WHOLE LIFE CARBON ASSESSMENT

330 Gray's Inn Road

Produced by XCO2 for 330 Gray's Inn Road Ltd.

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EXECUTIVE SUMMARY

This report provides a summary of the actions taken to date by the project team with regards to calculating whole life carbon for the proposed scheme. The scheme intends to reduce whole life carbon emissions as far as possible by implementing the principles outlined in the GLA's Whole Life Carbon Assessments guidance.

This report demonstrates that the scheme has a performance in line with the GLA's aspirational WLC benchmarks: A1-5 carbon has been calculated as 532 kg CO_2e / m^2 (compared with the GLA aspirational benchmark (offices) of 550-600 kg CO_2e / m^2).

SITE DESCRIPTION

The site is currently occupied by a number of buildings which make up the Royal National Throat, Nose and Ear (RNTNE) Hospital. The hospital comprises a number of departments occupying buildings of different scales and ages. The hospital closed in March 2020 when services began to transfer to the new Royal National ENT and Eastman Dental Hospitals on Huntley Street, London, WC1E 6DG. The building has only been fully vacated at the end of September 2020.

The proposed scheme consists of the redevelopment of the former Royal National Throat, Nose and Ear hospital. It comprises the retention of 330 Gray's Inn Road and a two storey extension for use as hotel; demolition of all other buildings; the erection of a part 13 part 9 storey building for use as a hotel including a café and restaurant; covered courtyard; external terraces; erection of a 7 storey building for use as office; erection of a 10 storey building for use as residential on Wicklow Street (office space at lower ground and basement floors); and erection of a 5 storey building for use as residential on Swinton Street; together with a gymnasium; new basement; rooftop and basement plant; servicing; cycle storage and facilities; refuse storage; landscaping and other ancillary and associated works.

METHODOLOGY

This report follows the GLA Whole Life Carbon Guidance and the methodology set out in RICS Whole life carbon assessment for the built environment. Whole life carbon has been calculated in accordance with BE EN 15978.

The project team have committed to carry out a review of the whole life carbon calculations at post completion stage and update this report if necessary.

Embodied carbon has been calculated using One Click LCA (an approved calculation software) and operational carbon has been calculated using IES VE building simulation package for Simplified Building Energy Models (SBEM) modelling and FSAP for SAP modelling calculations.

WHOLE LIFE CARBON

A detailed assessment of three scenarios was undertaken to measure and compare the whole life carbon of different development proposals against the proposed scheme.

SCENARIO 1 (THE PROPOSED SCHEME)

- Retain and refurbish the original hospital building;
- Demolish all other buildings on site (ensuring 95% of demolition materials are recycled);
- Erect two new buildings to accommodate offices, gym, hotel and residential uses.

SCENARIO 2

- Best practice refurbishment and extension of the Princess Louise Extension (1906) and Ward Building (1916-1929);
- Retain façade of Nurses' Building;
- Demolish all other buildings on site (ensuring 95% of demolition materials are recycled);
- Erect two new buildings to accommodate offices, gym, hotel and residential uses.

SCENARIO 2A

- This scenario considers the effects of an additional, second refurbishment of the Princess Louise Extension and Ward Building after 30 years of occupation[1];
- All other assumptions are the same as Scenario 2.

SCENARIO 3

- Light refurbishment of all existing buildings on site with no new extensions;
- Minor repairs to external fabric;
- New internal finishes;
- Make use of existing services and plant.

The project's structural engineer has confirmed that the floor loadings of the Nurses' Building (1.9 kN/m^2) would not be sufficient to carry the live loads required for office use (2.5 kN/m^2 and, for open plan offices, an allowance of 1.0 kN/m^2 for demountable partitions). Retention of this building is therefore not possible. Further information can be found in Appendix B

Whole life carbon associated with each of these scenarios is shown in Table 1.

These results demonstrate that whole life carbon would be lower by approximately 3% for the proposed scheme (Scenario 1) than for a best practice refurbishment, which retains as many of the positive contributing buildings as possible (Scenario 2).

Whole life carbon for the proposed scheme (Scenario 1) is significantly lower than an alternative that seeks to refurbish all building on site without making any major upgrades to plant (Scenario 3). This scenario was included for reference purposes only as it is not a viable solution. There are significant risks around accessibility, provision for disabled uses, fire risk and structural loadings.

The proposed scheme (Scenario 1) surpasses the GLA's aspirational benchmarks for lifecycle stages A1-5: 532 kg CO_2e / m^2, compared with the GLA aspirational benchmark (offices) of 550-600 kg CO_2e.

