



LONDON LIGHT LINE LTD

DUE DILIGENCE DOCUMENTS, NOVEMBER 2022

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**CERTIFICATE OF INCORPORATION
OF A
PRIVATE LIMITED COMPANY**

Company Number **13160590**

The Registrar of Companies for England and Wales, hereby certifies that

LONDON LIGHT LINE LIMITED

is this day incorporated under the Companies Act 2006 as a private company, that the company is limited by shares, and the situation of its registered office is in England and Wales.

Given at Companies House, Cardiff, on **27th January 2021**.

The above information was communicated by electronic means and authenticated by the Registrar of Companies under section 1115 of the Companies Act 2006



Companies House



THE OFFICIAL SEAL OF THE
REGISTRAR OF COMPANIES



Camden



Date: 10/01/2022

Our ref: [REDACTED]

Contact: [REDACTED]

Direct line: [REDACTED]
[REDACTED]

Planning Solutions Team
Planning and Regeneration
Culture & Environment
Directorate

London Borough of Camden

2nd Floor

5 Pancras Square

Dear [REDACTED]

Re: Pre-app enquiry for the London Light Line, Kingsway Exchange Tunnels

I refer to your pre-planning application enquiry ([REDACTED]) for the London Light Lines in the Kingsway Exchange Tunnels, WC1. I confirm receipt of your pre-application pack and the pre-application fee (£7,872).

1. Proposal

The proposal is to create an immersive digital visitor experience in the disused Kingsway telephone exchange – a series of tunnels in LB Camden and the City of London. The project proposes to use immersive technologies to allow visitors to explore the natural world and better understand man's impact upon it through the creation of digitally generated exhibitions. The experiences will be multi-sensory, incorporating digital projection, sound, movement, temperature changes, wind, etc. Alongside the core exhibitions, the attraction will present a program of temporary digital art experiences. The venue will also include a cocktail bar and it will also be a venue for functions and business events. It has been assumed that in addition to the 5,000m² of tunnel areas, there will be a further 1,000m² of floorspace at surface level where ticketing, security, lift lobby and some of the retail, catering and staff facilities will be accommodated. The main entrance of this building will be located in the City of London. An existing entrance to the tunnels in LB Camden (in Fulwood Place) will be used as a secondary entrance, with vehicles expected to use Bedford Row to the rear for pick-ups/drop-offs.

2. Site description

The Kingsway telephone exchange was built as a deep-level shelter underneath Chancery Lane tube station in the early 1940s. The site was originally designed to shelter 10,000 people and has a total floor area of 7,100m². There are (at least) two elevator entrances, one in LB Camden, in Fulwood Place (within 31 – 33 High Holborn) and the other in Funnival Street in the City.

Although intended for use as an air raid shelter, like many of the deep level shelters it was not used for its intended purpose and was instead used as a government communications centre. The site was given to the General Post Office (GPO) in 1949. The two-tunnel shelter was extended by the addition of four tunnels at right-angles to the originals. It was completed by 1954, and in 1956 it became the termination point for the first transatlantic telephone cable - TAT1. Throughout the 1960s, 1970s and early 1980s, Kingsway Trunk Switching Centre (as it became known) was a trunk switching centre and repeater station with Post Office engineering staff totalling over 200 at its peak. The site had a staff restaurant, tea bar, games

Any development should follow the Mayor's guidance in the London draft Fire Safety LPG.

Conclusion

The proposal to use the tunnels to create a new digital visual gallery/exhibition centre with ancillary facilities would be acceptable in principle under the Council's policies (principally policies C3 and E3 of the LB Camden Local Plan 2017) for encouraging tourist attractions in the Central London Area.

Subject to the design of any external buildings, the proposals would potentially be acceptable in the context of the Council's policies for conservation and design.

As no information has been provided as yet on how visitors and staff would access the site it would be necessary for you to submit a Transport Assessment which should set out information on the frequency and numbers of visits, transport modes, accessibility, transport measures etc. You are strongly encouraged to submit this as early in the process as possible in order for officers to review and comment on the proposed arrangements prior to the submission of any future planning application.

Within your engineering report it will be necessary to demonstrate that the use of the tunnels would not impact upon the structural integrity of the highways.

A Noise Assessment and Servicing Management Plan will be necessary to ensure that the development does not cause any loss of amenity to surrounding occupiers by way of unacceptable noise or disturbance.

In principle, there should be no objection in terms of sustainability, particularly as the development would involve the re-use of existing buildings to create new tourist/cultural and leisure facilities and employment/training. However, as you can see from the comments above, a planning application for the development would have to be accompanied by an Air Quality report, an Energy Statement, a Sustainability Statement (including BREEAM Excellent rating), a Flood Risk Assessment and a Sustainable Urban Drainage Strategy.

Finally, the Council would require a legal agreement including contributions and the provision of employment, skills and training in Camden as indicated above.

This document represents an initial informal officer view of your proposals based on the information available to us at this stage and would not be binding upon the Council, nor prejudice any future planning application decisions made by the Council.

If you have any queries about the above letter or the attached document please do not hesitate to contact Adam Greenhalgh on [REDACTED].

Thank you for using Camden's pre-application advice service.

Yours sincerely,

Adam Greenhalgh

Planning Officer
Planning Solutions Team



From: "Richards, Gwyn" [REDACTED]
Date: Friday, June 11, 2021 at 12:24 PM
To: [REDACTED] >
Cc: "Gagen, Kurt" [REDACTED] >, "Depala, Bhakti" <[REDACTED]>, "Pundsack, Mark" <[REDACTED]>, "Bright, Toni" <[REDACTED]>, "Parker, Joanna" <[REDACTED]>
Subject: RE: Call with Camden Council Monday June 7, 2021 (Kingsway Exchange)

Hi [REDACTED]

We had an internal meeting yesterday and reviewed the documents submitted to date. From the documents provided we are still not comforted that the following functional aspects of any scheme are surmountable. It's key that we understand if these can be addressed at the outset especially as the solutions may raise other issues which could be contentious or unacceptable.

- Fire escape
- Fire-fighting access
- Ingress and egress in other emergencies
- Ventilation
- Lifting Capacity
- Security control of visitors both for security checking and to avoid queuing on the street

In order to structure meetings, I would advise that we cover these functional and operational aspects in a dedicated initial meeting where your consultants present practical solutions. Given the internal resources and senior officer time that will be spent on such complex matters, in line with our procedures there will be a pre-application fee. We can confirm this fee next week. We can then arrange the meeting and ensure specialist senior officers from Planning and District Surveyors attend.

For such a proposal there will be a myriad of other considerations we will need to consider but an understanding of these functional / operational issues in terms of health and safety needs to be understood and supported at the outset.

It would also be worthwhile undertaking a site visit at an early stage.

Kind Regards

Gwyn

Gwyn Richards
Planning and Development Director
Department of the Built Environment
City of London

Tel No : [REDACTED] Mobile : [REDACTED]

Website : www.cityoflondon.gov.uk





Gagen, [REDACTED]

To: Depala, Bhakti

Cc: J.Waddy [REDACTED] [REDACTED] Parker, Joanna; Wilso
 Pundsack, Mark; Morley, Lydia

You forwarded this message on 02/11/2022 10:16.

Hello Bhakti

Are you able to kick start the PPA Process with Angus & Peter please? I will issue some written advice following on 16th November, with a full diary of meetings between now and then.

We have had 1 site visit, which I believe Angus paid for.

If we could plan for a series of meetings including the following people, another site visit or two would also be required:

- Myself DM (Perhaps 1 other Senior Planner too for resilience)
- Peter Wilson AD
- Joanna Parker Design
- Iain Steele Highways
- Mark Pundsack Fire Safety & Evacuation
- Lydia Morley Access
- You?

