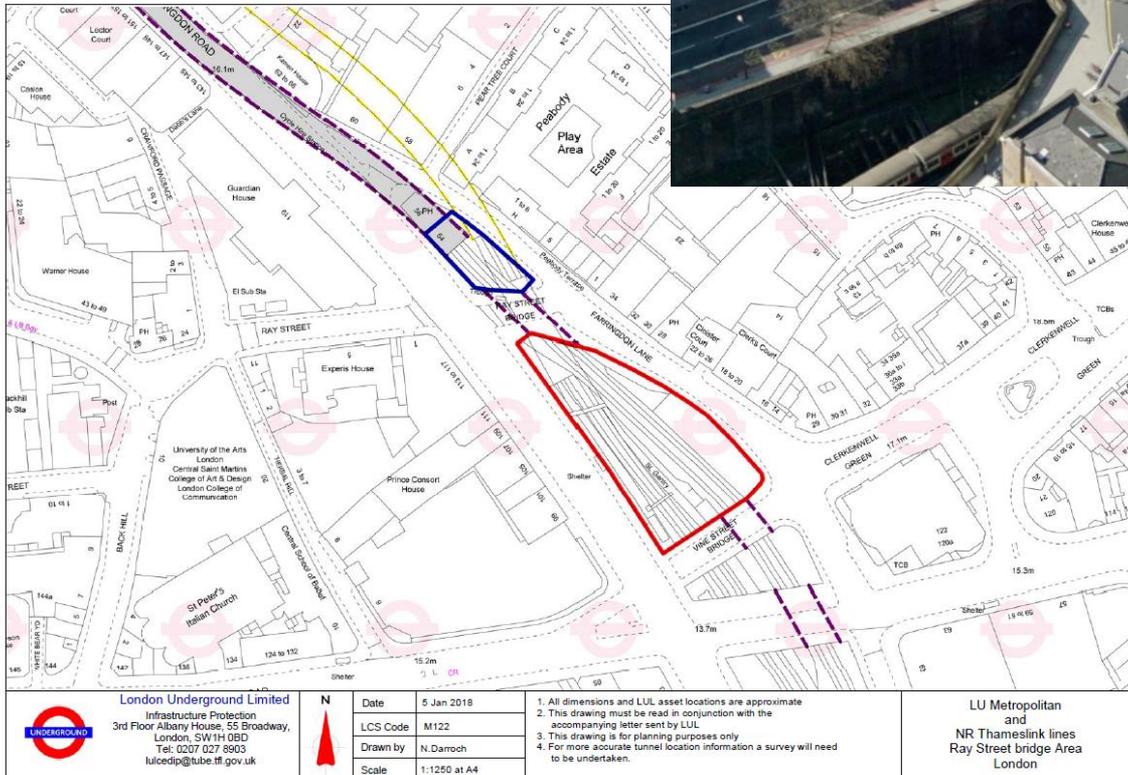


Photograph showing Ray Street bridge and some of its physical interfaces; and with some property features overlaid

- Red (A) = London Underground land and airspace
- Green (B) = Network Rail land and airspace
- Light blue (C) = TfL Streets highway
- Purple (D) = Local authority highway

No.54 Farrington Road - *holistic analysis* - a building located over a tunnel adjacent to a void over a fly under.

Satellite image showing 54 Farrington Road and environs
source: Bing Maps, 2017.



Plan showing 54 Farrington Road and environs
source: London Underground.

No.54 Farringdon Road – *macro analysis* - presence.



The Metropolitan railway opened in 1863;

The widened line was completed in 1867;

The building was erected c.mid 1870s, post railway construction;

All are still in use today.

Photograph showing 54 Farringdon Road and some of its physical interfaces

No.54 Farringdon Road – *macro analysis* - property.



Red (A) =
London Underground land
and airspace

Hatched Green (B) =
Network Rail land and
airspace (below)

Light blue (C) =
TfL Streets highway

Purple (D) =
Local authority highway

Pink (E) =
Building owner

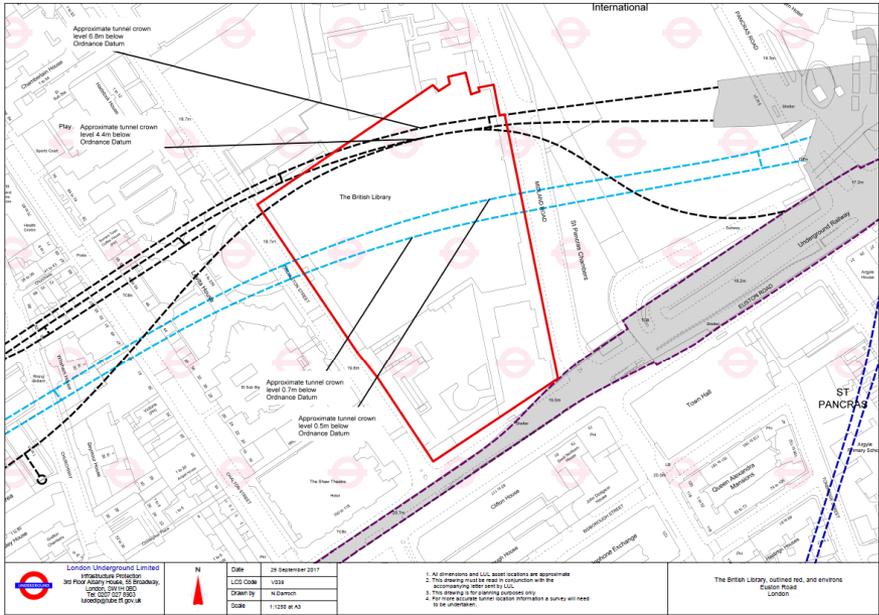
Photograph showing 54 Farringdon Road and some of its physical interfaces; and with some of the property features overlaid

The British Library - *holistic analysis* - a building over tube tunnels and adjacent to a sub-surface tunnel.