The proposed scheme offers multiple additional benefits aside from reduced whole life carbon as discussed in this report and associated reports submitted with the planning application.

Table 1: WLC (kg CO_2e / m^2) associated with each scenario

Whole life carbon	Scenario 1 (proposed scheme)	Scenario 2	Scenario 2a	Scenario 3
A1-A5: Upfront carbon	532	307	353[2]	163
B1-B7: Use stage carbon	1,902	2,218	2,218	5,362
C1-C4: End of life carbon	11	6	6	1
Total	**2,445**	**2,531**	**2,577**	**5,362**

[1] As the Princess Louise Extension and Ward Building are inherently less adaptable than a new build alternative an additional round of refurbishment may be required over the course of the development's lifecycle.
[2] Additional 46 kg CO_2e per m^2 added for major refurbishment works at some point over the building's 60 year lifecycle.

WHOLE LIFE CARBON PRINCIPLES

The project team have implemented the following principles to reduce whole life carbon (as calculated over 60 years):

REUSE & RETROFIT OF EXISTING BUILDINGS

The existing Royal National Throat, Nose and Ear Hospital building on Gray's Inn Road will be retained and refurbished, thereby reducing the scheme's embodied carbon and protecting a valuable historic building for future generations.

USE RECYCLED OR REPURPOSED MATERIALS

The scheme will make use of recycled materials to reduce embodied carbon; including reuse of ground granulated blast furnace slag within the concrete mix, recycled bricks within the external landscaping design, and crushed brick and concrete within the piling mat and as backfill.

MATERIAL SELECTION

Durable, long-lasting materials have been specified; all materials will be sourced sustainably; and material use will be optimised through efficient design principles.

MINIMISE OPERATIONAL ENERGY & WATER USE

The scheme will reduce carbon emissions associated with operational energy consumption via a fabric first approach (energy hierarchy) further details are contained within the Energy Statement.

Water use will be reduced through the specification of water efficient fittings and leak detection technology.

DISASSEMBLY & REUSE

The design has been optimised to facilitate recovery of major building materials at end of life.

BUILDING SHAPE & FORM

The shape and form of each building within the development has been designed to be as efficient as possible.

REGENERATIVE DESIGN

The scheme includes a green roof which will remove CO_2 from the atmosphere.

DESIGN FOR DURABILITY & FLEXIBILITY

The development has been designed to maximise building lifespans (beyond the standard 60 year study period) by providing durable finishes and adaptable spaces.

OPTIMISING OPERATIONAL AND EMBODIED CARBON

Throughout the design process the team have taken a holistic approach to reducing carbon emissions, considering both the embodied carbon associated with construction materials and the carbon associated with operational energy use.

BUILDING LIFE EXPECTANCY

In line with the whole life calculation guidance a building lifecycle of 60 years has been used. However, the design seeks to increase this period as far as possible, via the specification of adaptable, flexible spaces, and durable materials.

LOCAL SOURCING

The main contractor will be required to reduce carbon emissions associated with material transport, this will involve sourcing materials locally wherever possible.

MINIMISING WASTE

As noted in the Circular Economy Statement (submitted as part of this application) the project team have sought to minimise waste as far as possible; where waste generation is unavoidable, rigorous targets have been set for recycling of excavation, demolition and construction waste (at least 95%).

EFFICIENT FABRICATION

The development will make use of off-site modular construction; façade cladding panels and hotel bathroom pods will both be manufactured off-site thereby reducing energy consumption and waste, and facilitating disassembly and reuse.

LIGHTWEIGHT CONSTRUCTION

The structural design has been optimised as far as possible to make spaces flexible and adaptable for future change. Concrete is not lightweight but it will be sourced to provide an efficient structure. This has been considered alongside both material durability and the need to deliver a multi-storey development.

CIRCULAR ECONOMY

The project has utilised and incorporated circular economy principles; these are outlined in more detail in the accompanying Circular Economy Statement.

CONCLUSION

The proposed scheme (Scenario 1) will result in lower whole life carbon emissions than an alternative proposal that seeks to retain the Princess Louise Extension and the Ward Building (Scenario 2).

The proposed scheme (Scenario 1) is preferable to the alternatives as it is able to deliver more flexible spaces and also provides better working conditions for building users, in terms of air quality, daylight and thermal comfort.

Furthermore, there are potential issues around construction methodology for Scenario 2, in particular around the installation of new columns within an existing building and the need for additional piles.

