

St Paul's Cathedral External Lighting Design Summary & Trial report

St PAUL'S
CATHEDRAL

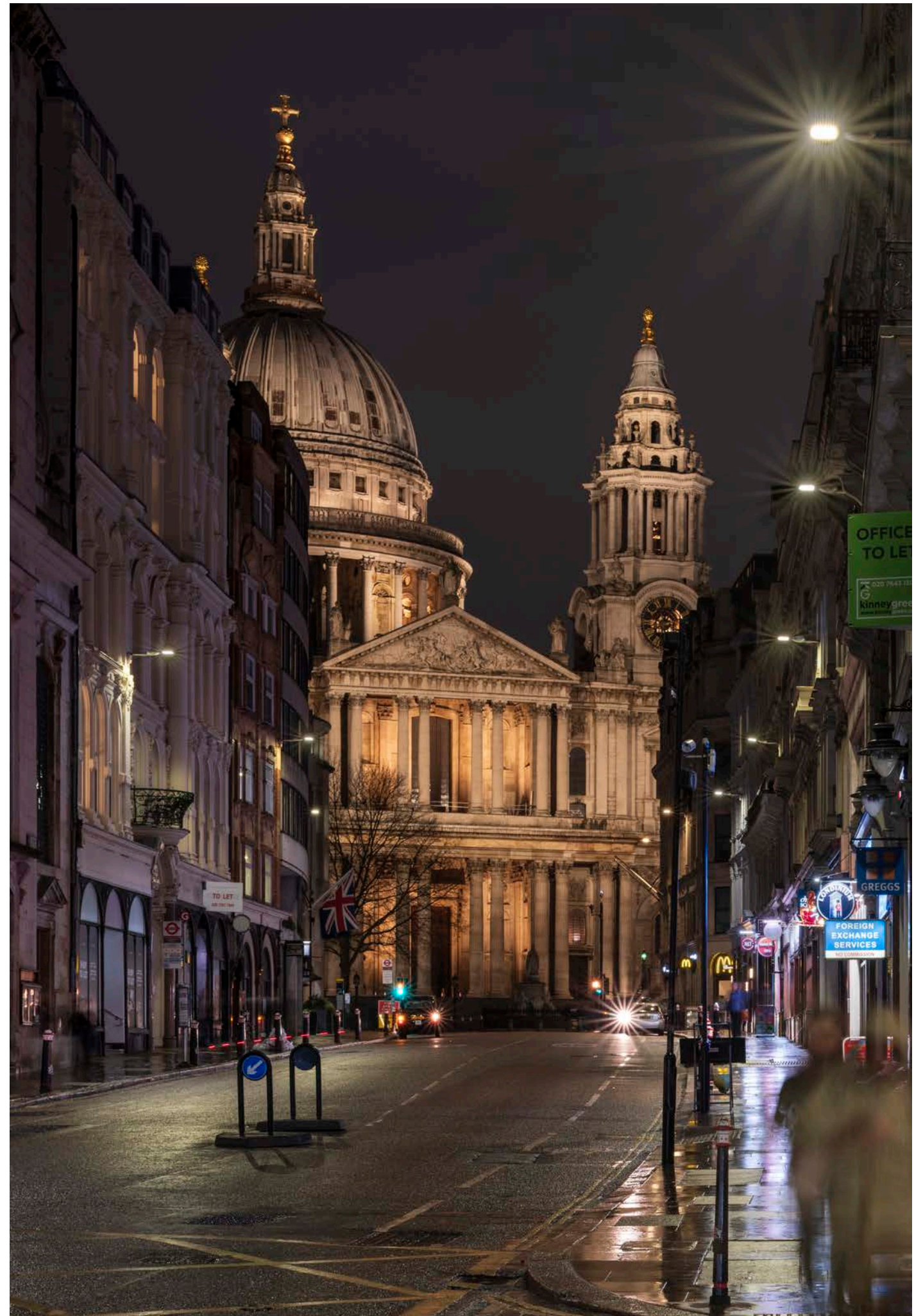


**SPEIRS
MAJOR**

1. Introduction

This report summarises the proposed Lighting Design and Lighting Trial for the External Lighting to St. Paul's Cathedral that took place on Wednesday 24th January 2024 and Thursday 25th January 2024.

It records details of the trial itself, its outcome and feedback from those that attended it and provides the background and context, briefly describing the Lighting Strategy and concept that it demonstrated.



View St Paul's Cathedral from Ludgate Hill.

2. Executive Summary

A. Background

The case for re-lighting the cathedral arises from the following:

- High energy 1989 lighting scheme is past the end of its life.
- Scheme has lost its integrity due to the piecemeal replacement with LED over several years.
- Lighting to north elevation is missing having been removed as part of the redevelopment of Paternoster Square in 2003.
- Scheme is patchy and inconsistent with unsightly shadows and variable colour temperatures.
- Lighting control is very basic being 'all on' or all off'.
- Increasingly expensive to maintain.

The decision to re-light St. Paul's Cathedral was taken due to:

- Much-loved iconic cultural landmark.
- Informs the enjoyment of the public realm.
- Contributes to ambience and a sense of place and safety.
- Assists with legibility and wayfinding.
- Important to local and national economy.
- Key tourist destination in line with Destination City initiative.
- Protected views important after dark as well as by day.
- Needs to co-exist with background lighting to City.

The Lighting Trial was based on the Lighting Strategy and Lighting Concept that were developed between 2011 and 2023 which examined a wide range of issues including:

- Image
- Interpretation
- Visibility
- Impact on fabric
- Environmental impacts
- Impact on fabric
- Safety
- Maintenance
- Management
- Capital and operational cost

A sustainable approach has been taken to the re-design that includes:

- Reinforcing social and economic benefits.
- Minimising environmental impacts including:
 - Energy use.
 - Embodied and operational carbon.
 - Light pollution.
 - Impacts on local residential amenity.
 - Impacts on local ecology.

The approach to Heritage Value was also investigated including a review of the requirement for ecclesiastical and secular consents.

B. Lighting Strategy and Concept

The Lighting Strategy and Lighting Concept established the following core principles for the proposed new lighting scheme:

1. Graduation: The lighting should be more graduated, being brighter towards the top to be seen from a distance gradually becoming dimmer lower down to compliment the public realm.
2. Light from Within: Warm light is to be employed in those key areas which are otherwise in shadow by day to provide a different interpretation of the architecture at night. This warm 'light from within' reminds the viewer that St. Paul's Cathedral is a living place of worship.
3. Change: The control of the lighting should be brighter at dusk and very slowly, dim throughout the course of the evening to create a late-night character.
4. Layers: Each of the following architectural elements should be illuminated independently to allow the visual hierarchy of the building to be properly balanced:
 - Cross
 - Lantern
 - Golden Gallery
 - Dome
 - Stone Gallery
 - Peristyle
 - Tambour
 - Towers
 - West façade
 - West portico
 - South façade
 - South portico
 - North façade
 - North portico
 - East façade

The Lighting Strategy resulted in a schematic design for the proposed scheme. This was reviewed as part of the further development of the Lighting Concept. This included:

- Further analysis of the existing and proposed lighting to create benchmark data.
- Modelling of the lighting in software resulting in a rationalisation of the scheme.
- Lighting tests to help establish the basis for the Lighting Trial.
- Production of additional visual communication of the proposed scheme (CGIs)

C. Lighting Trial:

The Lighting Trial was carried out to the following:

- West elevation including façade, portico and towers.
- South elevation including façade and portico.
- East elevation including façade.
- Cross, lantern, dome, stone gallery, peristyle and tambour.