Satellite image showing the British Library looking east
 source: Bing Maps, 2017.

Plan showing the alignment of the Northern and Victoria lines in relation to the British Library
 Map source: London Underground.



The British Library - *holistic analysis* - a building over tube tunnels and adjacent to a sub-surface tunnel.



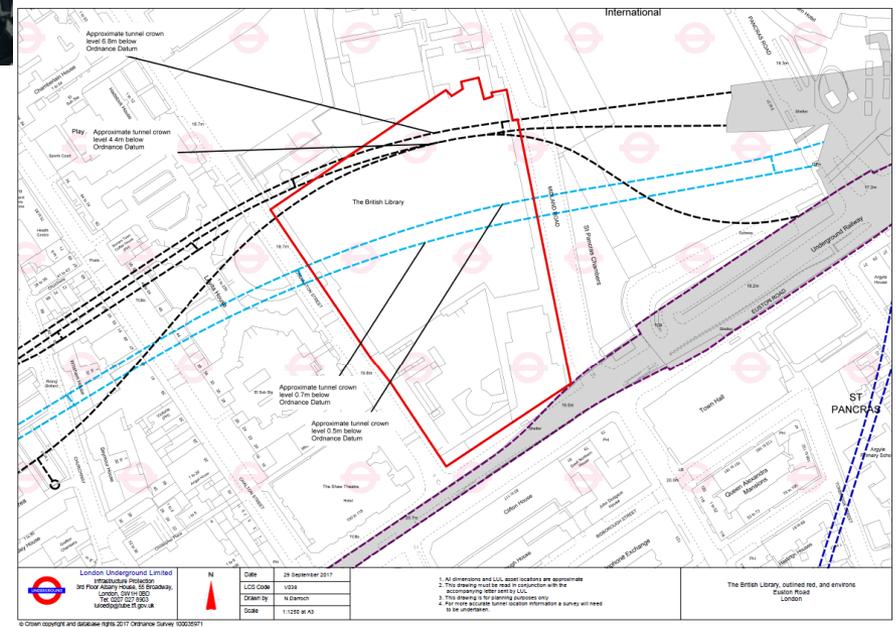
The current British Library was built in the 1990s;

The Metropolitan line opened in 1863;

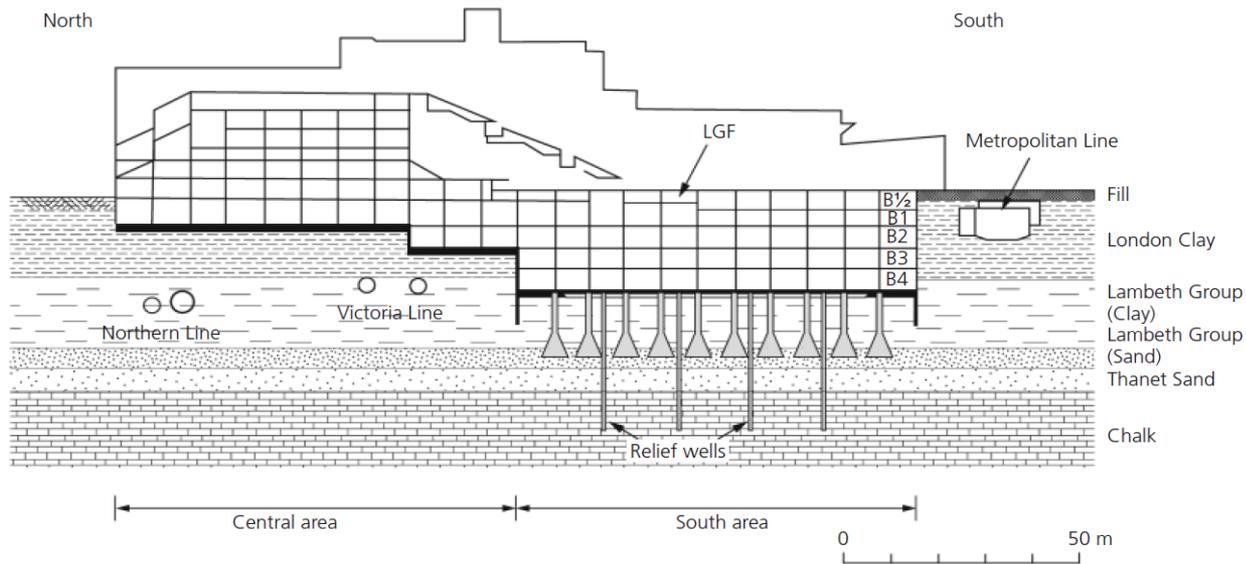
The Northern line opened in 1907;

Kings Cross Metropolitan line station opened in 1941;

The Victoria line opened in 1968.



The British Library – macro analysis - property.



Section through the British Library showing foundation and building design

Drawing source:
Simpson, B., and Vardanega, P., 2014.