The Heritage Statement (submitted as part of this application) also concluded that, in their professional opinion, the Princess Louise Extension and the Ward Building were not of architectural interest and that their positive contribution to the conservation area could be made as well or better by a replacement building.

In consideration of the potential retention of the buildings on site, additional implications and challenges were identified to deem those alternative proposals as unviable:

- The proposed new buildings can provide a much better internal environment for future users with enhanced thermal, daylight, air quality and noise performance, in comparison to Scenarios 2 and 3 where, a change of room layouts, window configurations and application of air and noise pollution mitigation measures will be challenging;
- Scenario 1 is anticipated to enable a more flexible and long-lasting development that can adapt to future changes in building uses;
- Accessibility measures (stairs and lifts) can be more readily integrated within the architecture of the new buildings as part of the proposed scheme (Scenario 1);
- There are potential issues with thermal bridging and interstitial condensation with upgrade of thermal elements[3] of existing buildings through internal insulation, leading to potential degradation of the building structure and fabric.
- The integration of building services on existing buildings to meet current energy and environmental expectations is complex to achieve in existing buildings likely requiring additional structural strengthening and increase costs.
- Scenario 2 would incur additional cost, risk and complexity over scenario 1.
- The quality of the spaces created through implementation of Scenario 1 will be far superior to those offered by Scenarios 2 and 3. It is not considered commercially viable for the applicant to retain the amount of buildings presented under Scenarios 2 and 3 as the quality of the buildings is not in line with their quality expectations and the aspiration to bring forward a set of exemplar buildings that will enhance the local economy and the built environment.

This report therefore recommends implementing Scenario 1: retain, refurbish and extend the original hospital building; demolish all other buildings (reclaiming, recovering and recycling demolition materials); and construct new buildings to accommodate residential, office, gym and hotel uses.

[3] It was not possible to fully investigate the existing buildings' fabric by carrying out an intrusive survey as the buildings were in use until very recently.

The preferred Scenario 1 is expected to perform notably better than the GLA WLC benchmarks and therefore the development is in line with GLA policy on WLC aspects.

For a holistic appreciation of the benefits of the proposed scheme, this report should be read in conjunction with the Design and Access Statement, Heritage Assessment and other reports submitted as part of the planning application.

INTRODUCTION

This chapter presents the description of the site and of the development proposal, relevant policy requirement, and an overview of the key terminology used in this report.

SITE & PROPOSAL

The site is bound to the north in part by the UCL Ear Institute and in part by Wicklow Street and railway cuttings to the east; Swinton Street to the south and Gray's Inn Road runs along the site's western boundary. The site sits towards the centre of the growing Knowledge Quarter within the eastern section of the area.

The site is immediately adjoined by Swinton House and the Water Rats public house to the south on Gray's Inn Road, and to the north by UCL Centre for Auditory Research and 334-336 Gray's Inn Road to north.

Within the immediate vicinity the prevailing development is characterised by a mix of commercial, residential and hotel uses.

The site is currently occupied by a number of buildings which make up the Royal National Throat, Nose and Ear (RNTNE) Hospital. The hospital comprises a number of departments occupying buildings of different scales and ages. The hospital closed in March 2020 when services began to transfer to the new Royal National ENT and Eastman Dental Hospitals on Huntley Street, London, WC1E 6DG. The building has only been fully vacated at the end of September 2020.

The proposed redevelopment of the former Royal National Throat, Nose and Ear hospital, comprises the retention of 330 Gray's Inn Road and a two storey extension for use as a hotel, demolition of all other buildings, the erection of a part 13 part 9 storey building plus upper and lower ground floors for use as a hotel including a café and restaurant; covered courtyard; external terraces; erection of a 7 storey building plus upper and lower ground floors for use as office together with terraces; erection of a 10 storey building plus upper and lower ground floors for use as residential on Wicklow Street and office space at lower ground and basement floors; erection of a 5 storey building plus upper and lower ground floors for use as residential on Swinton Street and associated residential amenity space; together with a gymnasium; new basement; rooftop and basement plant; servicing; cycle storage and facilities; refuse storage; landscaping and other ancillary and associated works.

REGIONAL POLICY FRAMEWORK

As shown below section F of Policy SI 2[4] of the Intend to Publish London Plan requires all referable developments to submit a Whole Life Carbon (WLC) assessment.