The aim of the Lighting Trial was as follows:

1. Establish proof of concept.
2. Test lighting positions.
3. Examine key issues.
4. Support the approvals process.
5. Support engagement.

The lighting equipment was installed in the following locations:

- Columns located in Carter Lane Gardens adjacent to the pedestrian crossings on St Paul's Churchyard (opposite the South Portico).
- St. Paul's Cathedral roof.
- 1-4 St. Paul's Churchyard roof..
- Juxon House roof.
- St Paul's Cathedral Choir School roof.

All the luminaires were specified to be fully dimmable. The various lit elements were capable of being controlled independently of each other so that they could be programmed and viewed separately.

The 2 No. demonstration events were attended by a variety of key stakeholders and interested parties including members of the client group, project board, regulatory authorities, and funders.

Each event commenced included a visual presentation followed by a guided tour.

The lighting was witnessed from the following locations:

- West elevation
- Ludgate Hill.
 - St. Paul's Churchyard.

- East elevation
- One New Change.

- South elevation
- Carter Lane Gardens.
 - Peter's Hill.

Attendees were also encouraged to witness the lighting from:

- Millennium Bridge.
- Bankside.
- Gabriel's Wharf.

At each location the following was presented:

- Layers.
 - Scenes.
1. Early evening.
 2. Mid evening.
 3. Late evening.

The Lighting Trial was fully recorded by a professional architectural lighting photographer.

Attendees were invited to ask questions and to submit written feedback to stpaulsighting@cityoflondon.gov.uk

The outcome of the Lighting Trial was generally regarded as extremely successful. The key conclusions were:

1. Flexibility of the lighting scheme was clearly demonstrated.
2. Viability of remote lighting positions on neighbouring rooftops and identified additional locations that could further improve the outcome.
3. Amount of lighting equipment and overall energy use might be further reduced without compromise to the overall lit effect.

The feedback received from attendees of the Lighting Trial was very positive. Key points included:

- Appearance: No negative feedback was received about the general appearance of the cathedral when lit. The majority saw it as an improvement over the existing scheme.
- Visibility: It was agreed that the cathedral was still clearly visible from close and mid views. Photography shows it remains visible from key distant views.
- Interpretation: There were many positive comments about the way the lighting revealed the architecture and the diagram of the building, particularly 'the light from within'.
- Brightness: It was generally agreed that the brightest scene was bright enough. There was some concern that the dimmest scene might not be bright enough depending on timings.
- Colour: The use of warm light (3000K) for the main body of the cathedral was an improvement over the current 'cool' light (4000K and 4500K).
- Shadows: It was agreed that the worst of the shadows from the existing scheme had been eliminated but the darker area at the top of the dome is to be reviewed.

- Pollution: The climatic conditions were different each evening. The focus of the lighting is to be further improved to help reduce light spill.
- Equipment: No specific comments were made about the visibility of the lighting equipment other than the size of the spotlights mounted on the columns.
- Control: The policy for the timing of any switch off is to be reviewed.

Next Steps:

Whilst the Lighting Trial successfully demonstrated what was possible, a considerable amount of detailed work is required to be undertaken before the proposed lighting scheme can be delivered. This includes:

- Ecclesiastical and secular approvals.
- Design Development.
- Detailed Design and Production.
- Tender Action.
- Procurement.



Existing lighting.



Lighting trial.

3. Sustainability

Both the Church of England's 'Cathedral and Church Building Division's Statement on the Sustainability and the Environment' and the City of London's 'Climate Action Plan' require projects to put sustainability front and centre. Meeting this calls for an appropriate balance between the social and economic advantages that re-lighting St. Paul's Cathedral can bring to the local area and the wider city, and the inevitable environmental consequences that arise from illuminating such a large building. In reviewing the 'three pillars' of sustainability for the project the following should be considered:

A. Social

Good lighting can help create a positive character and ambience to an area. Re-lighting the cathedral will help to improve the perception of the public realm after dark, enhancing safety and security and encouraging dwell time in the local public spaces, particularly during the warmer summer months. This in turn will promote social interaction and directly contribute to the area becoming a more successful night-time destination.

B. Economic

Good lighting can support the night-time economy both locally and through tourism. The successful re-lighting of the cathedral has the potential to boost visits to the area and actively contribute to the City of London's 'Destination City' initiative.

C. Environmental

Artificial light is a highly visible form of energy use. It can also create unwanted impacts such as light pollution and intrusive light that can adversely affect people's sleep and cause potential harm to biodiversity. Lighting infrastructure including LED light sources, luminaires, bracketry, cabling, containment, and fixings use embodied and operational carbon. They can also contribute to electronic waste.



Light pollution viewed from Bankside.

4. Fabric

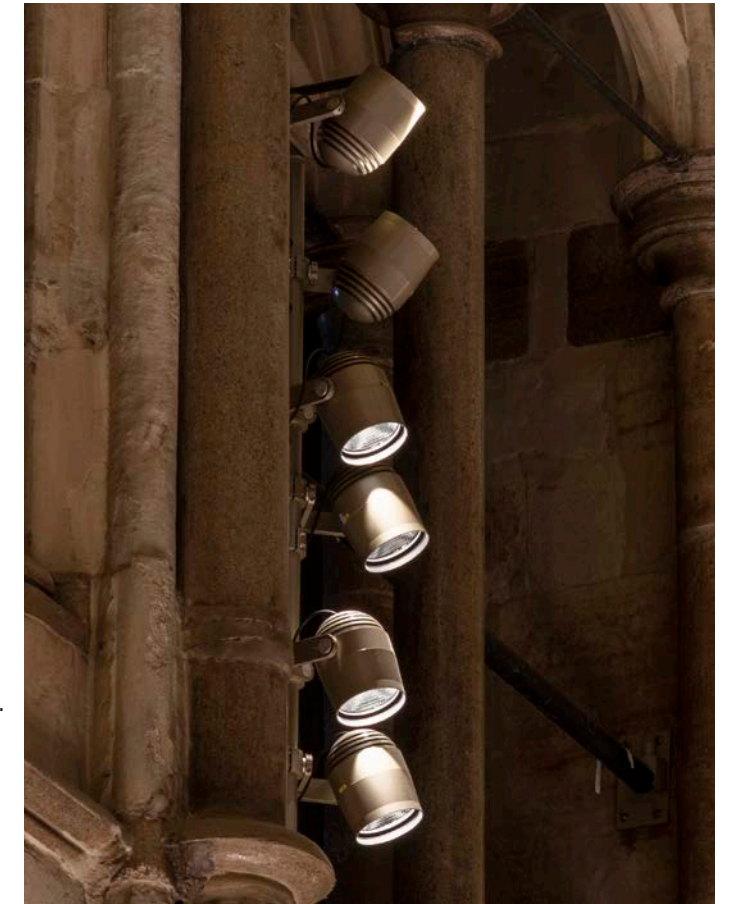
The installation of a new lighting scheme to the exterior of St Paul's Cathedral represents a significant intervention. The positioning of lighting equipment is not limited to the rooftops of adjacent buildings but will also see new locations in the Lantern, on the Golden Gallery, Stone Gallery, and Peristyle, within the Towers and on the main roof. Every care must be taken to avoid damage to the cathedral's fabric. This can be achieved by minimising fixings directly into stonework, not penetrating roof coverings and other sensitive parts of the external fabric whilst reducing the visibility of the lighting equipment and the supporting bracketry and electrical infrastructure.