Green (F) =
Freehold of the British Library;

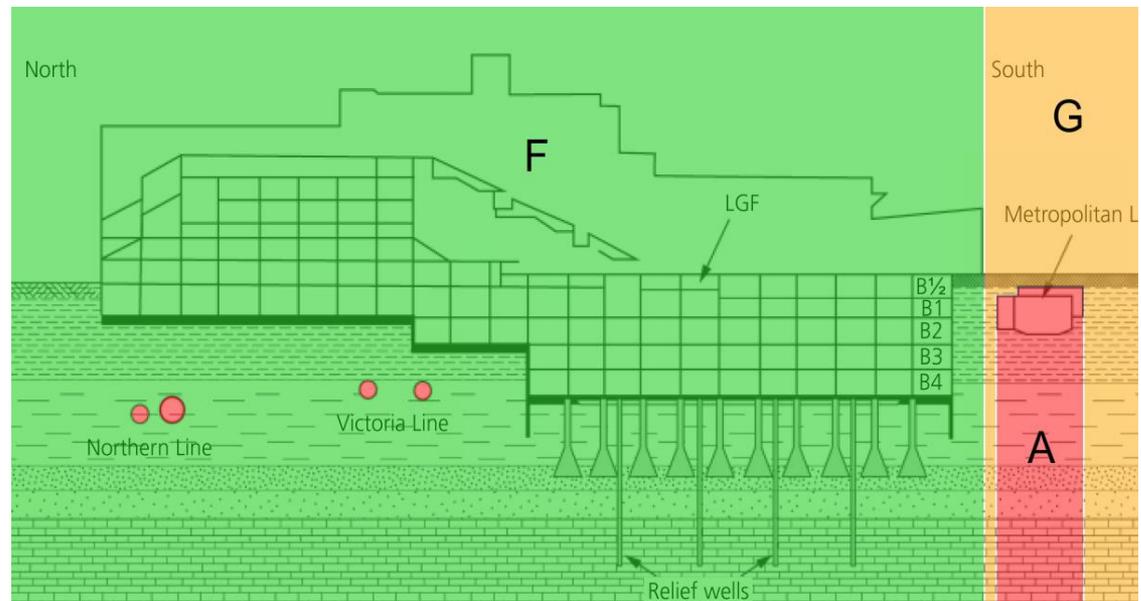
Red (A) =
Freehold of London Underground;

Yellow (G) =
Undetermined.

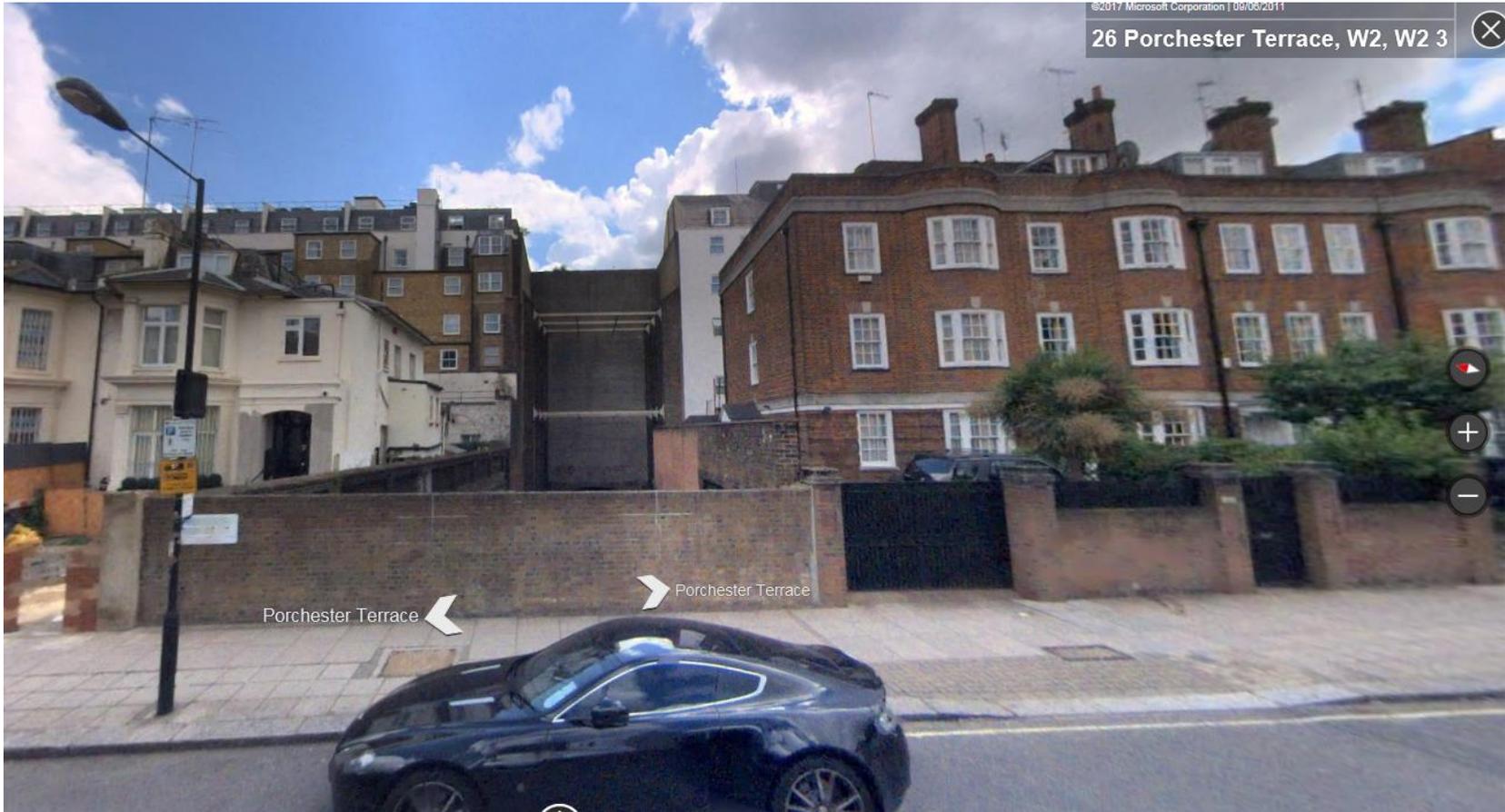
Section through the British Library showing foundation and building design; and with some property features overlaid

Drawing source:
Simpson, B., and Vardanega, P., 2014.