> *Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.*

As buildings become more energy efficient, operational carbon emissions[5] will make up a smaller proportion of a development's whole life-cycle carbon emissions. It is therefore becoming increasingly important to calculate and reduce carbon emissions associated with other aspects of a development's life cycle; namely, embodied carbon emissions and unregulated emissions (all operational energy uses not

[4] Policy SI 2 Minimising greenhouse gas emissions (Intend to Publish London Plan, December 2019).
[5] Throughout this report the term 'carbon emissions' is taken to mean carbon dioxide equivalent emissions.

covered by Building Regulations, for example cooking and small power).

LOCAL POLICY FRAMEWORK

Camden Local Plan Policy CC1 *Climate change mitigation* requires:

> *... all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and ... all developments to optimise resource efficiency.*
>
> *As part of the assessment of resource efficiency, all developments involving five or more dwellings and/or more than 500 sqm gross internal floor space are encouraged to assess the embodied carbon emissions associated with the development within the energy and sustainability statement.*

This report addresses both requirements. It includes an assessment of the embodied carbon of the proposed scheme as well as assessment of the whole life carbon emissions associated with retaining, refurbishing and extending the four buildings on site that have been identified as 'positive contributors' within the historic buildings assessment[6].

PROCESS

As outlined in the WLC Assessments guidance applicants are required to take action at the following stages:

- Pre-application
- Stage 1 submission
- Post-construction

This report summarises the actions taken at pre-application stage and stage 1 submission (detailed application stage). This report should be read in conjunction with the WLC Assessment Template, which has been submitted as part of this planning application.

The applicant recognises that the WLC calculations presented in this report will need to be revisited and if necessary, amended at post-construction stage (upon commencement of RIBA Stage 6).

KEY TERMINOLOGY

PRODUCT STAGE EMISSIONS / CARBON INTENSITY

Carbon dioxide equivalent emissions associated with product/material manufacture, including extraction of raw materials, transport of raw materials to manufacturing facilities, and manufacturing processes.

Product stage emissions are typically calculated and presented in Environmental Product Declarations (EPDs), see Appendix B for further information.

UPFRONT CARBON

Carbon dioxide equivalent emissions resulting from product stage, transport of materials to the construction site and construction site activities.

USE STAGE CARBON

Carbon dioxide equivalent emissions associated with building use (including leakage of refrigerants), maintenance, repair, replacement and refurbishment.

EMBODIED CARBON

A combination of upfront carbon, use stage carbon and end of life stage carbon, which consists of building demolition, transport of demolition waste to processing facilities, waste processing activities and disposal.

[6] *Feasibility Studies with Retained Existing Buildings* (March 2020)

OPERATIONAL CARBON

Carbon dioxide equivalent emissions resulting from operational energy use.

WHOLE LIFE CARBON

Carbon dioxide equivalent emissions associated with all lifecycle stages, with the exception of operational water use and Module D (benefits and loads beyond the system boundary).

It is standard practice to communicate and assess module D separately due to the inherent uncertainty around what might happen to materials following disposal stage. Any benefits from this stage cannot be included within a formal life cycle assessment. However, using recycled/repurposed materials will reduce total embodied carbon (by reducing emissions associated with stage A1).

METHODOLOGY

This chapter presents the methodology followed for calculating whole life carbon emissions, including building life-cycle stages, building elements, materials and products, and software tools. The chapter also covers the approach taken to future grid decarbonisation.

The WLC assessment presented in this report has been carried out in accordance with a nationally recognised assessment methodology (BS EN 15978) and the RICS Processional Statement[7]. The study reference period is 60 years.