I have cc'd the applicant team in

Many thanks

Kurt



Kurt Gagen | Principal Planning Officer

Environment Department | City of London | Guildhall | London EC2V 7HH

T: [REDACTED]

M: [REDACTED]

E: [REDACTED]





9th SEPTEMBER, 2022

(1) BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY

and

(2) [REDACTED]

EXCLUSIVITY AGREEMENT
relating to Land being the part of the subsoil known as Kingsway Tunnels

DWF Law LLP
One Snowhill, Snow Hill
Queensway
Birmingham B4 6GA
DX: 13051 BIRMINGHAM-1



WSP



MEMO, SUMMARY OF THREE REPORTS

TO		FROM	WSP
DATE	25 October 2021	CONFIDENTIALITY	Public
SUBJECT	Kingsway Exchange – Engineering summary		

This memo is to summarise the advice provided for Kingsway exchange tunnels with respect of the tunnel assets, 1. Vertical transportation, 2. Tunnel ventilation, and 3. Fire Engineering.

This summary should read in conjunction with the following design notes:-

1. KWE-WSP-DDN-VT-0002 revP04
2. Kingsway Exchange tunnels fire safety feasibility rev 3
3. 70082828 Kingsway ventilation rev 3

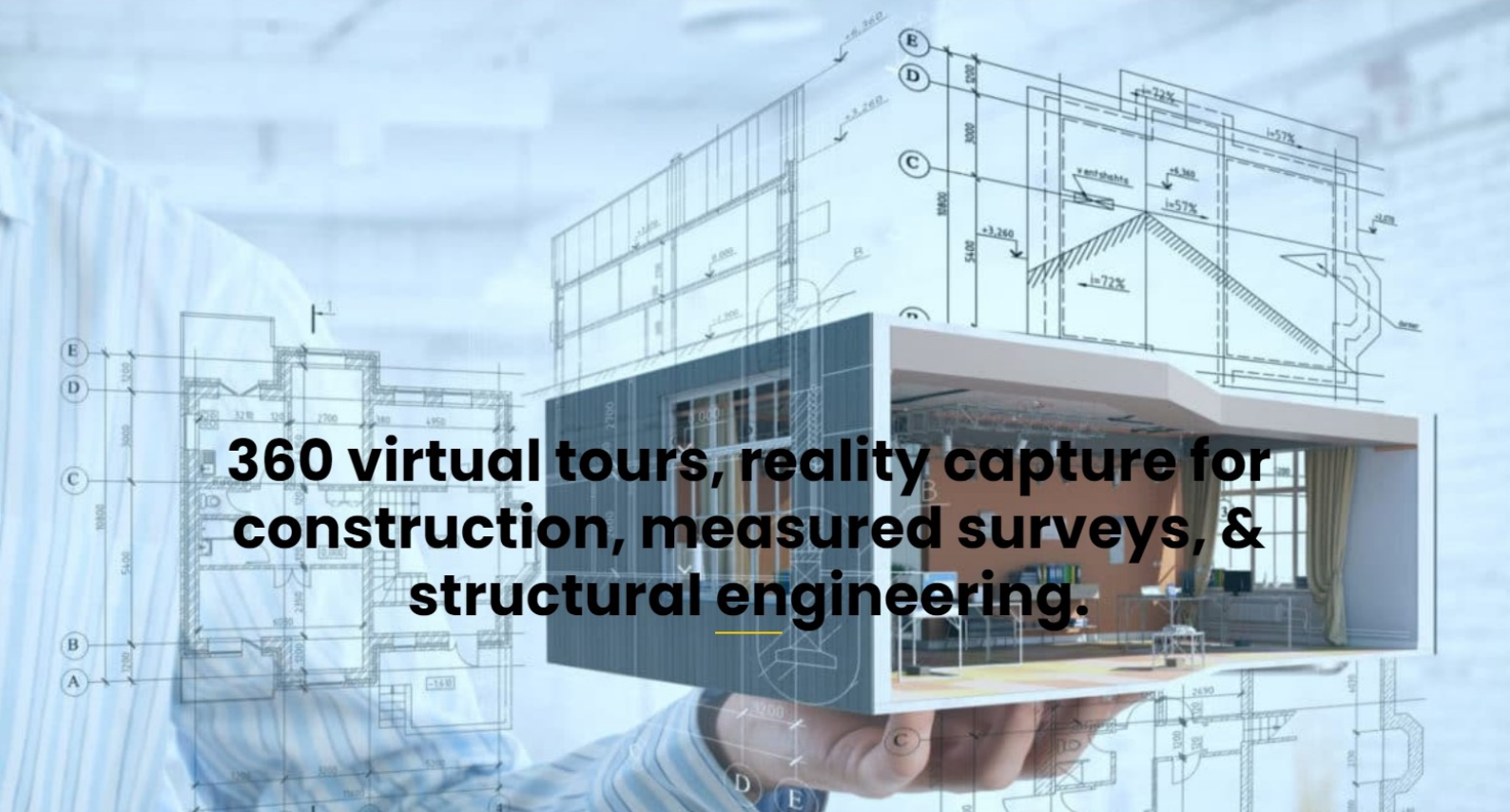
The following summaries can be drawn from each of the reports:-

1. Vertical transportation

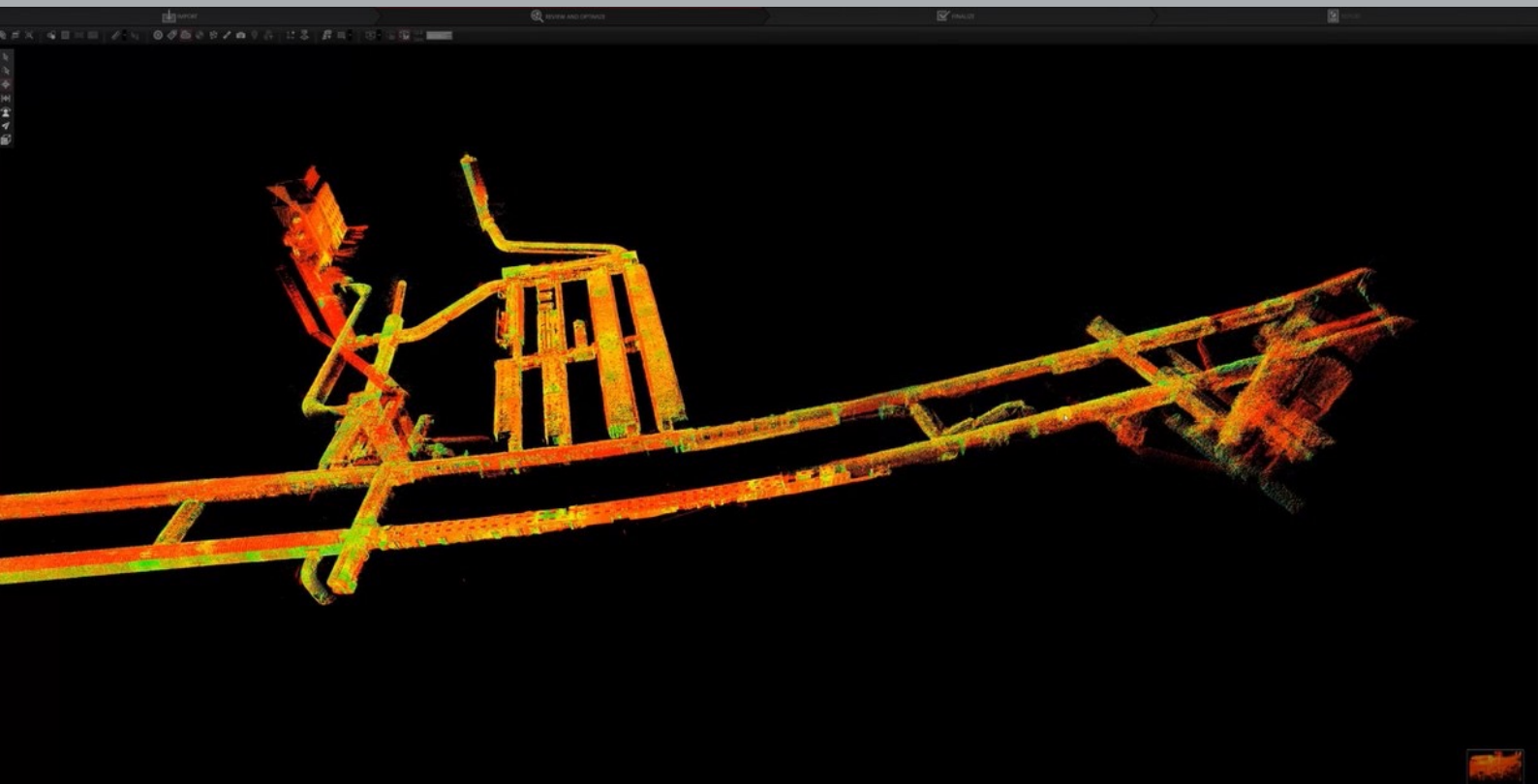
- The existing lifts shafts at Fumival street and Fulwood place appear to have sufficient diameter to install a single deck lift carrying 35 able bodied passengers which would provide a capacity of up to 490 people per shaft, per hour, giving a total of 980 per hour.
- Double deck lifts were investigated but are not considered feasible at this time due to the amount of tunnelling work that would be required to enlarge the spaces at the base of the tunnels.
- Please see comments below confirming that independent firefighting shafts is achievable.