Dom Tower, Utrecht, lighting fixed onto concrete slab to avoid damage to the fabric.



Dom Tower, Utrecht, concealed lighting detail in the architectural fabric.



Westminster Abbey, lighting color matched to architectural surroundings to reduce equipment visibility.



Dom Tower, Utrecht, Lighting fixed in tension

5. Approach

The Lighting Strategy for re-lighting St. Paul's Cathedral made the following recommendations:

A. Setting

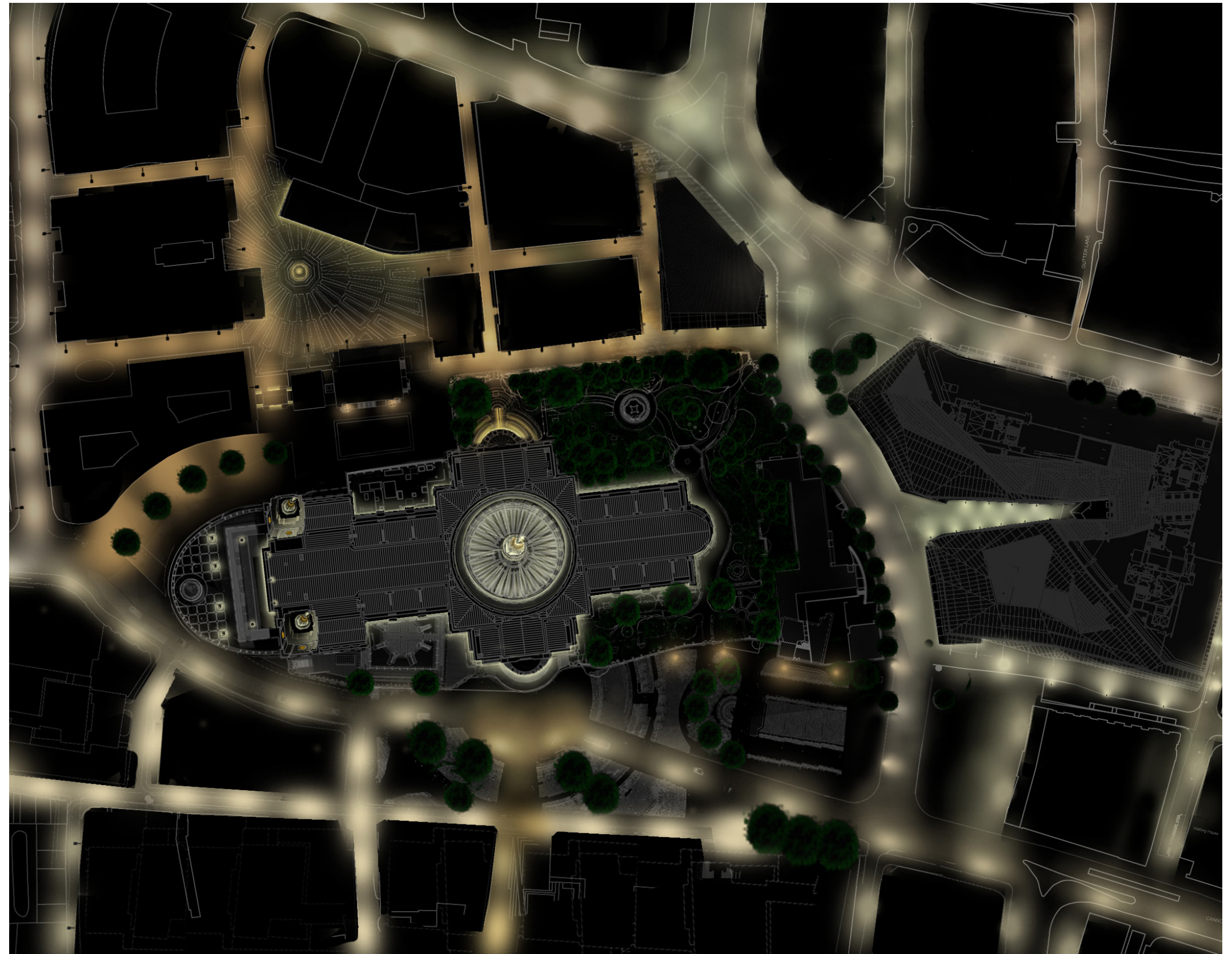
While the illumination of the public realm immediately adjacent to the cathedral does not form part of the project scope, the new lighting scheme for the building must be carefully considered in relation to its lit context. There is currently very little dusk to dawn public street and amenity lighting highlighting the routes and open spaces around the cathedral with St. Paul's Churchyard being largely unlit around its entire perimeter. There is also no other architectural lighting locally other than a poor-quality scheme to Temple Bar, and no landscape lighting other than accidental spill light into the trees in the churchyard from the existing floodlighting.

Illumination to the public realm around the cathedral is currently provided as follows:

- West - spill light from City of London streetlighting, listed heritage lanterns adjacent to the statue of Queen Anne and reflected light from the existing building floodlighting.
- South - spill light from street lighting and reflected light from the existing building floodlighting.
- North - reflected light, some spill from retail lighting and spill light from the existing building floodlighting.
- East - reflected light and spill light from St. Paul's Choir School and the existing building floodlighting.

The initial Feasibility Strategy therefore recommends general improvements to the lighting of the immediate public realm. It also suggests that subtle spill light from such a scheme might positively contribute a soft, warm light to the base of the building.

N.B. One issue that has been identified is that the removal of the existing ground-based floodlighting in the soft landscaped part of the churchyard north-east and east end will remove spill light that is currently used to guide the choristers back to St. Paul's Choir School from the cathedral during the hours of darkness. Using light spill from an architectural scheme is not best practice. Consideration will therefore be needed to be given to this and other similar issues when considering safety, security, and accessibility throughout the churchyard after dark, This does not only include the needs of the choristers but also women walking on their own, those with visual impairments and others who may be impacted by a lack of adequate illumination.



Illustrative plan showing indicative lighting proposal to the immediate public realm surrounding St Paul's Cathedral. 2011.

B. Brightness

Whilst the main body of the cathedral should remain visible from distant views such as Richmond Park, Greenwich Park, Primrose Hill, etc., the overall brightness of the scheme should be reduced as far as possible to help save energy.

C. Colour

The Lighting Strategy recommends that new lighting scheme should use warm white light in the range of 3000K for the main body of the cathedral rather than the current cool white light 4000K. It also suggests even warmer lighting in the variable range of 2700K-2200K for the internal highlighting of the Lantern, Peristyle, Towers and Portico (see "Light from Within" below). St. Paul's Cathedral have a strict policy of not using any saturated coloured light to highlight the building at any time other than on a very occasional basis when associated with temporary art installations, educational outreach projects, and other non-commercial applications. Such rare occasions are subject to approval from Dean and Chapter, the Surveyor, and the Fabric Advisory Committee.