LIFE-CYCLE MODULES

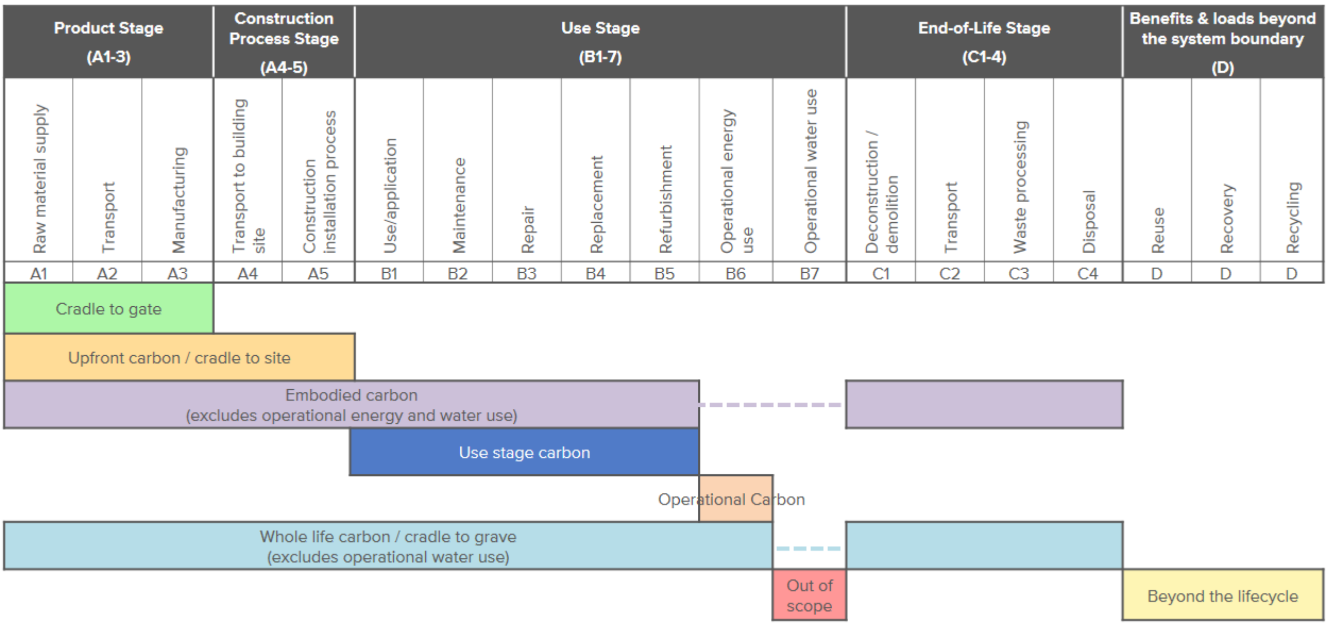


Figure 1: Lifecycle stages (modules) according to EN 15978

[7] Whole life carbon assessment for the built environment (RICS, November 2017)

As shown in Figure 1 the WLC assessment includes emissions associated with:

- A1-A5: Product sourcing and construction stage (cradle to site)
- B1-B7: Use stage
- C1-C4: End of life stage

As per the RICS methodology Module D (benefits and loads beyond the system boundary) are presented separately.

Carbon emissions associated with operational energy are presented in more detail in the accompanying Energy Strategy. As per current GLA guidance the carbon performance has been modelled using SAP10 carbon factors.

End of life strategies (modules C and D) are presented in more detail in the accompanying Circular Economy Statement.

BUILDING ELEMENTS

The WLC assessment covers all building elements listed in Table 2 (where applicable). Floor areas (GIA) have been measured in accordance with RICS Property Measurement standards.

Material quantities have been provided by the Quantity Surveyor (Turner and Townsend). A minimum of at least 95% of the cost allocated to each building element category has been accounted for.

Table 2: Building Elements (RICS)

Group	Building Element	Applicable
0. Demolition & facilitating works	0.1. Toxic / hazardous / contaminated material treatment	No
	0.2. Major demolition works	Yes
	0.3. & 0.5. Temporary / enabling works	Yes
	0.4. Specialist groundworks	Yes
1. Sub-structure	1.1. Substructure	Yes
2. Super-structure	2.1. Frame	Yes
	2.2. Upper floors incl. balconies	Yes
	2.3. Roof	Yes
	2.4. Stairs & ramps	Yes
	2.5. External walls	Yes
	2.6. Windows & external doors	Yes
	2.7. Internal walls & partitions	Yes
	2.8 Internal doors	Yes
3 Finishes	3.1 Wall finishes	Yes
	3.2 Floor finishes	Yes
	3.3 Ceiling finishes	Yes
4 Fittings, furnishings & equipment	4.1 Fittings, furnishings & equipment	No
5 Building services / MEP	5.1–5.14 Services	Yes
6 Prefabricated Buildings and Building Units	6.1 Prefabricated buildings and building unit	Yes
7 Work to existing building	7.1 Minor demolition and alteration works	Yes

Table continues overleaf.

Group	Building Element	Applicable
8 External works	8.1 Site preparation works	Yes
	8.2 Roads, paths, pavings and surfacings	Yes
	8.3 Soft landscaping, planting and irrigation systems	Yes
	8.4 Fencing, railings and walls	No
	8.5 External fixtures	No
	8.6 External drainage	Yes
	8.7 External services	No
	8.8 Minor building works and ancillary buildings	No

MATERIALS & PRODUCTS

WLC calculations have been carried out using:

- Type III environmental declarations (EPDs and equivalent) and datasets in accordance with BS EN 15804; and,
- EPDs and datasets in accordance with ISO 14025 and ISO 14040/44.