2. Fire Engineering

- The size of the facility means that escape distances are large and therefore the solution to be in compliance with the building regulations could be achieved through a performance-based design approach.
- This performance-based approach would be a fire engineered solution in accordance with BS 7974 and would be achieved by splitting the tunnels into fire compartments with fire doors and employing a progressive horizontal evacuation strategy. This would ensure the travel distances comply with BS9999.
- Measures would be needed to control the maximum numbers in the tunnels would not be exceeded.
- We have assumed a 1 per 5m² occupancy giving a maximum occupancy of around 1350 people.

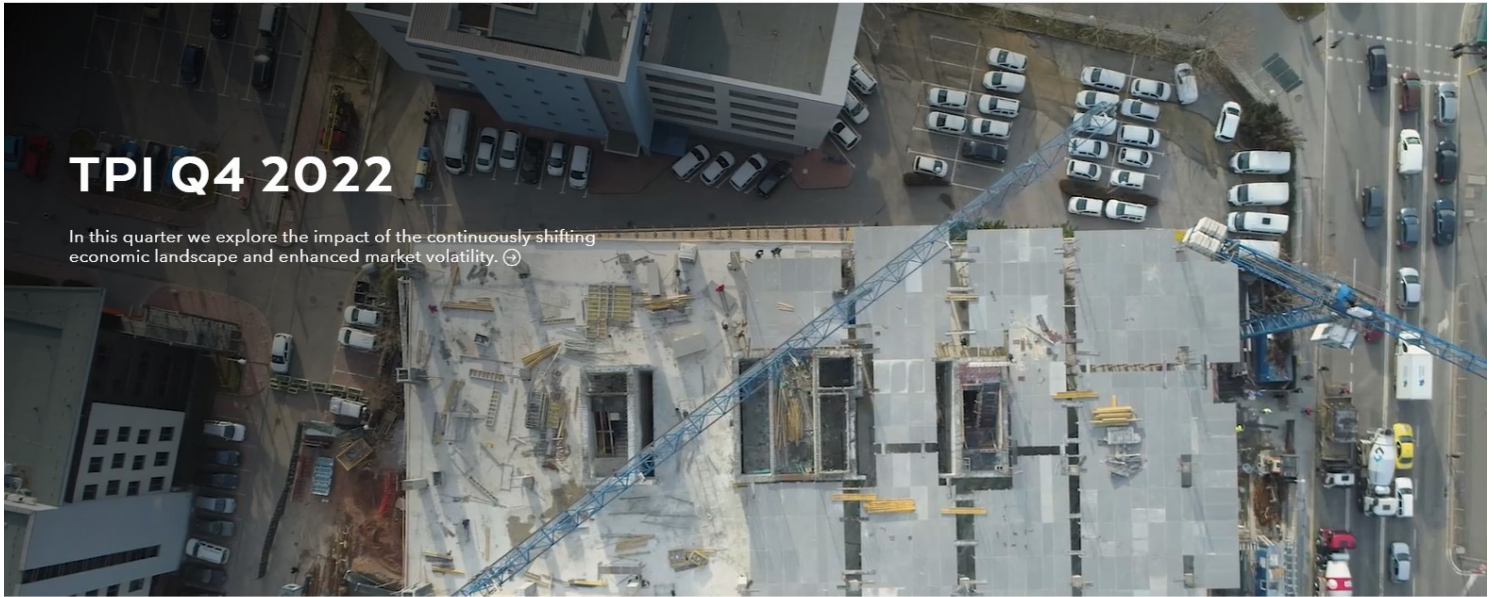


360 virtual tours, reality capture for construction, measured surveys, & structural engineering.



TPI Q4 2022

In this quarter we explore the impact of the continuously shifting economic landscape and enhanced market volatility. ☹️



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Don't miss out on the latest market insights and news from across the industry.



LONDON LIGHT LINE
FEASIBILITY DELIVERABLES
November 2022





C | 5
core five





KINGSWAY TUNNELS DEVELOPMENT
INITIAL COST ESTIMATE - DRAFT
 27 May 2021

PROJECT COST SUMMARY

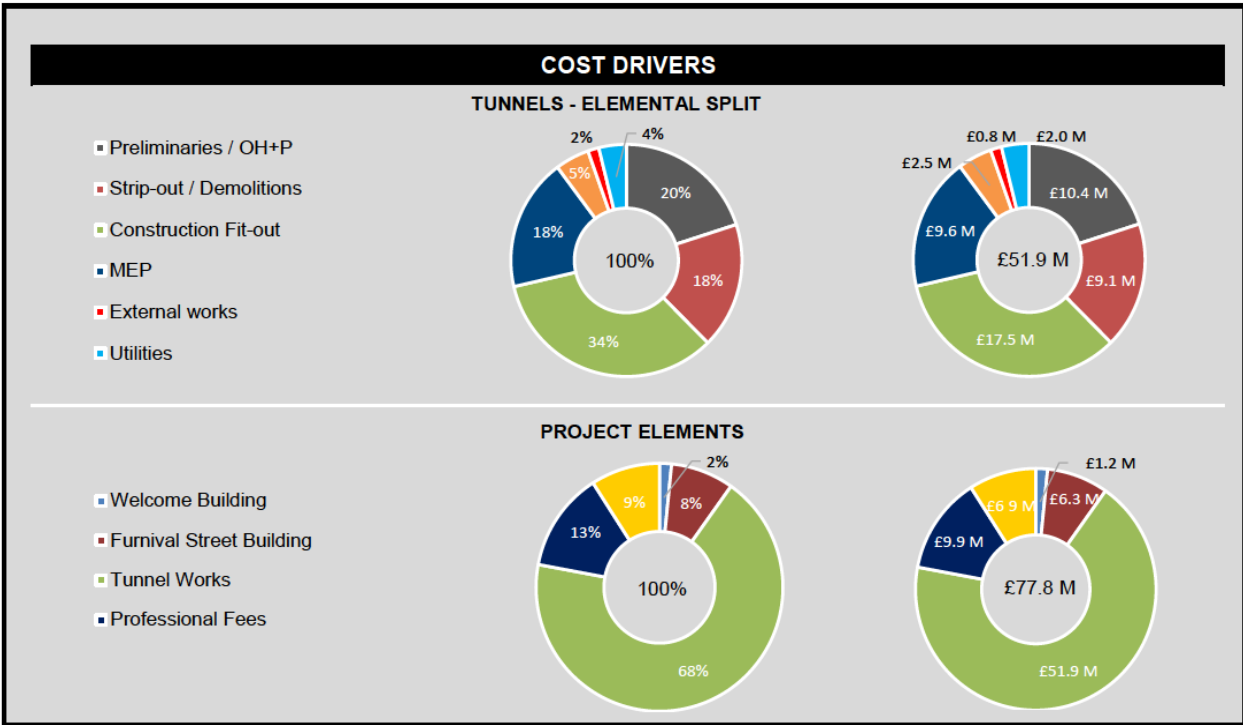
Welcome Building		Total Construction Cost Range		£/m2	
Welcome Building		£1,100,000	to £1,300,000	£2,750	to £3,250
TOTAL Fit-out		£1,100,000	to £1,300,000	£2,750	to £3,250
Furnival Street Building		Total Project Cost Range		£/m2	
Furnival Street Building		£6,000,000	to £6,600,000	£4,528	to £4,981
TOTAL New Building		£6,000,000	to £6,600,000	£4,528	to £4,981
Tunnel Works		Total Project Cost Range		£/m2	
Demolitions & strip out		£10,800,000	to £12,000,000	£1,080	to £1,200
Fit-out		£35,200,000	to £38,900,000	£3,520	to £3,890
External Works & Services		£1,000,000	to £1,100,000	£100	to £110
Utilities Infrastructure		£2,000,000	to £3,000,000	£200	to £300
TOTAL Tunnels		£49,000,000	to £55,000,000	£4,900	to £5,499
TOTAL CONSTRUCTION COST		£56,100,000	to £62,900,000	£5,609	to £6,289
Direct Cost & Client Contingency		Total Project Cost Range		£/m2	
Professional Fees		£9,400,000	to £10,400,000	£940	to £1,040
Client Contingency		£6,600,000	to £7,200,000	£660	to £720
TOTAL Direct Costs & Client Contingency		£16,000,000	to £17,600,000	£1,600	to £1,760
TOTAL PROJECT COST		£72,100,000	to £80,500,000	£7,209	to £8,049