D. Principles

The strategic design approach to the new lighting is governed by four key principles:

- 1. Graduation:** The cathedral is currently washed with a relatively uniform level of light from top to bottom. This fails to recognise the hierarchy of the architecture and human scale in the public realm. The Feasibility Study recommends that the lighting should be more graduated, being brighter towards the top including the Cross, Lantern, Golden Gallery, Stone Gallery, Peristyle and Towers to be seen from a distance and become gradually dimmer across the facades and porticos such that an appropriate level of brightness compliments the public realm.
- 2. Light from Within:** The current lighting scheme tries to make the building appear at night as it does by day. One of the problems with this approach is that it creates strong shadows to the various recesses and setbacks, and in particular to the peristyle and porticos, with uneven shadows of columns and other details being projected onto the surfaces behind them. Whilst deep shadows may be appropriate in natural daylight conditions under artificial light such strong contrasts create a very unwelcoming, monumental, almost ghostly character. The Feasibility Study recommends that warm light be employed in those key areas which are otherwise in shadow by day to provide a different interpretation of the architecture at night. Such areas include the Lantern, Peristyle, Towers, Porticos and recessed openings to the east end. This has the advantage of revealing forms and details that may otherwise not normally be seen. This warm 'light from within' also reminds the viewer that St. Paul's Cathedral is a living place of worship open to all and draws upon

the positive liturgical meaning and use of soft warm focal light.

- 3. Change:** The current lighting scheme is either 'all on' or 'all off'. The Feasibility Study recommends that the lighting should be more dynamic being perceived as brighter at dusk and in the early evening when the city is busy, particularly during the long dark winter's months. The level of brightness should then very slowly, gradually and imperceptibly dim throughout the course of the evening to create a late-night character that may be retained throughout the rest of the night until early morning. This gradual change aims to reflect the reduction of light within the City as it transforms from a working environment to a nighttime destination. It also has the additional benefit of saving energy.
- 4. Layers:** Like many buildings St. Paul's Cathedral is composed of several architectural elements. The Feasibility Study recommends that each of these be illuminated independently such that the highlighting of each can be carefully addressed to allow the visual hierarchy of the building and its overall composition to be properly balanced. The layers of light are as follows:
 - Cross
 - Lantern (outer)
 - Lantern (inner)
 - Golden Gallery
 - Dome
 - Stone Gallery
 - Peristyle (outer)
 - Peristyle (inner)
 - Tambour
 - Towers (outer)
 - Towers (inner)
 - West façade
 - West portico (outer)
 - West portico (inner)
 - South façade
 - South portico (outer)
 - South portico (inner)
 - North façade
 - North portico (outer)
 - North portico (inner)
 - East façade
 - East façade (inner)



Diagram illustrating the gradation principle.



Dom Tower, Utrecht, internal lighting.

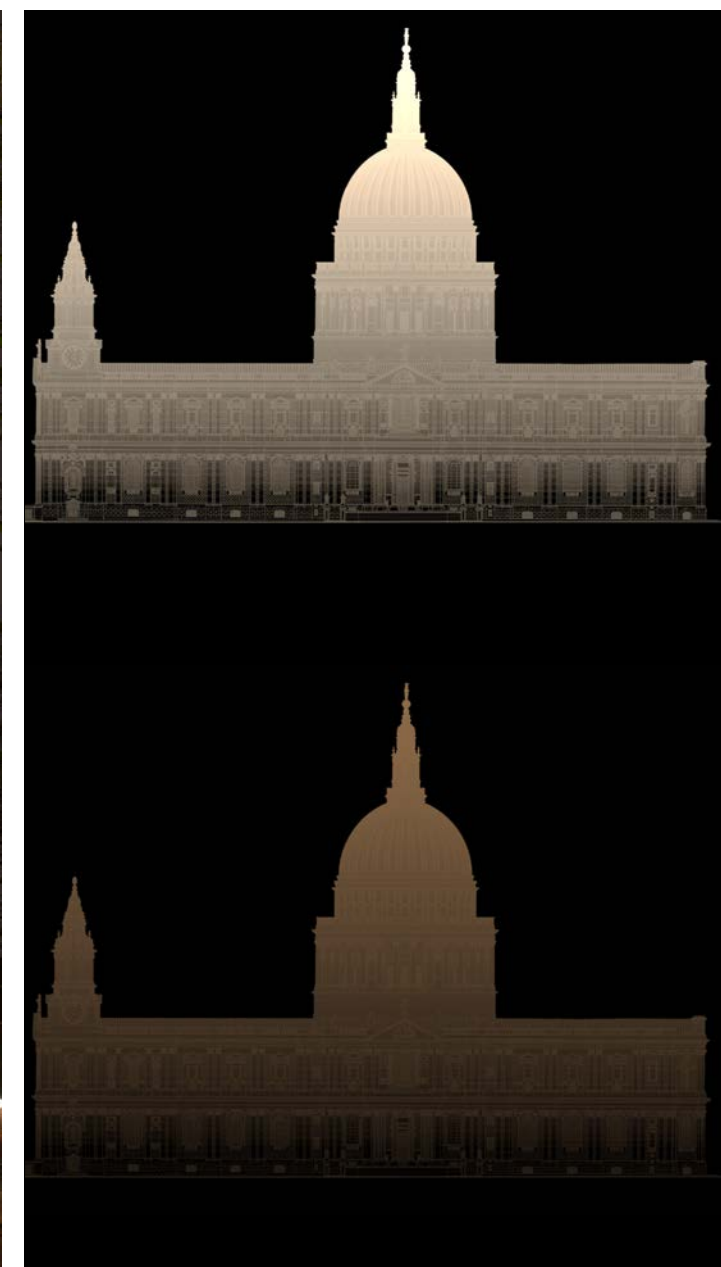


Diagram illustrating change in colour and brightness.

6. Development

A. Analysis

Further analysis was carried out of the existing lighting including a series of surveys that recorded the surface brightness of the different parts of the external building fabric. This was to enable the benchmarking of the proposed design against the existing as part of the ongoing design. The data was also used to help assess a series of lighting tests and the Lighting Trial.