Sequestered (biogenic) carbon, in particular form the use of timber products, has been reported separately for A1-A3 stages.

Embodied carbon is difficult to calculate for many MEP systems due to a lack of available data. Where manufacturer specific data is not available figures for embodied carbon have been taken from the closest matching system within the One Click LCA database. In cases where there are no comparable systems embodied carbon has been calculated based on the key materials used to manufacture the equipment, by weight.

SOFTWARE TOOLS

All calculations have been carried out in accordance with EN 15978 using One Click LCA.

Operational carbon has been calculated using IES VE building simulation package for Simplified Building Energy Models (SBEM) modelling of the commercial units and Stroma FSAP for the residential part of the development as per current Building Regulations.

GRID DECARBONISATION

As required by the GLA two sets of WLC emissions figures have been presented: one based on the current status of the electricity grid (SAP 10 carbon factors); and the other based on the expected decarbonisation of the electricity grid over the lifetime of the development (National Grid's Figure Energy Scenario: slow progression).

The first of these scenarios (current status of the electricity grid) has been used to form the basis of the design decisions and is therefore maintained throughout the assessment.

ASSUMPTIONS

Building element	Assumptions			
	Maintenance	**Repair**	**Replacement**	**End of life**
Substructure	No maintenance required.	No repair required.	No replacement required: foundations and lowest floor are designed to exceed the 60 year calculation period.	Foundations either reused in-situ or crushed and reused as aggregate.
Structure	No maintenance required.	No repair required.	No replacement required: structure has been designed to exceed the 60 year calculation period.	Structure either reused in-situ or crushed and reused as aggregate.
Envelope	Annual inspection of building fabric; window cleaning; gutter/roof cleaning; annual maintenance of green roof.	External building fabric has been specified to be durable and require no annual repair. Windows may require ad-hoc repair if damaged – this will be reviewed at RIBA Stage 4 once specific products have been specified.	No replacement required: external building fabric / envelope has been designed to exceed the 60 year calculation period.	Insulation will be recovered and returned to the manufacturer for specialist recycling; green roof will be recovered and reused; cladding panels are demountable and will be recovered at end of life; glazing will be recovered and either reused or returned to the manufacturer for recycling.
MEP services	Annual servicing of all plant; change filters; maintain light fixtures; maintain water fixtures.	No repair assumed at this stage. This will be investigated further at RIBA Stage 4 once specific equipment has been specified.	25 year service life assumed for all major plant (AHUs, ASHPs, FCUs). If well maintained, the service life of major plant will be higher than 25 years. The building has been designed to facilitate the replacement of all MEP equipment.	All major plant will either be refurbished at end of life and reused or sent for specialist recycling.
Internal finishes	Daily/weekly maintenance & cleaning.	Annual repair assumed for internal finishes (1-2% annual repair rate).	10-20 year service assumed for internal finishes.	All major plant will either be refurbished at end of life and reused or sent for specialist recycling.

MATERIAL QUANTITIES

The quantities of material associated with each building element are outlined in Table 3.

Table 3: Building elements mass (kg)

Category	Mass (kg)
1.1.4. Basement excavation (fuel use only)	60,545,760
1.1.3. Lowest floor construction	19,833,245
5. Services	18,861,426
2.2.1. Floors	15,237,085
1.1.1. Standard foundations	13,533,000
2.1.4. Concrete frames	11,275,000
8.1.2. Preparatory groundworks	7,685,760
1.1.5. Basement retaining walls	4,574,400
2.5.1. External enclosing walls above ground floor level	4,553,877
Unclassified/other	5,865,891

WHOLE LIFE CARBON ANALYSIS

This section presents the whole life carbon strategy and actions discussed and implemented by the design team to reduce whole life carbon emissions associated with the proposed development at 330 Gray's Inn Road. This information is also presented in the GLA's Whole Life Carbon Assessment Template, which is submitted as part of this planning application.