OPTIONS

Audio Visual (AV) Installations	Fixed Screens say £4,000 - £5,000/m ²
Exhibition Fit Out (Excluding AV Install)	Budget £10m - £20m, subject to brief
Significant green / sustainable technology	Typically 5-10% cost uplift
Sponsorship Opportunities / Free supply	TBC
Retain some of Existing Fit-out	TBC
Phasing - Reduce Initial Impact	Refer to Phasing Split
Retain Some of the Existing Flooring	Suggest retain 25% of existing floors, target saving £0.5m
Furnival Street (Re-use / Simplify / Reduce size)	Target saving £1 - £2m
Amend Floor Height to Maximise Cost Efficiency	TBC

4.0 Schedule of Areas & Key Quantities

Description	Length	Diameter	Girth on plan	Plan Area	Gross Internal Floor Areas	Wall Area (Above Floor Area)	Wall Area (Including below Floor)	Volume
	m	m	m	m ²	m ²	m ²	m ²	m ³
Tunnels								
Primary Tunnels	388	7.62	873	3,132	2,817	5,547	9,288	17,694
First Avenue	85	7.62	187	643	617	1,215	2,035	3,876
Second Avenue	85	7.62	189	667	617	1,215	2,035	3,876
Third Avenue	85	7.62	194	735	617	1,215	2,035	3,876
Fourth Avenue	85	7.62	195	734	617	1,215	2,035	3,876
Service Avenue	48	7.62	109	353	348	686	1,149	2,189
Secondary Tunnels	820	5.06	1,707	4,541	3,950	7,851	13,025	16,463
North Street Centre	200	5.06	416	1,084	963	1,915	3,177	4,015
North Street East	120	5.06	247	676	578	1,149	1,906	2,409
North Street West	85	5.06	177	438	409	814	1,350	1,707
South Street Centre	200	5.06	407	1,104	963	1,915	3,177	4,015
South Street East	115	5.06	244	671	554	1,101	1,827	2,309
South Street West	100	5.06	216	568	482	957	1,588	2,008
Entrance tunnels	155	Various	353	580	704	1,399	2,321	2,789
Secret Tunnel	65	5.06	139	178	313	622	1,032	1,305
Goods Alley	50	5	106	214	238	473	785	982
Goods avenue	40	4	108	188	152	303	503	503
Tertiary Tunnels	271	Various	638	1,038	919	1,991	3,164	3,004
Cross Alley	20	5	63	81	95	189	314	393
Frame alley	14	4	36	61	53	106	176	176
Main Alley	50	4	107	223	191	379	628	628
South Avenue	65	4	143	268	248	492	817	817
Tea bar alley	35	4	77	127	117	234	385	337
West alley 2	15	4	39	51	50	100	165	144
Centre Alley	15	3	35	45	35	102	141	106
East alley	12	3	32	40	28	82	113	85
Oil close	15	3	37	58	35	102	141	106
West alley	30	3	67	84	69	204	283	212
Ancillary Rooms	150	n/a	406	710	612	1,217	2,019	2,307
MDF	20	7	54	134	133	263	440	770
East Toilet	38	4	104	175	145	288	478	478
Female WC	17	4	45	67	65	129	214	214
First aid/sick bay	22	4	58	94	84	167	276	276
Male WC	22	4	66	116	84	167	276	276
Control room	13	3.5	32	48	42	84	137	120
No 2 shaft lobby	18	3.5	46	76	60	120	198	173
TOTAL	1,784	n/a	3,977	10,001	9,002	18,005	29,816	42,258



RISKS AND MITIGATION

Building Regulations (Usage/Fire/Layout)		Early Engagement with Building Control
Condition of existing tunnels (Civil Engineering)		Detailed survey required & specialists engaged
Contamination (Asbestos and other material)		Detailed survey required & specialists engaged
Condition of MEP infrastructure		Detailed survey required & specialists engaged
Water in tunnels		Detailed survey required & specialists engaged
Planning requirements		Early engagement with Local Authority
Utilities upgrades required		Early engagement with Local Authority
Inflation and market conditions		Prepare programme
Client brief		Finalise scope and prepare formal Brief
Access & logistics		Early engagement with contractors
Lack of interest from contracting market		Early engagement with contractors