Property data source:
TfL Property Asset register.



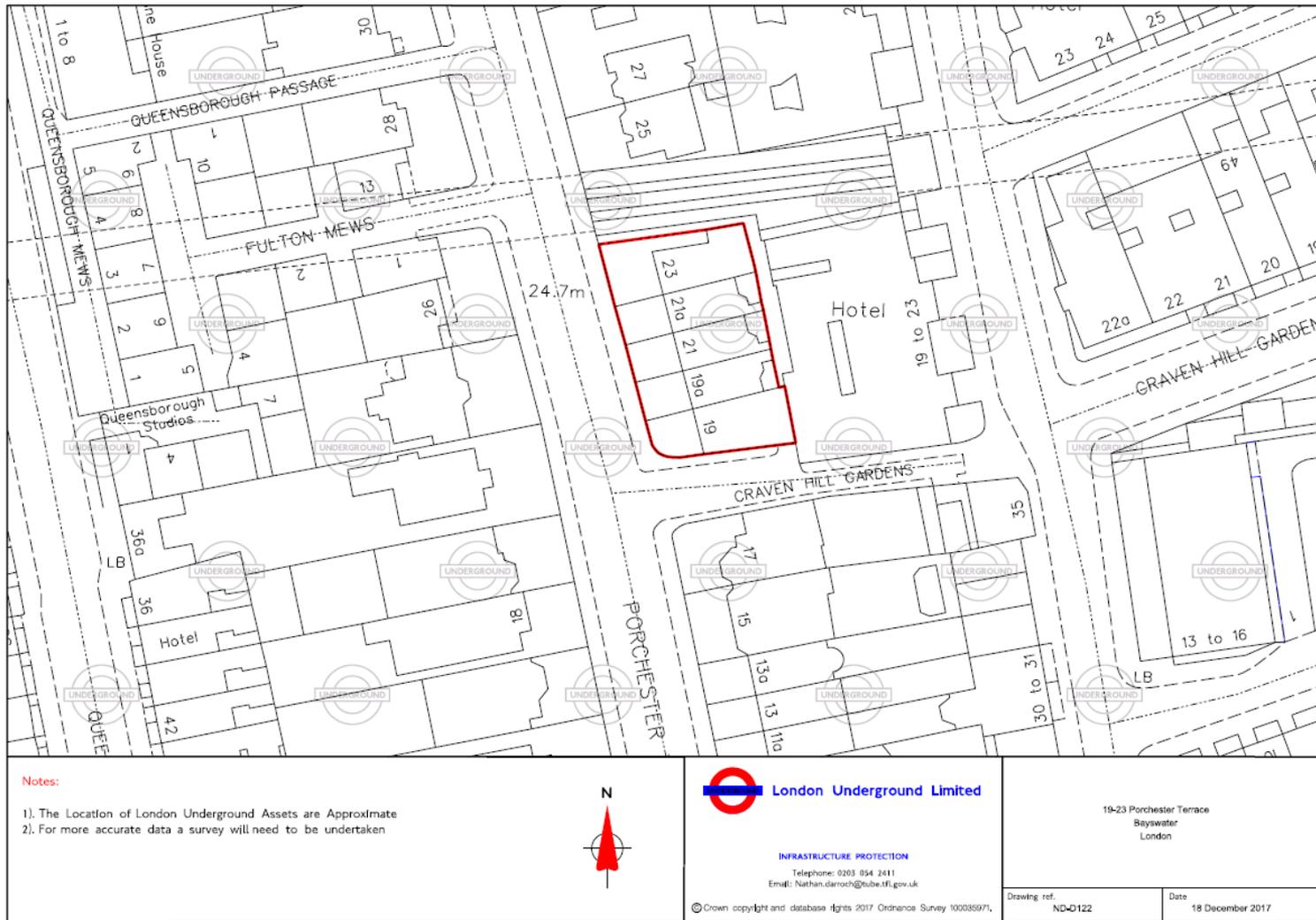
Porchester Terrace – a case study of archival research.



Metro interfaces with its environment at Porchester Terrace, Bayswater, London

Source: Bing Maps, 2018.

Porchester Terrace - *holistic analysis* – presence.



Notes:

- 1). The Location of London Underground Assets are Approximate
- 2). For more accurate data a survey will need to be undertaken



London Underground Limited

INFRASTRUCTURE PROTECTION

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19-23 Porchester Terrace
 Bayswater
 London

Drawing ref.
 ND-D122

Date
 18 December 2017

Plan showing Porchester Terrace and environs, Bayswater, London
 Source: London Underground.