REUSE & RETROFIT OF EXISTING BUILDINGS

Until March 2020 the site was occupied by the Royal National Throat, Nose and Ear (RNTNE) Hospital (Formal VP did not take place until 1st October 2020). As shown in Figure 2, the site includes a number of buildings and structures:

1. Original hospital building (1875-1878)
2. Hospital extension (1906)
3. Ward building (1916-1929)
4. Entrance screen wall (1906-2929)
5. Nurses' home (1935)
6. 1st floor structure above screen wall
7. Single storey metal extension
8. Audiology centre

The hospital site was developed in an ad-hoc manner over the last 145 years. Consequently, many of the existing structures are not fit for purpose.

The original hospital building was constructed in 1875 and expanded in 1878. A further extension was completed in 1906 and a new ward building added in 1916. On-site accommodation for nurses was provided in 1935. Throughout the 1960s and 80s the site was further developed by the NHS with a series of infill buildings – as discussed below these have been identified as being of low quality and limited value.

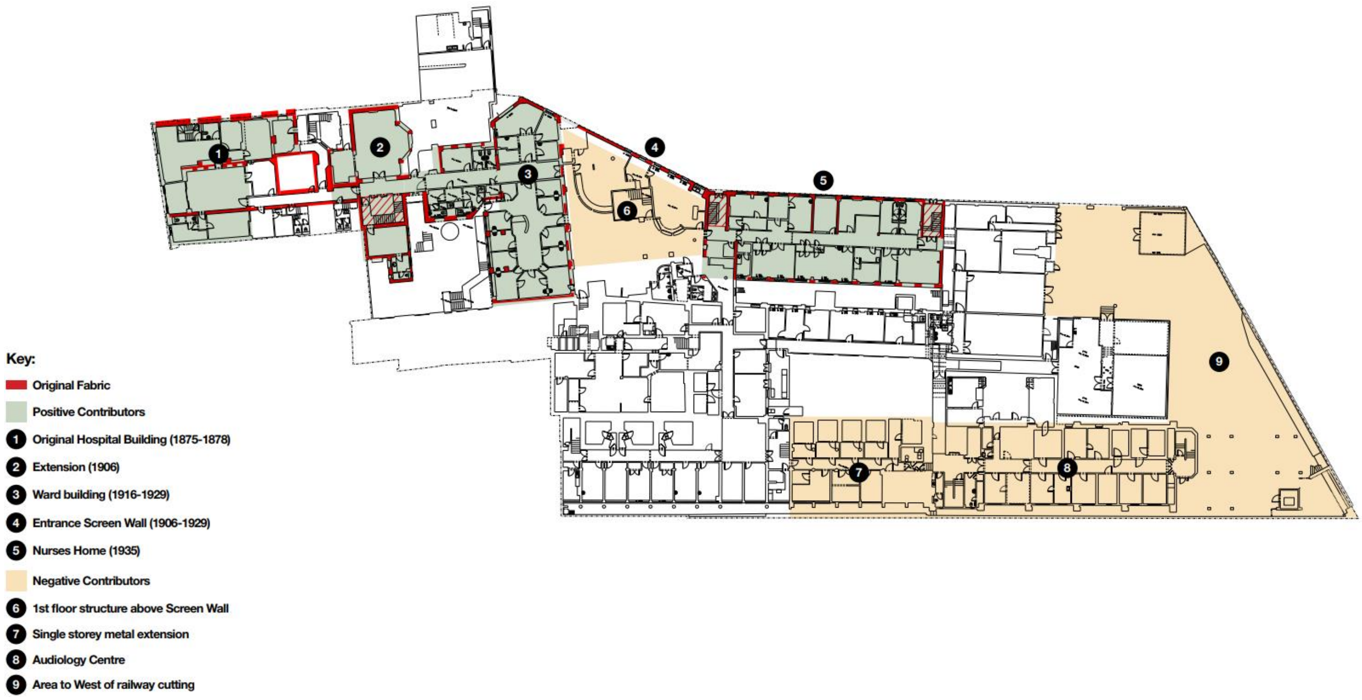


Figure 2: Existing buildings on site (Feasibility Studies with Retained Existing Buildings, March 2020)

Additional information on the development of the site can be found in the Heritage Assessment, carried out by Peter Stewart Consultancy and submitted as part of this planning application. It is recommended that the Whole Life Carbon Assessment is read in conjunction with this document (and other key planning documents, including the Design and Access Statement) all of which provide more information and context about the existing buildings on site.

PRELIMINARY STUDIES

Early in the design process the project team held several team workshops and engaged with the London Borough of Camden to discuss the conditions of the existing buildings on site and refurbishment viability.