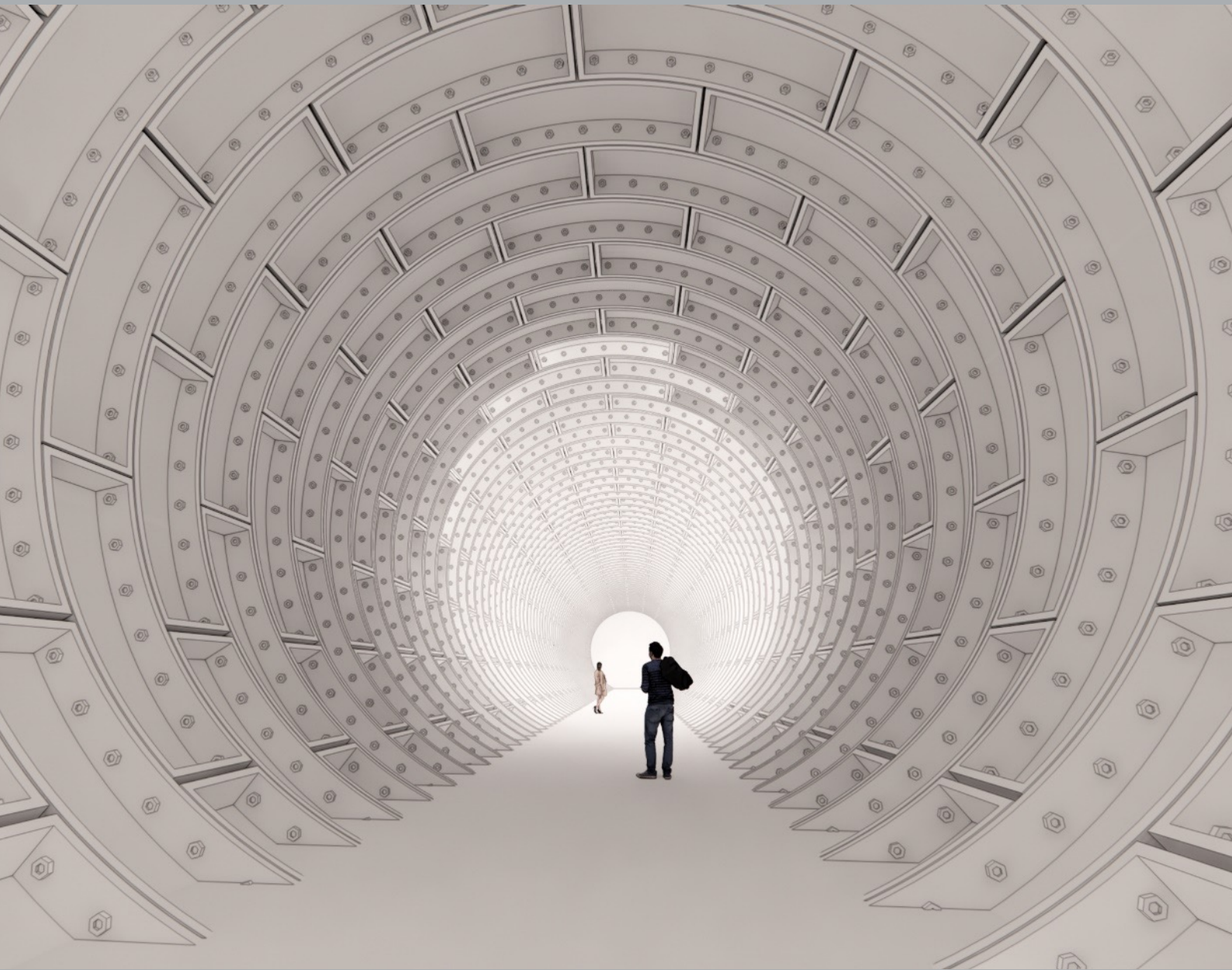
KEY EXCLUSIONS

-VAT	- Finance charges	- Intellectual content / Exhibition
- Inflation	- Site acquisition	- S106/S278 / Planning gains
- AV installation	- Civil engineering	- Works to Chancery Lane station
-Exhibition fit-out	- Significant external works	- Branding & external wayfinding