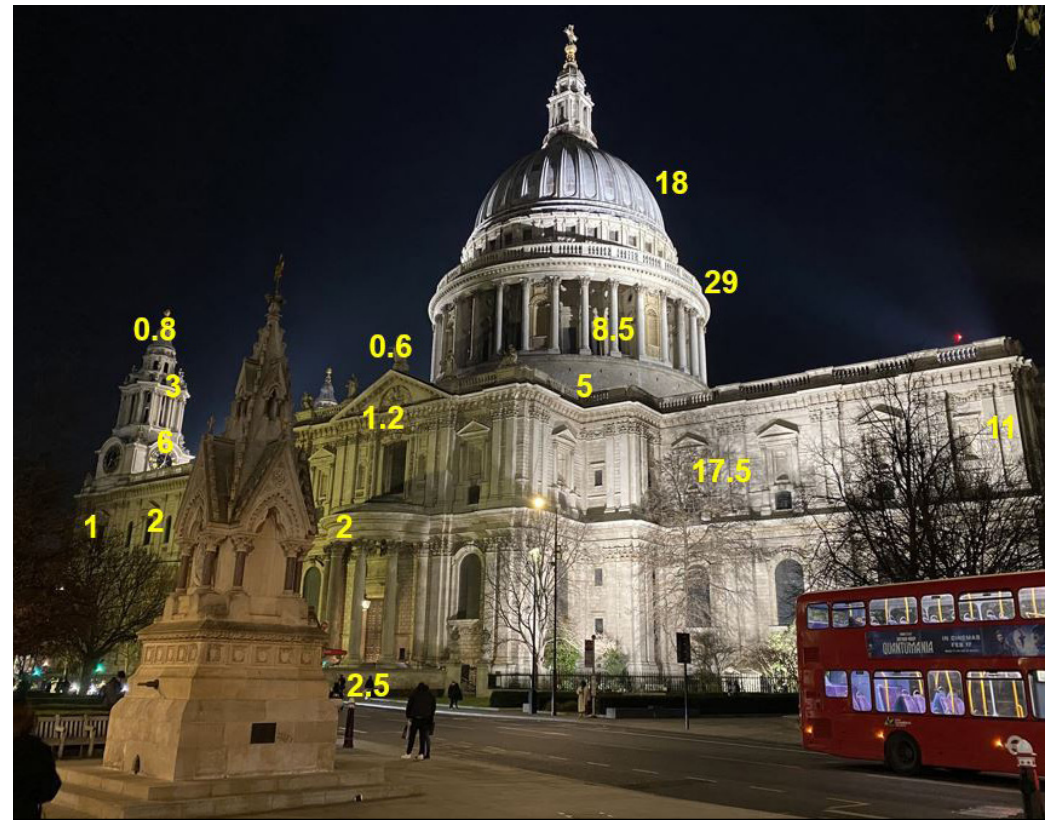
B. Modelling

Additional design development included fully modelling the lighting in software. This had not been carried out as part of the original Feasibility Study due to the absence of an available digital model of the cathedral at the time. The modelling allowed the initial schematic design produced to be completely re-assessed. Two key changes were made as a result:

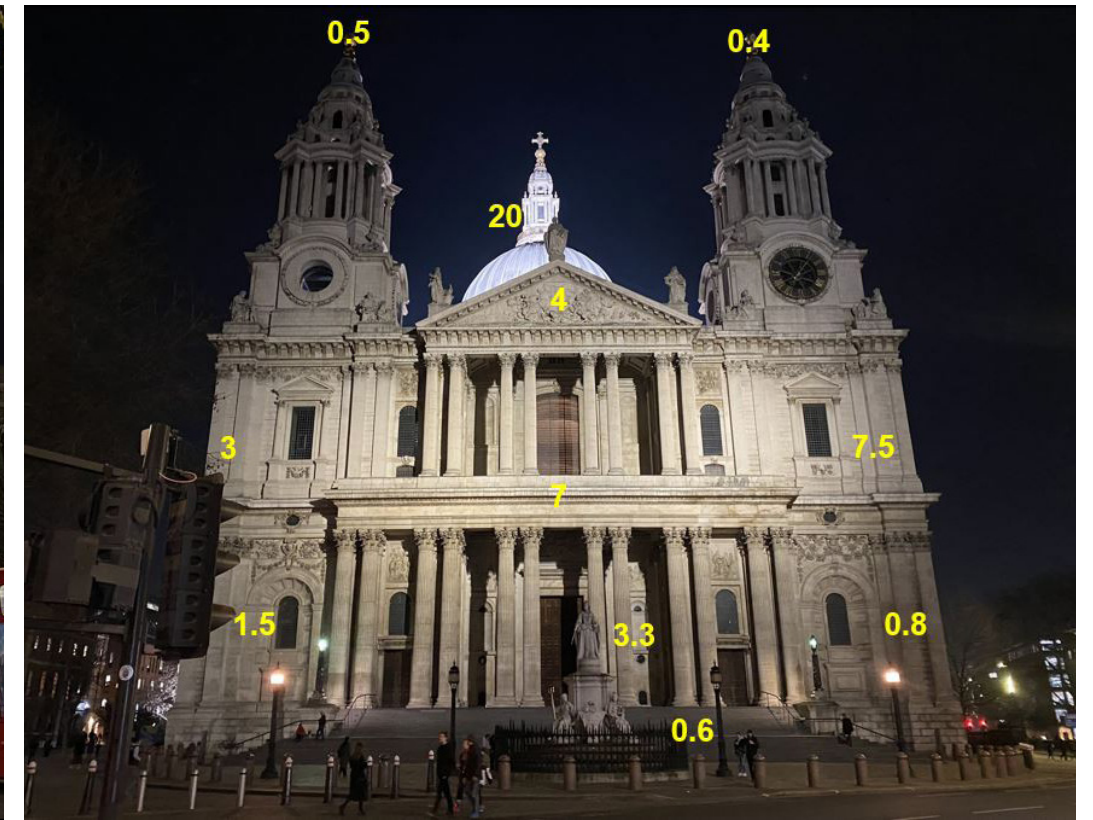
1. The Feasibility Study anticipated much of the lighting to the facades and porticos would be from luminaires mounted on street columns. The modelling and reappraisal led to the investigation into mounting lighting equipment on neighbouring buildings including 1-4 St. Paul's Churchyard, Juxon House and St. Paul's Choir School. This helped improve the distribution of the light onto key surfaces and improved the efficiency of the scheme.
2. Technological progress over the ensuing period showed that the lighting scheme could be achieved using less lighting equipment. This was due to the improvement of efficiency in LED luminaires. This in turn not only helped lower costs but also brought about significant reductions in energy use too.