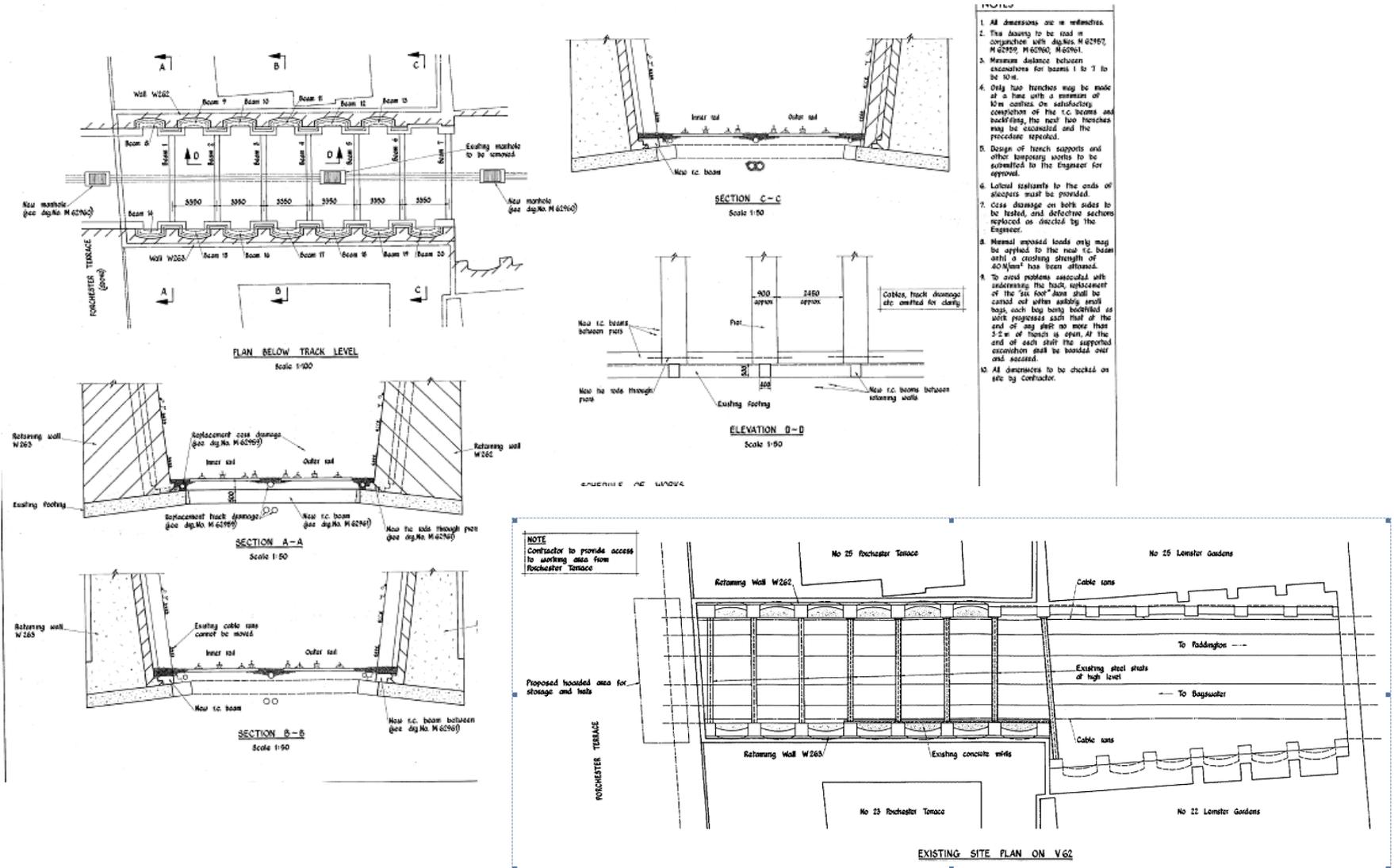
Porchester Terrace – *macro analysis* - presence.



Photographs showing the construction of the Circle line between Bayswater and Notting Hill, to the rear of Leinster Gardens

Source: The Sun, undated.

Porchester Terrace – micro analysis - presence.



Extracted drawings from invitation to Tender document (1990)

Source: Invitation to Tender, 1990.

Porchester Terrace – *micro analysis* - presence.



Identifiable through this process were:

- 1860s constructed railway in cutting;
- False wall to rear;
- C.1850s buildings either side of cutting to rear;
- Props supporting buildings to rear;
- Parapet walls to the fore;
- c.1850s building (left), building of unknown date (right);
- c.1860s retaining walls supporting land and buildings;
- 1940s and 1980s props supporting retaining walls;
- Track;
- Track drainage;
- Under track ground beams.



Porchester Terrace – *micro analysis* - presence.

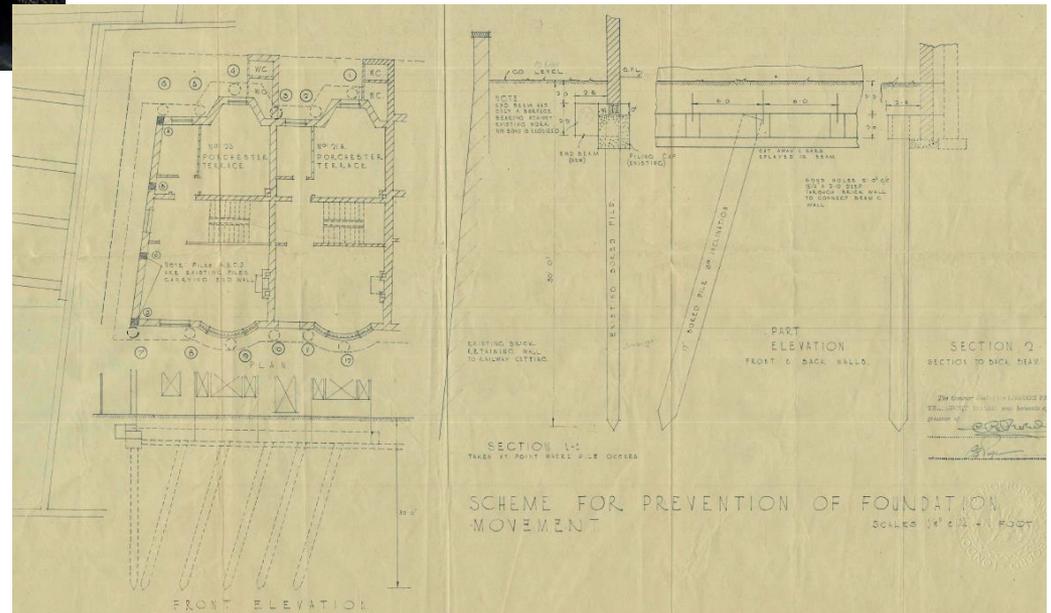


Identifiable through this process were:

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- c.1860s retaining walls supporting land and buildings;
- 1940s and 1980s props supporting retaining walls;
- Track;
- Track drainage;
- Under track ground beams;

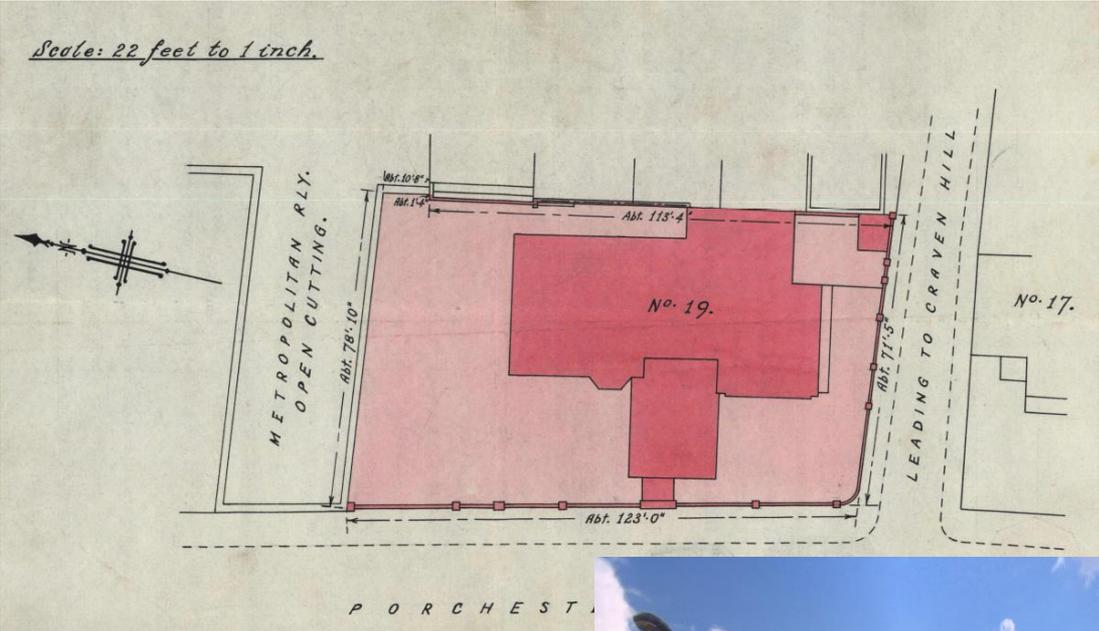
Analysis of 4 different archive legal documents (dated between 1873-1945) clarified the interfaces further:

- The presence of the foundations for the buildings on the right behind the retaining wall;
- That some of the subsoil on the right also belonged to LU;
- There are protective covenants on the whole of the land forming 19-23 Porchester Terrace.



Extracted drawing from Licence of 1945, showing the foundations under 21a and 23 Porchester Terrace
Source: Licence, dated 26 January 1945.

Porchester Terrace – macro *analysis* - property.

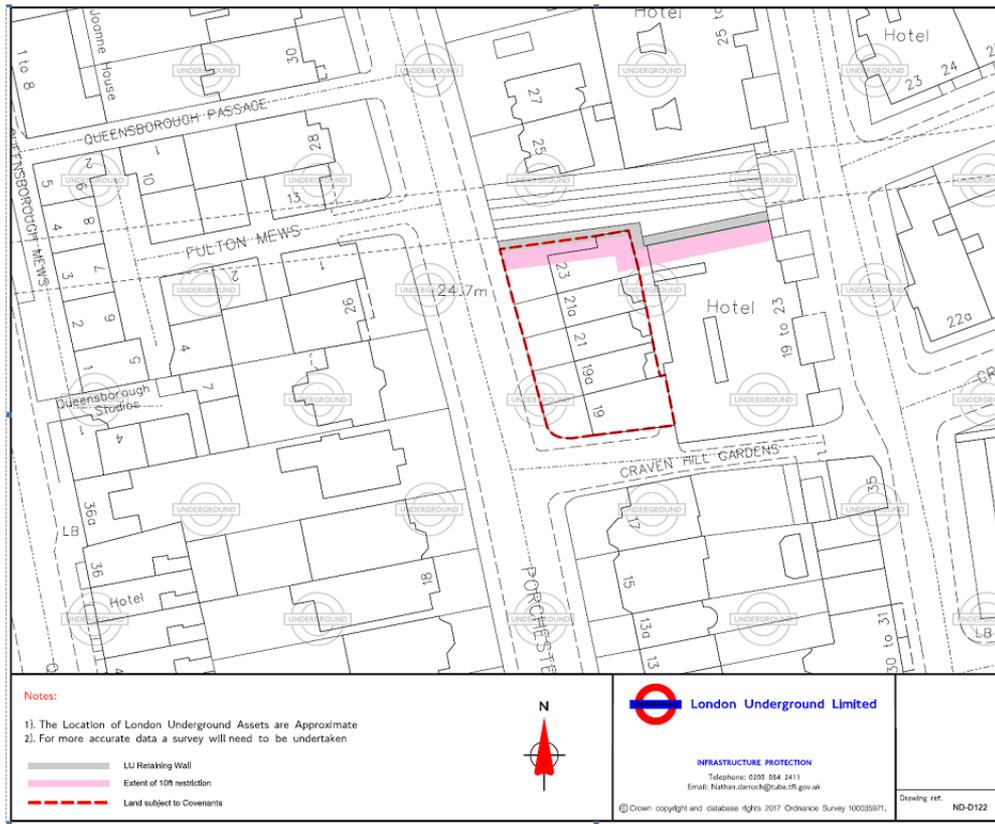


Extracted drawing from the conveyance of 1930, showing the land sold
Source: Conveyance, dated 10 July 1930.