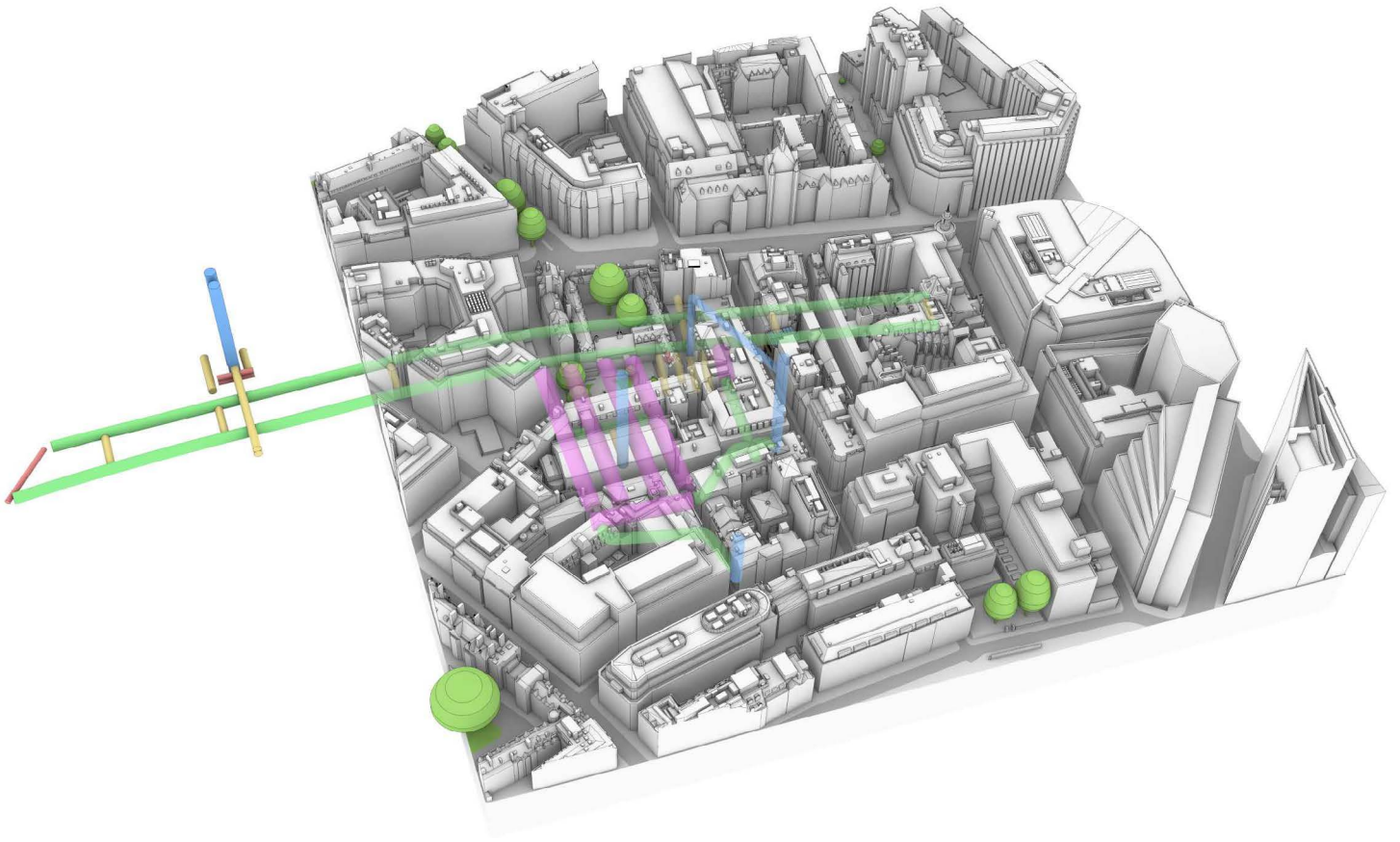


WilkinsonEyre

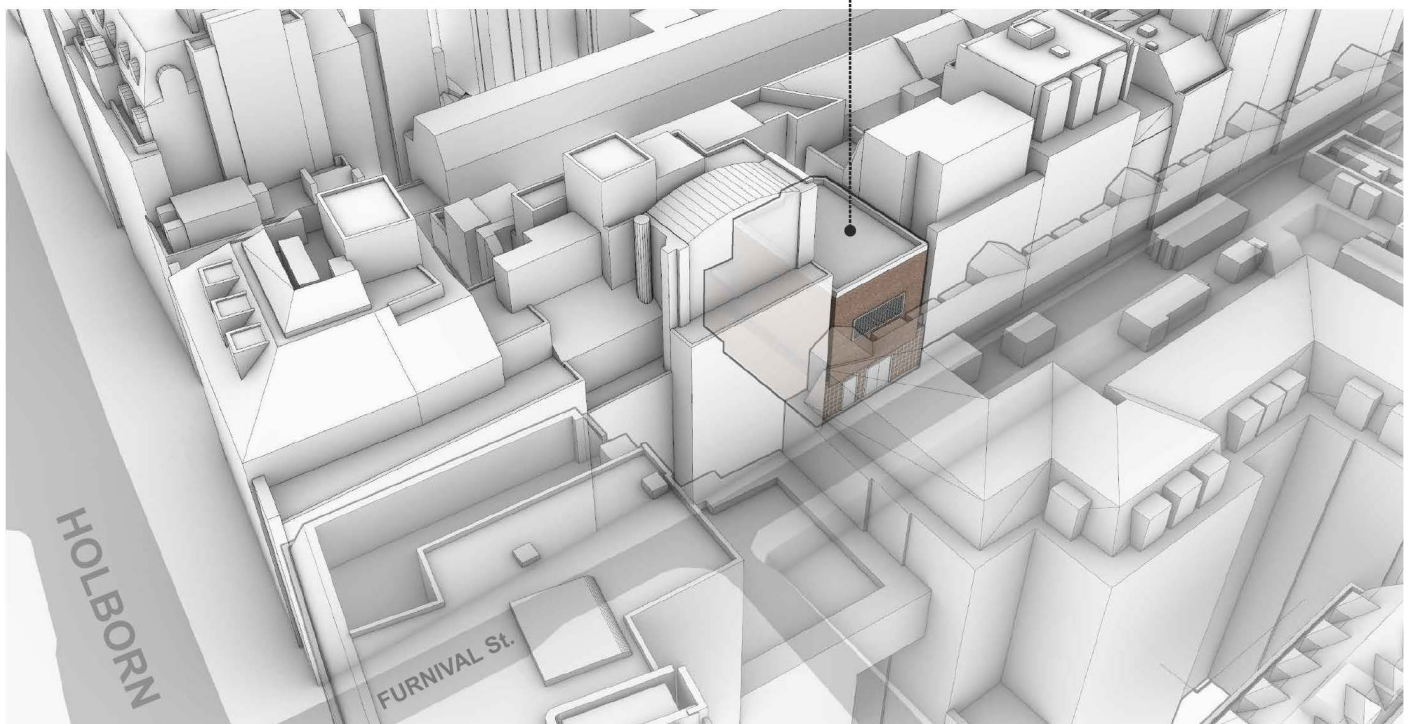




CONTEXT | KINGSWAY EXCHANGE TUNNELS LOCATION UNDER CHANCERY LANE

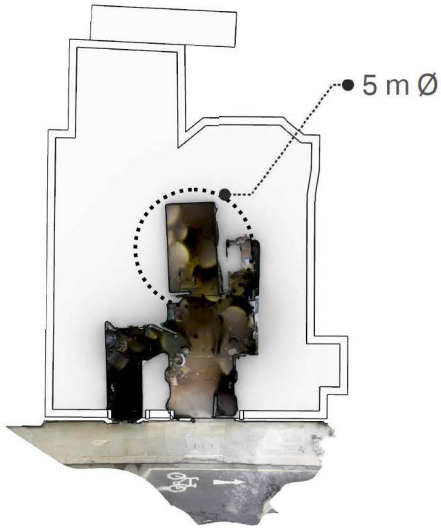


ACCESS | FURNIVAL ST. ACCESS TO TUNNELS



ACCESS | FURNIVAL ST. ACCESS BUILDING

-SHAFT LOCATION - EXISTING



-3D SCAN RECONSTRUCTION



-BASE CASE STUDY



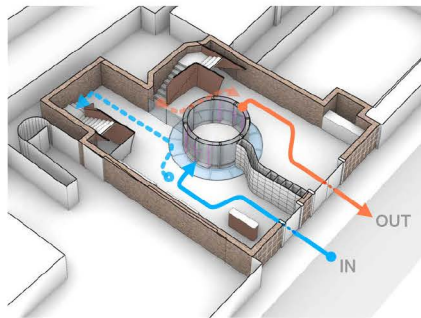
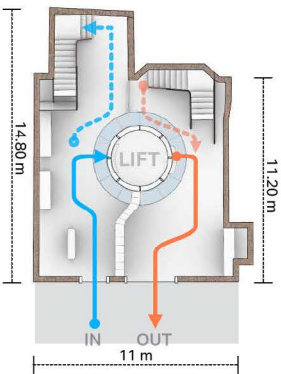
ACCESS | LIFT ACCESS TO TUNNELS - DOUBLE DECK OPTION

NOTE:

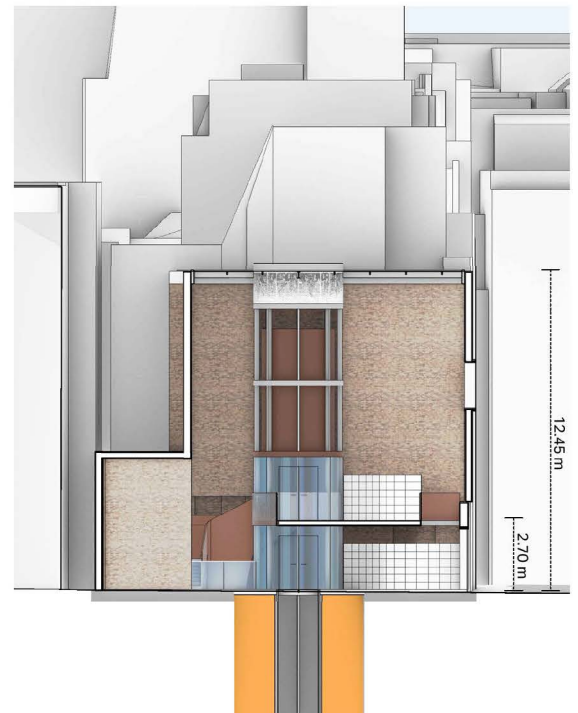
- All dimensions are indicative - No survey available.
- Furnival Street shaft location based on 3d scan provided.
- Double deck lift option is subject to capacity at tunnel level.



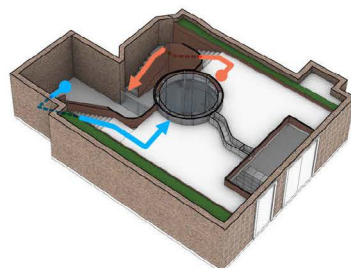
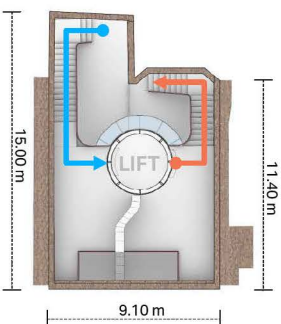
GROUND FLOOR



BUILDING SECTION



LEVEL 01



TUNNELS | TUNNELS STRUCTURE - REFERENCE

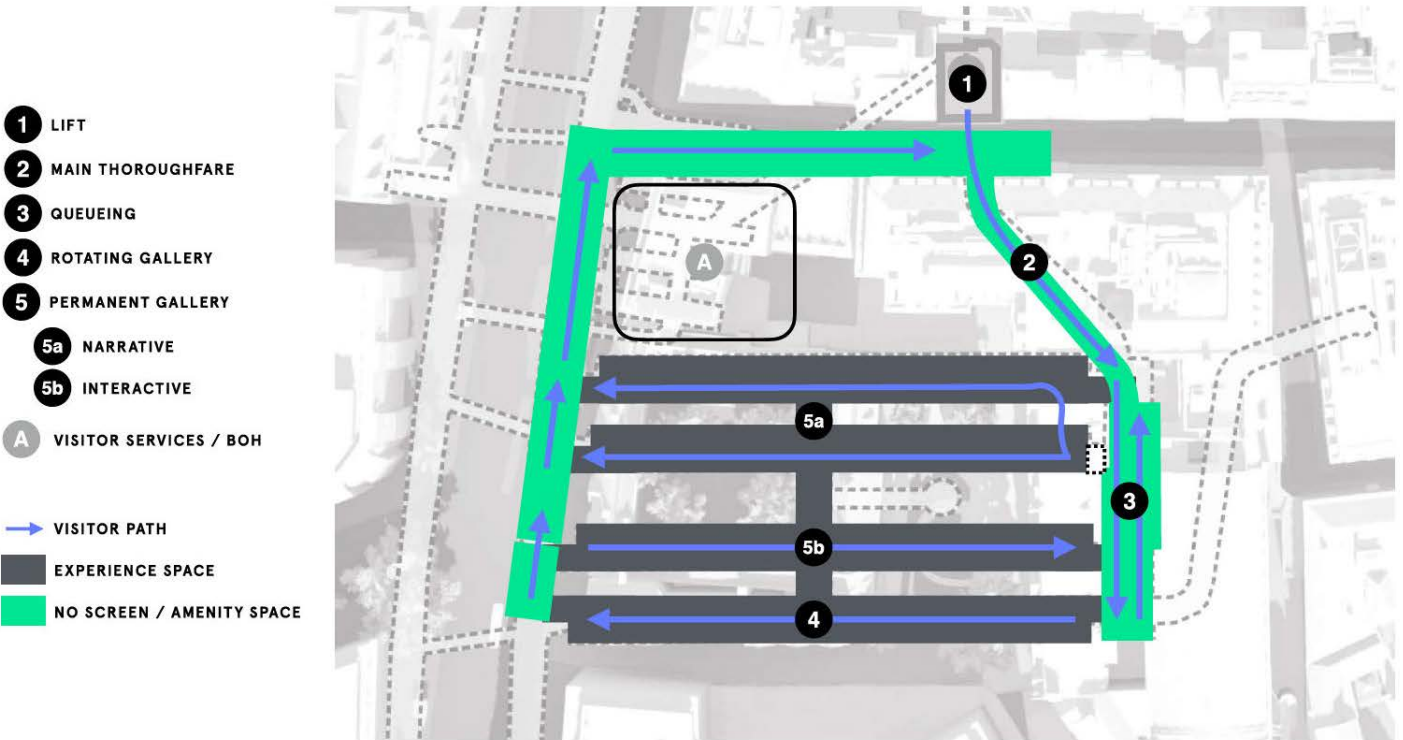




**LOCAL
PROJECTS**



VISITOR FLOW PROPOSAL



MAIN THOROUGHFARE | A PUBLIC SPACE FOR DIGITAL ART, PROGRAMMING AND AMENITIES

Build Anticipation

Showcase the themes and technologies related to the galleries as visitors make their way through the main thoroughfare, en route to the core experience areas of the Light Line.