C. Tests

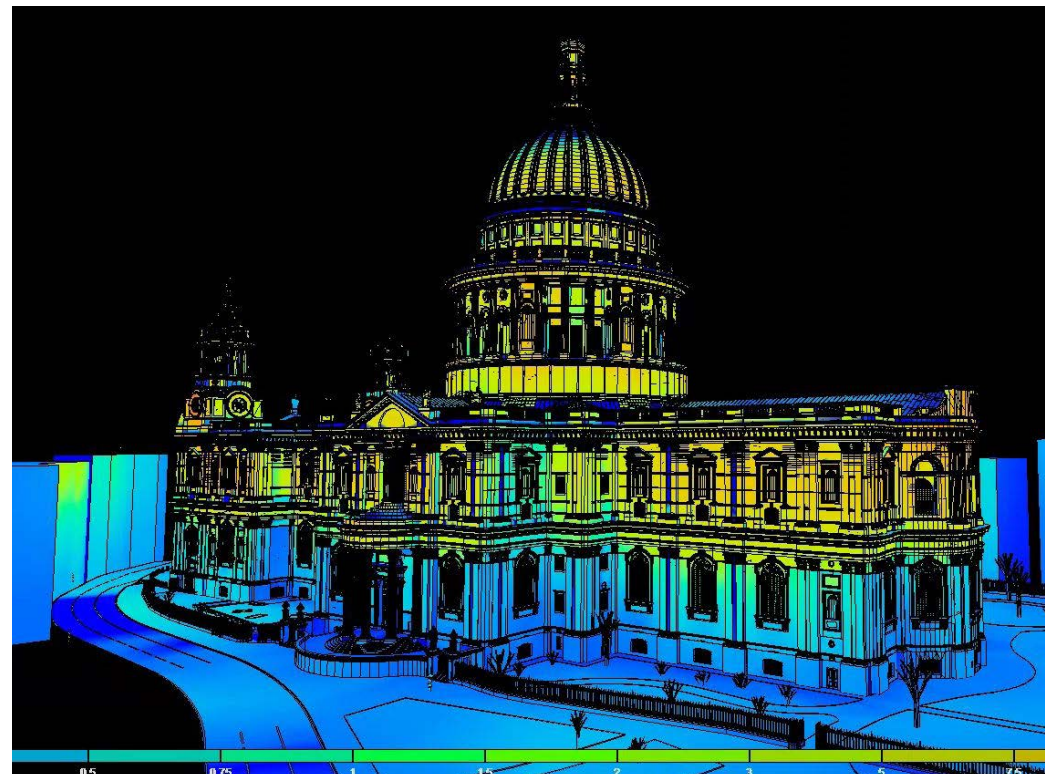
Another important aspect of the development of the 'Lighting Concept' were a series of 'lighting tests' that were carried out in October 2023, the report on which can be found in the appendix. The tests were largely carried out as initial 'proof of concept' and to help determine the quantities of equipment and their locations for the much larger Lighting Trial that was planned for January 2024.



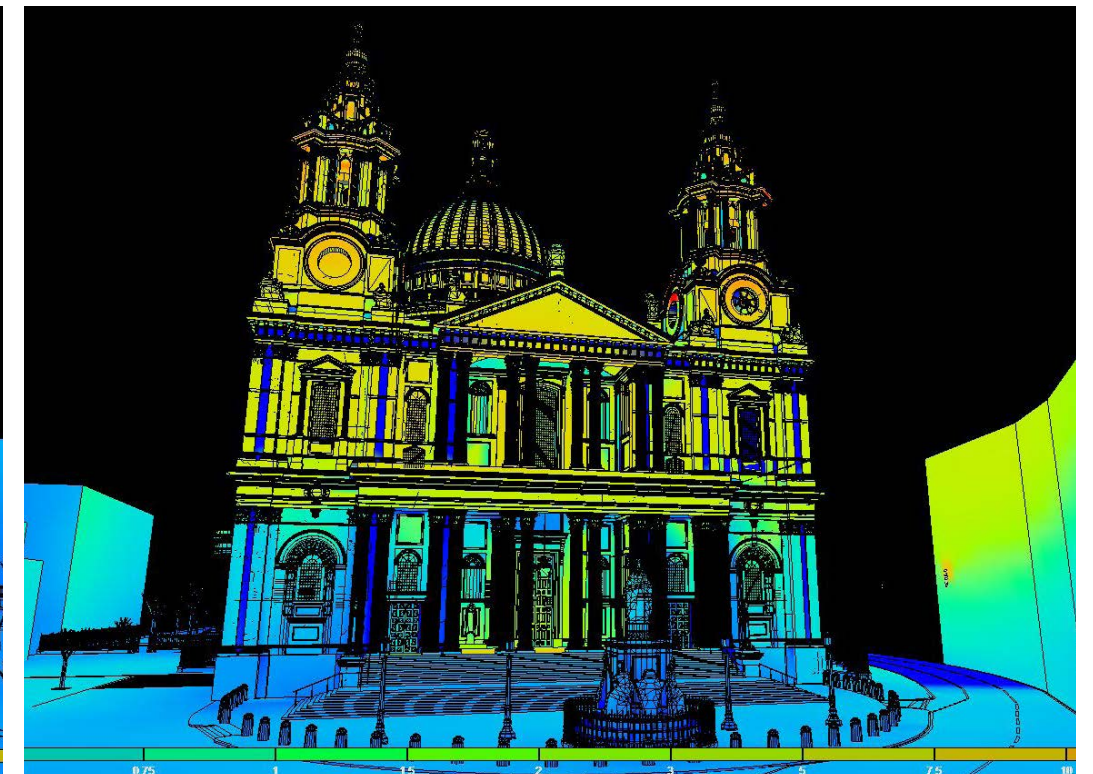
Luminance values on St Paul's Cathedral South.



Luminance values on St Paul's Cathedral West.



Lighting Calculation results on St Paul's Cathedral South.



Lighting Calculation results on St Paul's Cathedral South.

D. Visual Communication

The final piece of work carried out as part of the 'Lighting Concept' was the generation of a series of detailed Computer Graphic Images (CGIs) that clearly illustrated the design intent at a near-photographic level. Whilst the Feasibility Study had concluded with high quality 'renderings' of typical elevations to help communicate the key ideas it was felt that the production of CGIs would help improve communication of the proposed design and assist with both engagement and fund raising.



Artist impression of the South façade on early evening scene.



Artist impression of the South façade on mid evening scene.



Artist impression of the South façade on late evening scene.



Artist impression of the West front on early evening scene.



Artist impression of the West front on mid evening scene.



Artist impression of the West front on late evening scene.

7. Lighting Trial

7.1 Aims

One of the options when lighting an existing building is that it is possible to mock-up the lit effect ahead of carrying out the detailed design, let alone procuring and installing the equipment, bracketry, fixings, cabling, containment, etc. This allows ideas and techniques to be thoroughly tested and the optimum positions of lighting equipment to be assessed. In this way conducting a Lighting Trial, particularly to a building as important and historically sensitive as St. Paul's Cathedral, provides a good deal of helpful design information and helps de-risk the project and avoid mistakes.

There were five specific aims defined for the Lighting Trial:

- 1. Proof of concept:** Illuminating key parts of the building on a temporary basis, using equipment that is similar to that which might be employed as part of a permanent installation in the future, has enabled the potential success of the future scheme to be properly evaluated, both aesthetically and technically. This has included everything from the brightness and colour of the light to the play of shadows and the visibility of the scheme from different locations.
- 2. Lighting positions:** The trial helped identify the potential positions required for lighting equipment to deliver the agreed lighting concept, within the curtilage of the site and on the roofs of adjacent properties, some of which are owned by third parties. It also enabled an initial examination of the way the scheme might be controlled. In so doing it helped begin the process of evaluation of key issues such as impact on fabric, the complexity of installation for the light fittings, supporting bracketry, fixings, containment, and electrical infrastructure and the long-term requirements for access and maintenance.
- 3. Key issues:** The trial has helped address a wide variety of key issues such as urban and heritage considerations, ecclesiastical and secular consents and the sustainable balance of social and economic benefit with potential environmental impacts. It also began the process of measuring future energy use, waste, circularity, light pollution, impact on local residential amenity and potential harm to local ecology.
- 4. Approvals:** Both ecclesiastical and secular approvals are required for the proposed lighting scheme. Given the effect of the light can change the character, image, identity, and interpretation of the cathedral after dark it is essential that every aspect of the project is carefully considered. Also given that the scope engages with the whole of the external fabric the new lighting scheme may be regarded as a highly significant intervention in terms of its scope and impact. Another aim of the trial therefore was to inform the approvals process by regulators being able to witness examples of the lighting in person whilst photography provides a more permanent record that helps inform submissions.
- 5. Engagement:** Given the importance of the external lighting of St. Paul's Cathedral a large number of key stakeholders need to be consulted as to the direction of the design. This includes the City of London and St. Paul's Cathedral, together with various regulatory bodies such as the Cathedral Fabric Commission for England (CFCE) the Fabric Advisory Committee for St. Paul's Cathedral (FAC), Historic England (HE) and the City of London planners (CoL). Also, funders, and other interested parties. The Lighting Trial was seen as a critical means by which to clearly explain and demonstrate the lit effect and discuss and review a wide range of issues arising from the replacement of the scheme.