Bing Maps Streetside image from 2011
Source: Bing Maps, 2018.



Porchester Terrace – micro analysis - property.



Pink =
LU subsoil ownership;

Grey =
retaining wall thickness;

Red dashed =
extent of covenants.

Plan showing property interests at 19-23 Porchester Terrace, Bayswater
 Plan Source: London Underground.

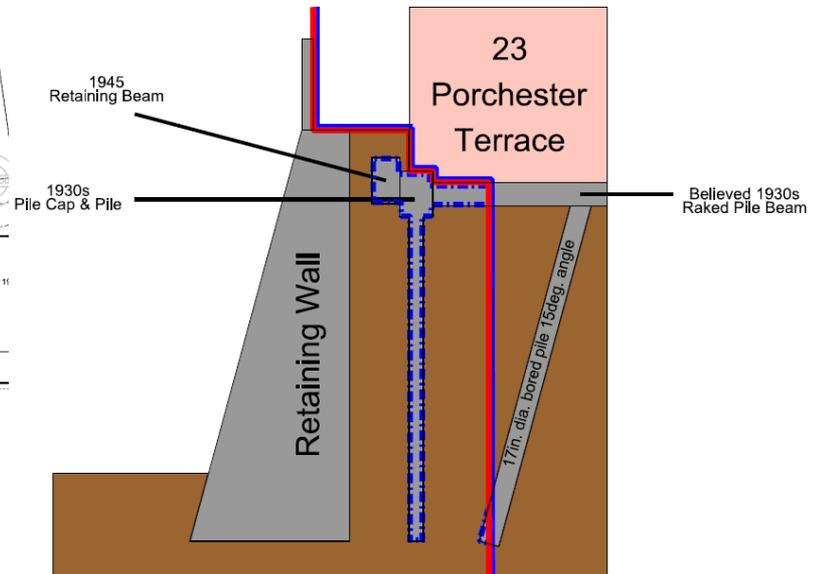
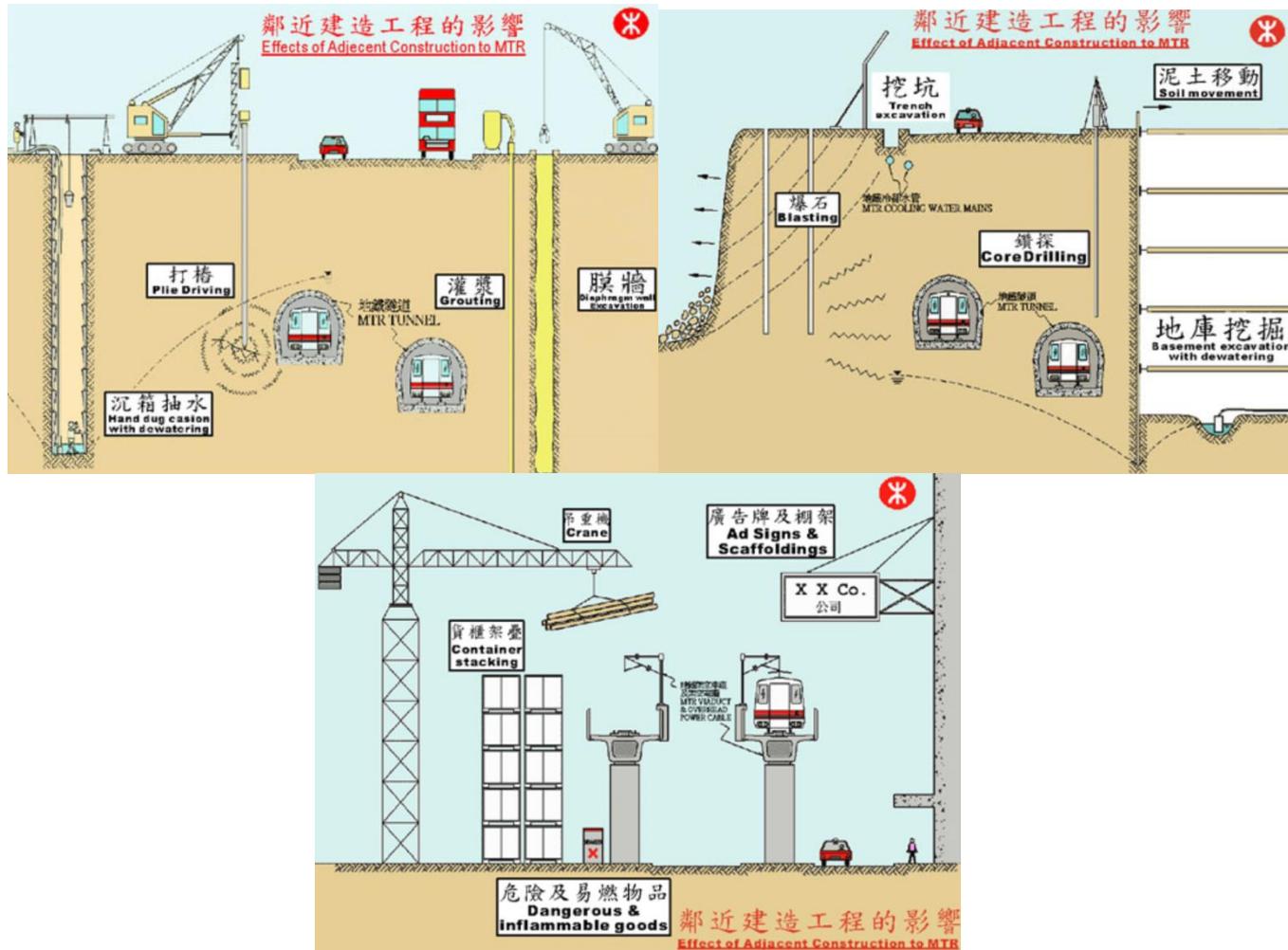


Diagram representing the presence and property interfaces

- LU owned subsoil/structure beneath third party land
- Third Party owned land
- - - Third Party right to have foundation within LU subsoil

Porchester Terrace – holistic *analysis* - protection.