Digital Art Showcase & Performance Space

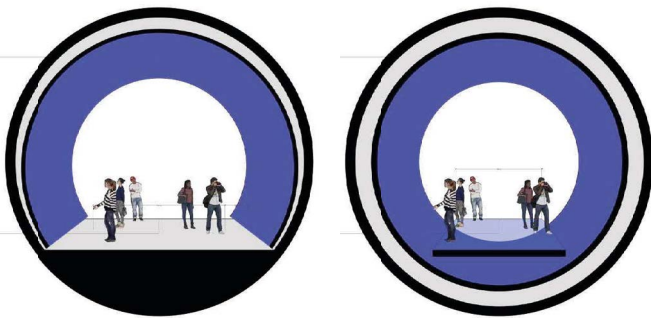
The portion of the tunnel used as the main thoroughfare can double as a digital art and performance space. The small portion of the tunnel that opens in the project's first phase will signal more to come in the future.

Encourage Repeat Visitation

Advertising teasing future programming, coming attractions can be teased here.



BALANCING IMMERSION AND NARRATIVE



IMMERSION APPROACH



SCENIC / NARRATIVE APPROACH

IMMERSION APPROACH



Elevation



Plan View

Immersive interactive environments

Optimal for experiences that place the visitor in expansive environments, maximizing "wow factor" of long tunnels

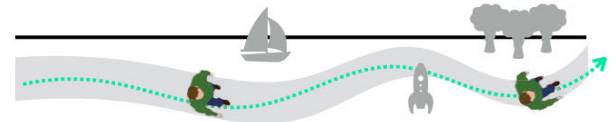
Can implement layered animations with controlled parallax

Straight path through = focus on immersion, higher throughput

SCENIC / NARRATIVE APPROACH



Elevation



Plan View

Narrative environments

Optimal for linear narratives with multiple parts.

Avoids heavily distorted perspectives (eg warping of an object seen far down a tunnel)

The digital canvas is articulated with physical elements to pace the story

The path through can be winding = greater engagement, lower throughput



SAMSUNG



From: Mike Brown [REDACTED]
Sent: 13 May 2022 09:20
To: Chris Holcombe [REDACTED]
Cc: Katy Leo [REDACTED] 'Steve Robertson' [REDACTED]
[REDACTED] Jeremy Standing [REDACTED]
Subject: RE: Don't miss Samsung at ISE 2022 – only 2 weeks to go!

Morning Chris,

It was our pleasure! We really appreciate you taking the time to visit us at ISE.

All parties acknowledge the uniqueness of the business application with a genuine motivation to put together a Samsung cross business proposition that meets with your value criteria. Your attendance with us in Barcelona certainly helps with this process.

Pete and Jeremy on copy for future comms.

Have a good weekend on the bike and let's get a date in the diary for a visit to Chichester during the summer months ahead.

Kind regards
Mike

From: Chris Holcombe [REDACTED]
Sent: 12 May 2022 16:34
To: 'Mike Brown' [REDACTED]
Cc: Katy Leo [REDACTED] Steve Robertson [REDACTED]
Subject: RE: Don't miss Samsung at ISE 2022 – only 2 weeks to go!

Hi Mike,

Thanks again for the introductions at the meeting and dinner yesterday, please pass on my thanks to Pete and Jeremy too.

Speak again soon



From: Chris Wilson <[REDACTED]>
Sent: 12 January 2022 15:27
To: [REDACTED]
Cc: Stuart Reay <[REDACTED]>; Alexander Decker <[REDACTED]> Katy Leo
[REDACTED] Chris Holcombe [REDACTED]
Subject: RE: Update | Camden Council | Kingsway Exchange Tunnels

Hi [REDACTED]

Good to hear from you - am very well thanks, hope you all had a nice festive break?

Couple of things to update you on. Over the Xmas period I met with BNP Paribas to discuss finance options for LG customers and thought it might be beneficial to arrange an introduction to the London Light Line team.

Are you OK with me sharing the presentation that you sent last year with them? I'm hesitant to do so without asking permission first out of courtesy.

I can also set up a Webex meeting as a next action if that suits?

Thanks,

Chris

Chris Wilson
Sales Manager European Business Solutions
LG Electronics
Mobile: [REDACTED]
E-mail: [REDACTED]
Visit: partner.lge.com www.lg.com



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From: Chris Wilson <[REDACTED]>
Sent: 11 November 2021 15:56
To: [REDACTED]
Cc: Chris Holcombe <[REDACTED]>; Katy Leo
[REDACTED]; Stuart Reay <[REDACTED]>; Alexander Decker
<[REDACTED]>
Subject: RE: Some questions

Dear [REDACTED]

Just to let you know I've been discussing the London Light Line project with my counterparts at European HQ and Global HQ this week.

There was a slight misunderstanding with regards to your intentions around securing investment. I'll put that down to 'lost in translation' but with the assistance of the CFO office at European HQ I've managed to clarify this with Global HQ. Angus, your email certainly helped so that's much appreciated.

I'm flying to European HQ on Monday and I'll use my time there to meet with the CFO team and I'll come back to you with a date for a follow up meeting.

Thanks

Chris

Chris Wilson
Sales Manager European Business Solutions
LG Electronics
Mobile: [REDACTED]
E-mail: [REDACTED]
Visit: partner.lge.com www.lg.com



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PTS



From: Robin Naish <[REDACTED]>
Sent: 13 January 2022 15:45
To: [REDACTED] Brian Chapman
<[REDACTED]>
Cc: Katy Leo [REDACTED] Chris Holcombe
[REDACTED]
Subject: RE: [EXTERNAL]: Update | Camden Council | Kingsway Exchange Tunnels

Hi [REDACTED],

Happy New Year to you and the rest of the team, I'm very well thank you, I trust you are too.

Thank you for the update on the progress of the project, [very positive](#) is an excellent way to start the New Year.

As always, should you need anything from PTS to support your proposal, please do not hesitate to call or email.

We look forward to catching up with you all in the near future, and meet in person when you feel that the times right.

Regards, Robin.

Robin Naish

[REDACTED]
W: www.pts.global



Please note that our email domain has changed and may need to be whitelisted. My new email address is [REDACTED]

Please consider the environment before printing this email.

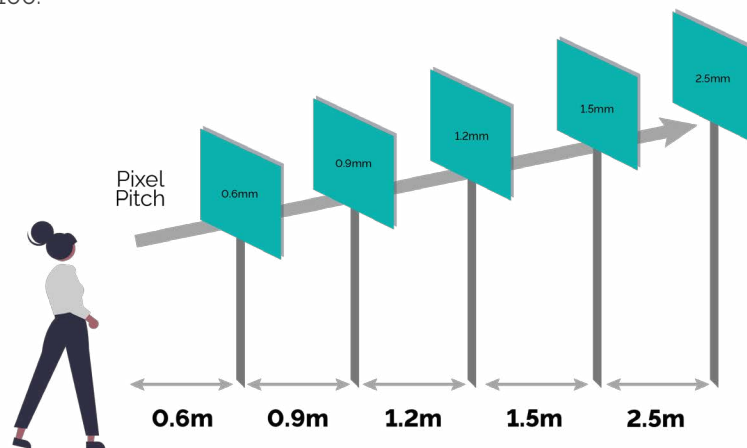
Registered as company number 01738788 and having its registered office at 7th Floor, 5 Jewry Street, London, EC3N 2EX. The information in this internet E-mail is confidential and is intended solely for the addressee. Unless you are the named addressee (or authorised to receive emails on behalf of the addressee) you may not copy, use or disclose this email to any other parties. If you are not the intended recipient please contact [REDACTED]. Views or opinions presented are solely those of the author and do not necessarily represent those of PTS Consulting Group.