View of existing lighting from Point Hill, Blackheath.



View of lighting trial from Point Hill, Blackheath.

7.2 Scope

It was agreed that the Lighting Trial would only illuminate parts of the building rather than the whole structure. This was for reasons of complexity, cost and to reduce risk in terms of both impact on fabric and safety. It was also felt that illuminating key parts of the building only would be sufficient to meet the aims as outlined in 6.1 above.

The agreed scope was to highlight the following elements only as described. These reflect the 'layers' of light described earlier in this report:



West elevation from Ludgate Hill.



South elevation from St Peter's Hill.



East elevation from One New Change.

- A. Cross
- B. Lantern
- C. Golden Gallery
- D. Dome
- E. Stone Gallery
- F. Peristyle (outer)
- G. Peristyle (inner)
- H. Tambour
- I. Towers (outer)
- J. Towers (inner)
- K. West Facade
- L. West Portico (outer)
- M. West Portico (inner)
- N. South Portico
- O. East Facade



Lighting trial viewed from Bloomberg, early evening scene.



Lighting trial: West façade viewed from Ludgate Hill, early evening scene.



Lighting trial: West façade viewed from Ludgate Hill, mid evening scene.



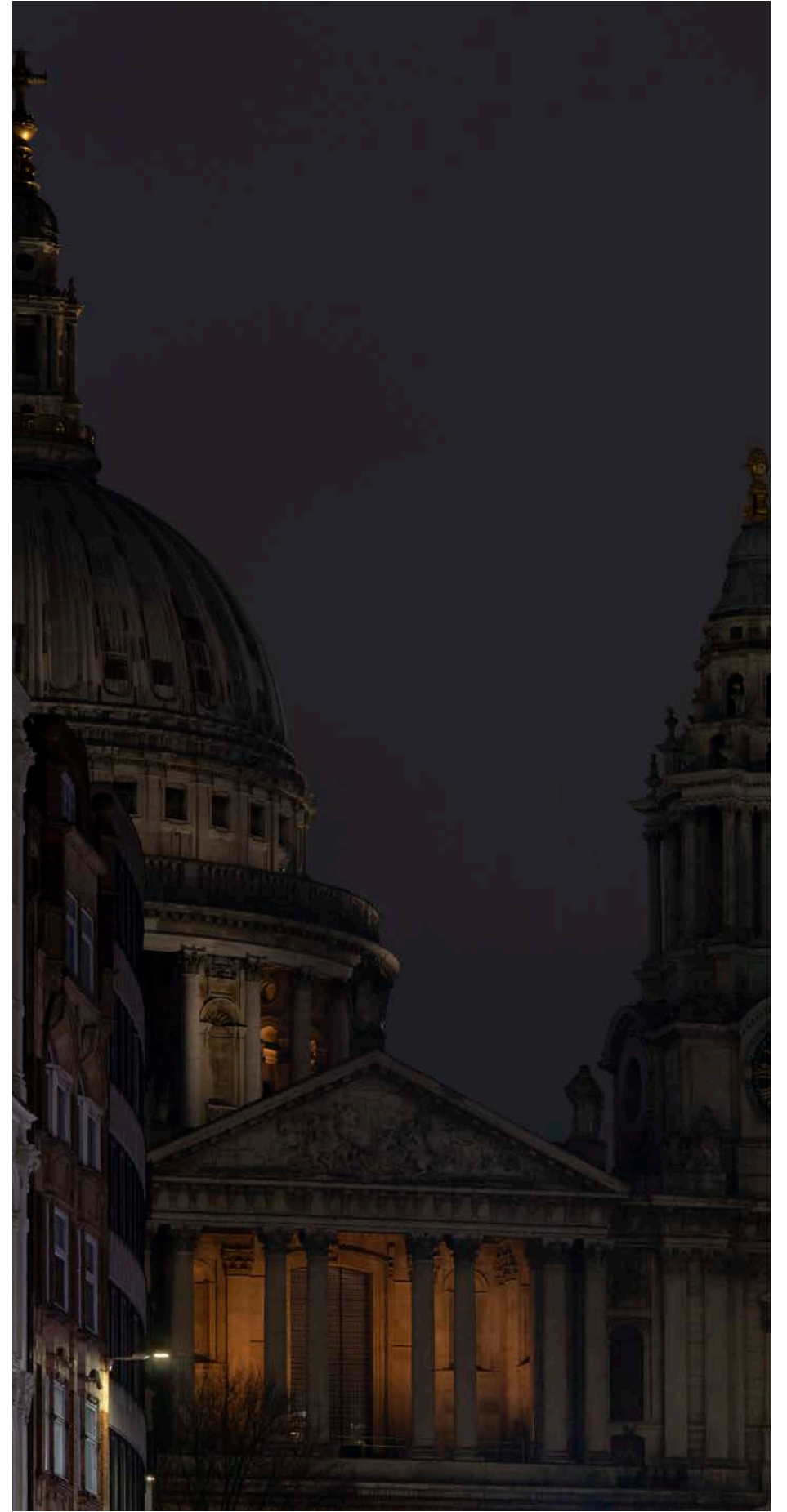
Lighting trial: West façade viewed from Ludgate Hill, late evening scene.



Lighting trial: West Portico viewed from Ludgate Hill, early evening scene.



Lighting trial: West Portico viewed from Ludgate Hill, mid evening scene.