Diagrams showing potential works that may have an effect on the safe presence and operation of railway infrastructure

Source: MTR, 2014.

So *why is* historical geography important to the understanding of an urban railway system, now and for the future?

“If you’re going underground,...why bother with geography?”

Henry (Harry) Beck, quoted in Ackroyd, P., 2012. pp.131-132.

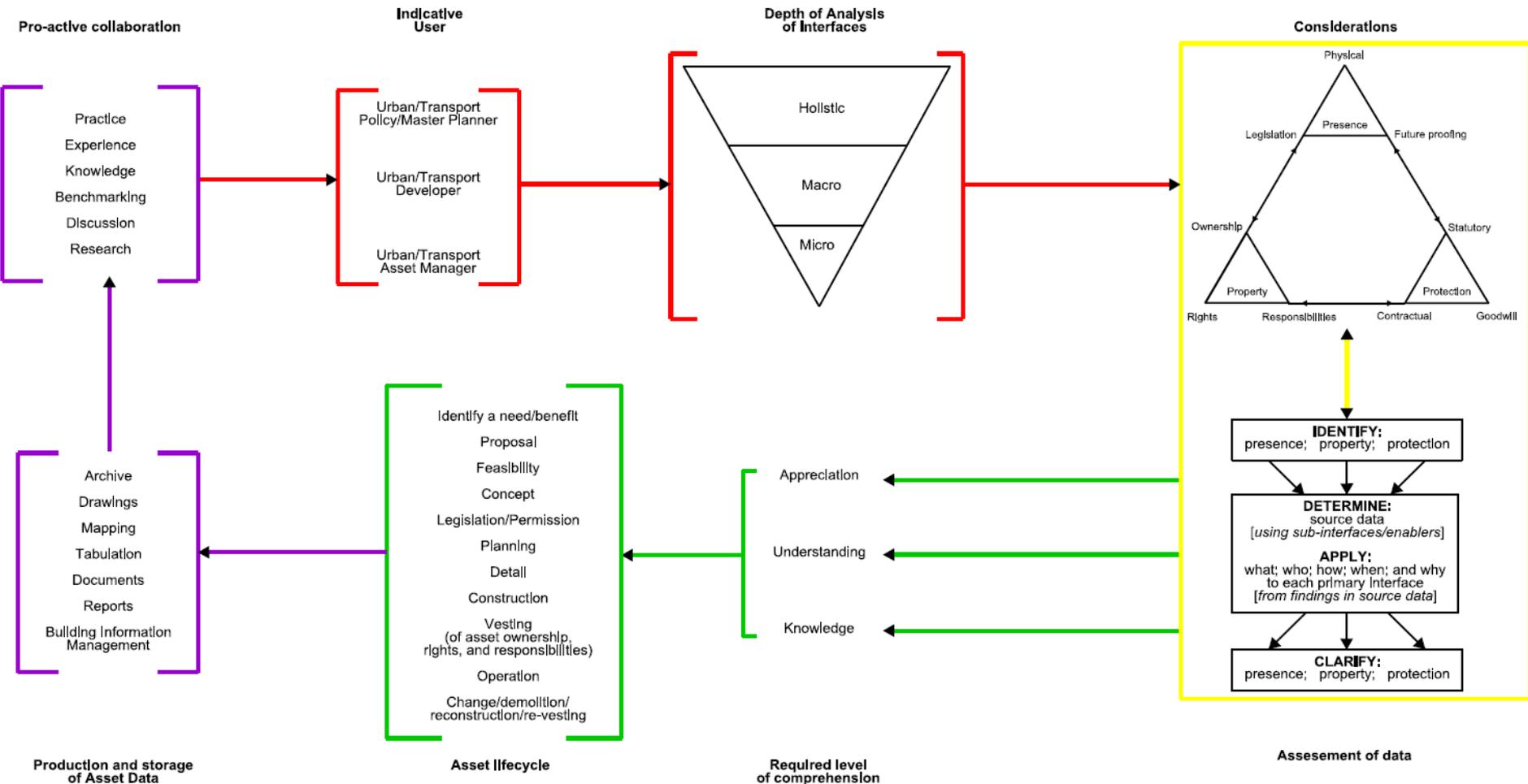
“Historical geography is a sub-discipline of human geography concerned with the geographies of the past and with the influence of the past in shaping the geographies of the present and the future”.

Heffernan, M., 2008.

*“If historical geography is about understanding how the ‘past shapes the geographies of the present and the future’, it must be used to advise and guide those managing and planning the urban environment, **and** its transport infrastructure, now and in the future”.*

Darroch, N., 2018.

This is achieved through archival research which assists and informs asset management now, for the future.



Operationalising the conceptual framework

Source: Darroch, Beecroft, and Nelson, 2018.

These principles potentially apply to other transport infrastructure, everywhere...



Hillingdon station and environs

Source: Bing Maps, 2018.



Wuppertaler Schwebebahn



Osaka, Japan

Source: Morrison, G., undated.



Hong Kong

Source: Carl Chung.

Thank you for listening! 🙄

- Any questions?

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- For more slides, please see:

Website: nathandaroch.co.uk

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