LED cabinets are differentiated primarily by pixel pitch, which describes the distance in millimetres between the centre of two adjacent LED pixels.

A smaller pixel pitch can support higher resolution content in a physically smaller display (therefore desirable for indoor applications), but carries a higher cost.

Generally, 'the rule of 100' defines the distance at which a viewer will see a contiguous image for a given pixel pitch. For instance, this distance for a 1.5mm display would be 1.5m, or 0.015 multiplied by 100.

For the rigid cabinets used with flat LED screens, pixel pitches can be as low as 0.6mm. For flexible screens the lowest pitch currently available is 1.5mm. This technology is constantly improving, so there will likely be further reductions by the time a design must be finalised for the project.





ELECTROSONIC



From: Paul Taylor [REDACTED]
Sent: 12 January 2022 11:16
To: [REDACTED]; Maggie Law
<[REDACTED]>
Cc: Katy Leo [REDACTED]; Chris Holcombe
[REDACTED]
Subject: RE: [EXTERNAL] Camden Council | Kingsway Exchange Tunnels

Hi [REDACTED].

Thanks for keeping us updated. That's great to hear.

Please do let us know when we can help you move this forward.

All the best.

Paul Taylor
Senior Consultant
Electrosonic

Tel [REDACTED] | Mobile [REDACTED] | Skype | Skype: [REDACTED]
Hawley Mill, Hawley Road, Dartford, Kent, DA2 7SY - UK
[REDACTED] | www.electrosonic.com

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Technical Notes and Considerations

Video Resolution and Replay

If each tunnel is approximately 80m long with a pixel pitch of 1.2mm the resolution will be 68333 in length.

If the tunnel has a diameter of 7.6m the circumference will be 23876mm. If we use $\frac{1}{4}$ of this for the area above the floor (17907mm) then the height of image with a 1.2mm pixel pitch will be 14922.

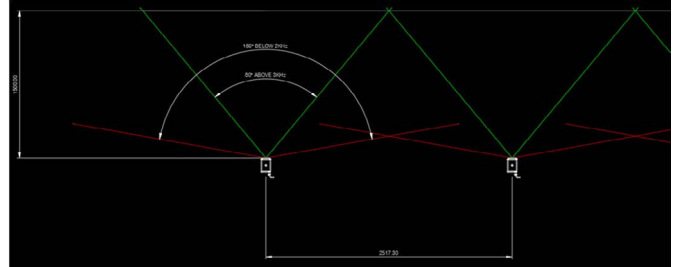
This would mean each tunnel would have an overall resolution of approximately 68333 x 14922.

If we use 4K UHD resolution (3860 x 2160) this equates to approximately 18x UHD long and 7x UHD high. This equates to 126 x channels of UHD media server required per tunnel and we have four tunnels. If we were to use something like the 7th Sense Infinity Server which has 4x UHD outputs per server we would require 32x Servers per tunnel. Each server is 3RU so this equates to 96RU of rack space for servers per tunnel for the core equipment racks

The above is based on a worst-case scenario of the tiles being mounted to the tunnel wall structure and feeding a pixel for pixel content to the LEDs. Obviously in reality this is likely to not be the case as there will need to be services at high level and the sides such as power and cable runs, air handling and fire detection and suppression systems so the resolution and therefore the server count being reduced is highly likely. Some of the following suggestions would also require gaps in the LED tiling and these could be utilised to fulfil many of the above requirements as well as just AV requirements.

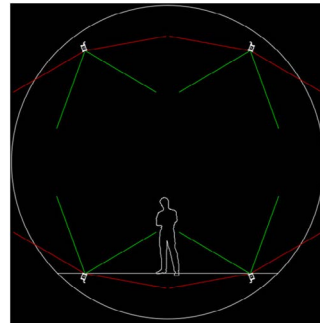
Audio

The main consideration here is loudspeaker placement. Placing loudspeakers at high level could be tricky as the immersive experience would be spoiled by black boxes in front of LED display. Stepping the display at high level could allow gaps to fit speakers discretely but needs investigation into feasibility. For better immersion and movement of sound lots of smaller speakers such as the Meyer MM4-XP lining the tunnels would allow for an even coverage as well as movement of sound along tunnel or spot sounds to match certain images within the tunnel. Other manufacturers such as D&B have the 4S which is a small passive point source speaker but would require amplifiers. Meyer MM4-XP has amplifier built in and has a 1RU PSU which feeds 8x MM4-XP. Using MM4-XP with a dispersion angle of 80 degrees above 3KHz and 120 degrees below 2KHz and an average standing ear height of 1500mm then the speakers would need to be placed approximately 2500mm apart.



Meyer MM4-XP Dispersion and Coverage Elevation

This would therefore require 32x Meyer MM4-XP speakers per side to run the length of the tunnel on the floor = 64x total. If we replicated this at high level this would equate to 128x Meyer MM4-XP speaker per tunnel. This would also require 16RU of Meyer MPS-488 rack mount PSU. The Meyer MM4-XP is ideal for high level as it's small and compact.

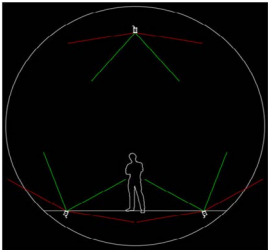


Meyer MM4-XP Dispersion and Coverage Section 1

E110464 rev 1 London Light Line

ELECTROSONIC

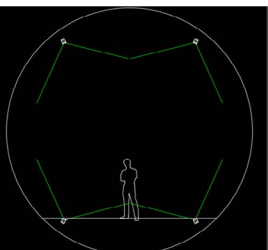
Another alternative could be to just have a single line of the speakers in the ceiling and this would reduce the required number to 96x MM4-XP and 12RU of Meyer MPS-488 rack mount PSU.



Meyer MM4-XP Dispersion and Coverage Section 2

Alternatively, the larger Meyer UP4-XP speakers could be used and these would give better low frequency response. Due to their 100° dispersion angle these speakers could be placed slightly further apart (3900mm).

This would therefore require 20x Meyer UP4-XP speakers per side to run the length of the tunnel on the floor = 40x total. If we replicated this at high level this would equate to 10x Meyer MM4-XP speaker per tunnel. This would also require 10RU of Meyer MPS-488 rack mount PSU.



Meyer UP4-XP Dispersion and Coverage Section 1

Another alternative could be to just have a single line of the speakers in the ceiling and this would reduce the required number to 60x UP4-XP and 8RU of Meyer MPS-488 rack mount PSU.

The Tunnel will have audio bounce around so more speakers at a lower level giving an even coverage will give a far better audio quality rather than few big speakers pumping out higher audio level.

One possible advantage plus from having a single line of speakers at high level could be to incorporate downward firing video projectors in the same line. If a break in the LED was implemented to place the speakers and provided there is enough space between the tunnel roof and the LED tiles, projectors could be installed, above and then used to project content onto the floor. This would obviously require a break in the LED tiling and access panels to the projector for servicing but would also allow air handling and extraction up through the gap.

This possible break/gap in the LED tiling could also be used for motion detection or visitor tracking. This could be used to trigger interactive elements on the floor projection and/or the LED tiling at specific points in the tunnels. This motion detection could also be used to trigger other interactive elements such as smell machines which ideally would be mounted at low level and feed into the space via vents in the flooring.

As with all elements there will need to be access for servicing. If the ceiling projector option was utilised then there would need to be easily removable sections of LED tiling around the projector to allow for quick servicing access and/or replacement in the event of equipment failure. Likewise low level below floor equipment such as speakers, subwoofers and smell machines would require floor access panels again for servicing and replacement in case of equipment failure.

We have not considered in the ROM budget any projection but it is an option that could be considered and developed as part of our technical design.

Audio Content Delivery

Top flexibility would be provided by something like a Meyer D-Mitri system, which allows for sound to be placed and moved around a space within a 3D environment.

QSC could also be an option but not as flexible with placing sound in a 3D environment. However, if carefully mixed within the space sound this could still move within the tunnel and spot effects/sounds can easily be placed in specific areas to match visual content.

Sub Woofers should be placed under floor and could be augmented in areas with Buttckickers to add to the effect/rumbling feel.