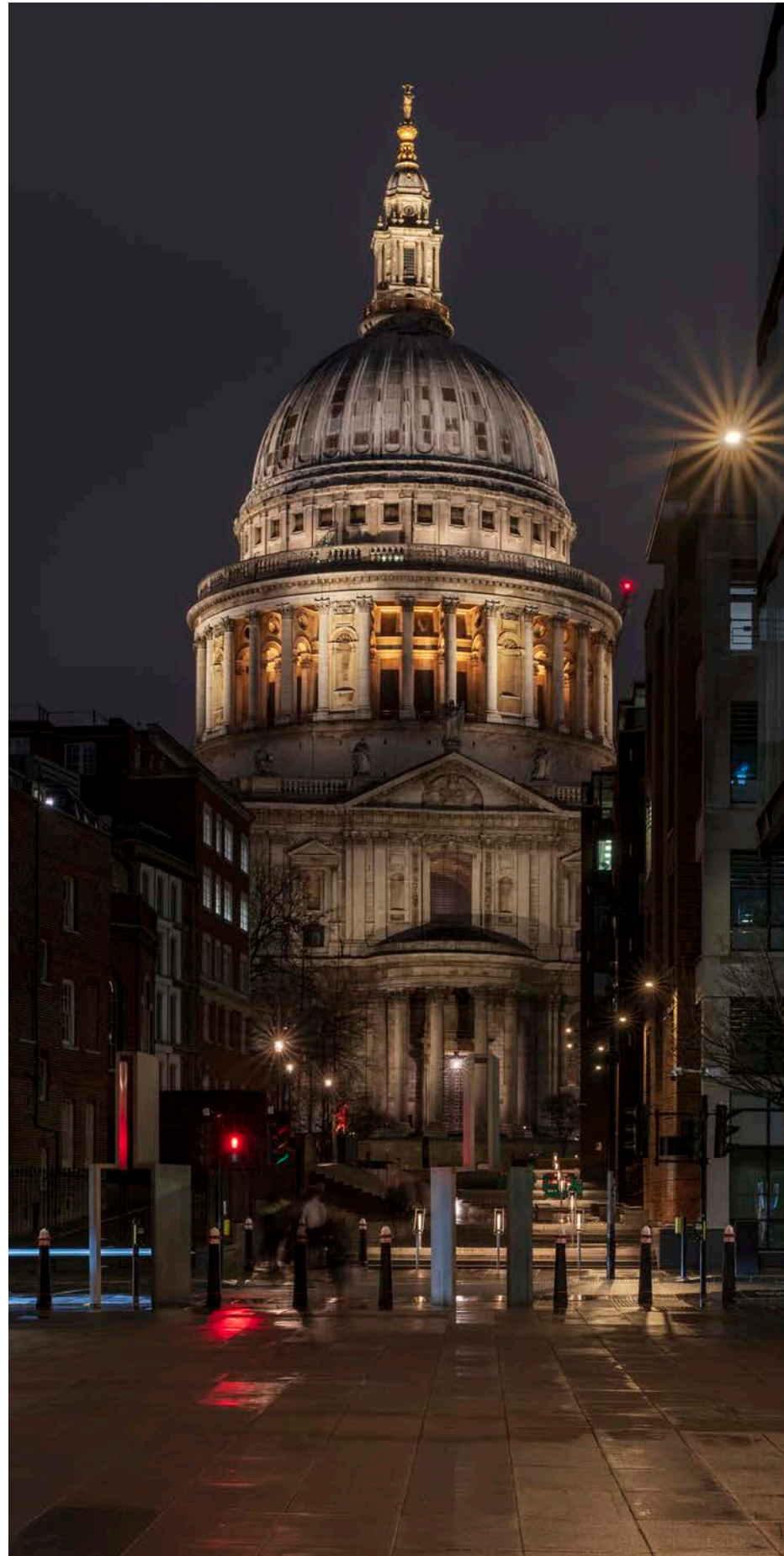
Lighting trial: West Portico viewed from Ludgate Hill, late evening scene.



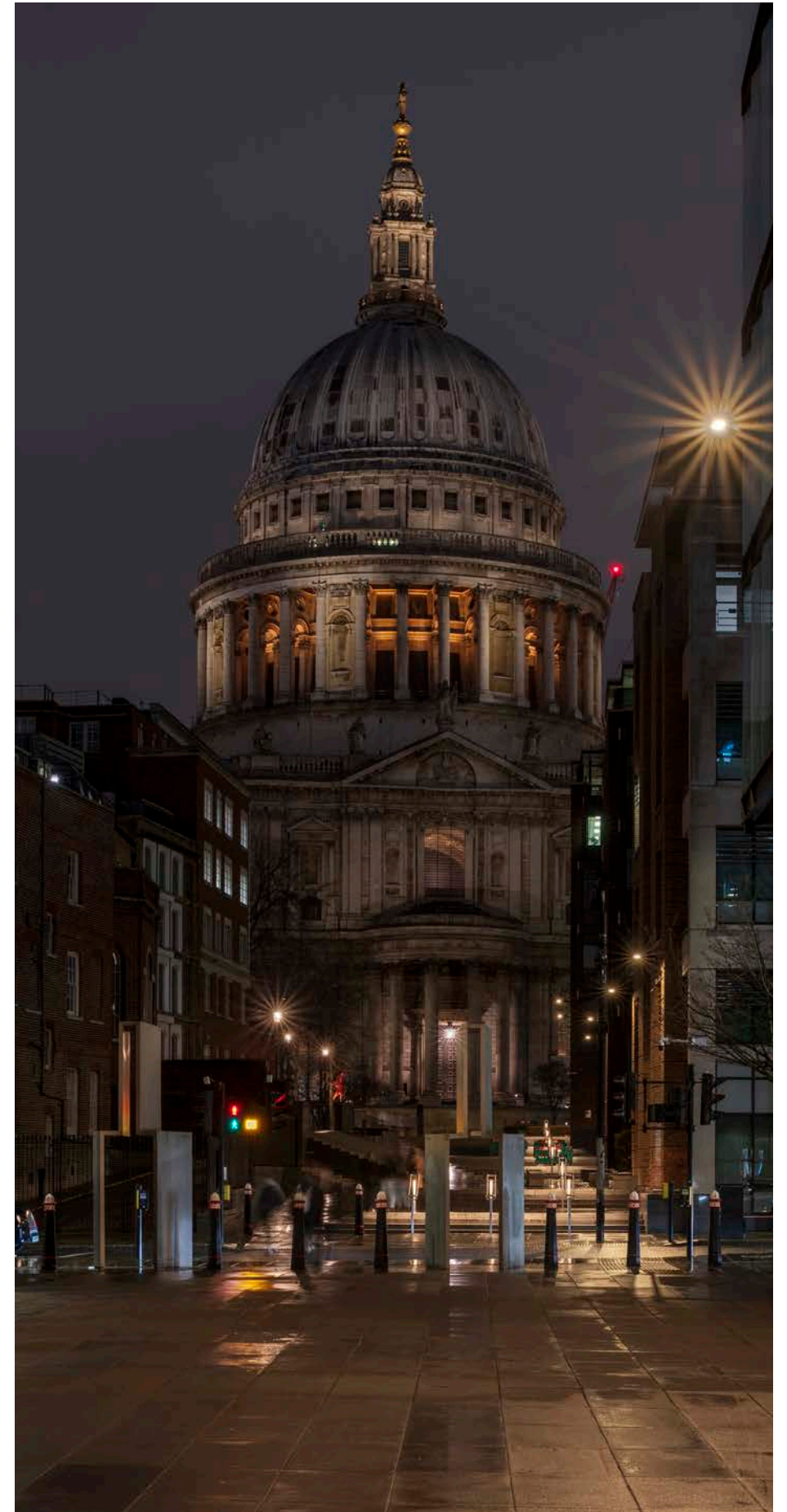
Lighting trial viewed from Peter's Hill, early evening scene.



Lighting trial viewed from Peter's Hill, early evening scene.



Lighting trial viewed from Peter's Hill, mid evening scene.



Lighting trial viewed from Peter's Hill, late evening scene.



Lighting trial viewed from Watling Street, early evening scene.



Lighting trial viewed from Watling Street, mid evening scene.



Lighting trial viewed from Watling Street, late evening scene.