None of the existing buildings are listed, although the site is located within sub-area 4 of the Kings Cross Conservation area. A Heritage Assessment was carried out by Peter Stewart Consultancy and is submitted as part of this planning application. This document includes an analysis of the King's Cross Conservation Area and identifies the following buildings as having a positive influence on the conservation area (these buildings are identified in the remainder of this report as 'positive contributors'):

- The Royal National Throat, Nose and Ear Hospital (original building)
- Princess Louise Extension (1906)
- Ward Building (1916-1929)
- Entrance Screen Wall
- Nurses' Building (1935)

However, the Assessment concluded that other than the original Royal National Throat, Noise and Ear Hospital (RNTNE) there was little merit in retaining any of the other existing buildings:

> *Other buildings prominent from the street that are identified as positive by the Council, the nurses' home (5) and the main hospital building (3)* [Ward Building]*, are not of architectural interest in our view, and any positive contribution to the conservation area could be made as well or better by a replacement building. Building 3 in particular is unremarkable in its detail and much altered today. Buildings 2* [Princess Louise Extension] *and 3, while remnants from the early phases of the hospital, have been compromised in themselves and their retention would compromise the redevelopment of the Site to a degree that is disproportionate in respect of their very limited interest.* [8]

The remaining buildings on site have been identified as either neutral (i.e. of no particular architectural merit) or negative contributors (i.e. having a negative effect on the conservation areas' character and appearance).

In many cases these buildings are poorly constructed and unsuitable for refurbishment and extension. It is highly likely they would suffer from poor thermal performance, potentially overheating in summer and unable to retain heat in winter. Attempts to insulate these buildings to modern standards would be costly and likely to exacerbate interstitial condensation risk. It is unlikely the structures of these buildings would be able to accommodate vertical extension (or office/hotel use) without significant strengthening and underpinning. As stated in the Heritage Assessment:

> *Considered as group of buildings rather than as an institution, the buildings do not add up to more than the sum of the parts in their contribution to the character and appearance of the conservation area.*[8]

There are also significant issues with permeability through the site. It is unlikely that all buildings could be retained and refurbished while maintaining safe, accessible walking routes. Therefore, in order to for the redevelopment to be viable, in all scenarios buildings will need to be removed. This is a conclusion shared by the Heritage Assessment, which argues that a new development has the potential to be 'arranged with regard to achieving high quality external routes and spaces'.

The project team undertook different technical reviews of the benefits of retaining varying proportions of the positive contributors on site. Four alternative designs

[8] Heritage Assessment, Peter Stewart Consultancy (2019)

with varying levels of retention were explored considering architecture, structure, building services, sustainability, and viability. Furthermore, a detailed analysis of the energy and carbon performance of the current buildings comparing to an upgrade fabric performance or new build was undertaken. These studies were issued to the LB Camden officers in March 2020.

In summary, the initial studies indicated that the most suitable and beneficial route forward would be to retain the most historic building on site (original hospital building on Gray's Inn Road) and demolish all other buildings. This approach offered the greatest overall benefit to the local area, community, and building users, with longevity and flexibility in the future.

During the design process, the initial approaches were revisited and tested in more robust detail with a whole life carbon assessment of three design scenarios. The results of these further analysis can be found in the next section.

ESTIMATED WLC EMISSIONS

PROPOSED SCENARIOS

In order to determine the most appropriate strategy for development, three scenarios have been considered.

1. Proposed development: retain and refurbish the original Royal National Throat, Nose and Ear Hospital; demolish all other buildings on site and rebuild (Figure 3)
2. Retain, refurbish and extend the four positive contributors - Original hospital, Extension and Ward building and Nurse's building façade (Figure 4)
3. Light refurbishment of all existing buildings on site (no extension or new build).

Each of these scenarios has been assessed in terms of:

- Carbon dioxide equivalent emissions per square metre of GIA over 60 years (whole life carbon)
- Health and wellbeing of occupants
- Adaptability and flexibility of space

In all scenarios the original hospital building is retained. This building is described in the Heritage Statement as making a 'noticeable positive contribution to the conservation area'.

Scenarios 1 and 2 have been designed by the architect to achieve a comparable gross internal floor area (GIA), which determines the commercial viability of the scheme.

Scenario 3 has been developed to capture the whole life carbon performance of a whole site refurbished scheme. It should be noted that this scenario delivers significantly less GIA and is unable to provide flexible, adaptable and accessible spaces. It has been considered for comparison purposes only.

Figure 3: Scenario 1 – Proposed development (retain and refurbish the original RNTNE Hospital; demolish all other buildings on site and rebuild)

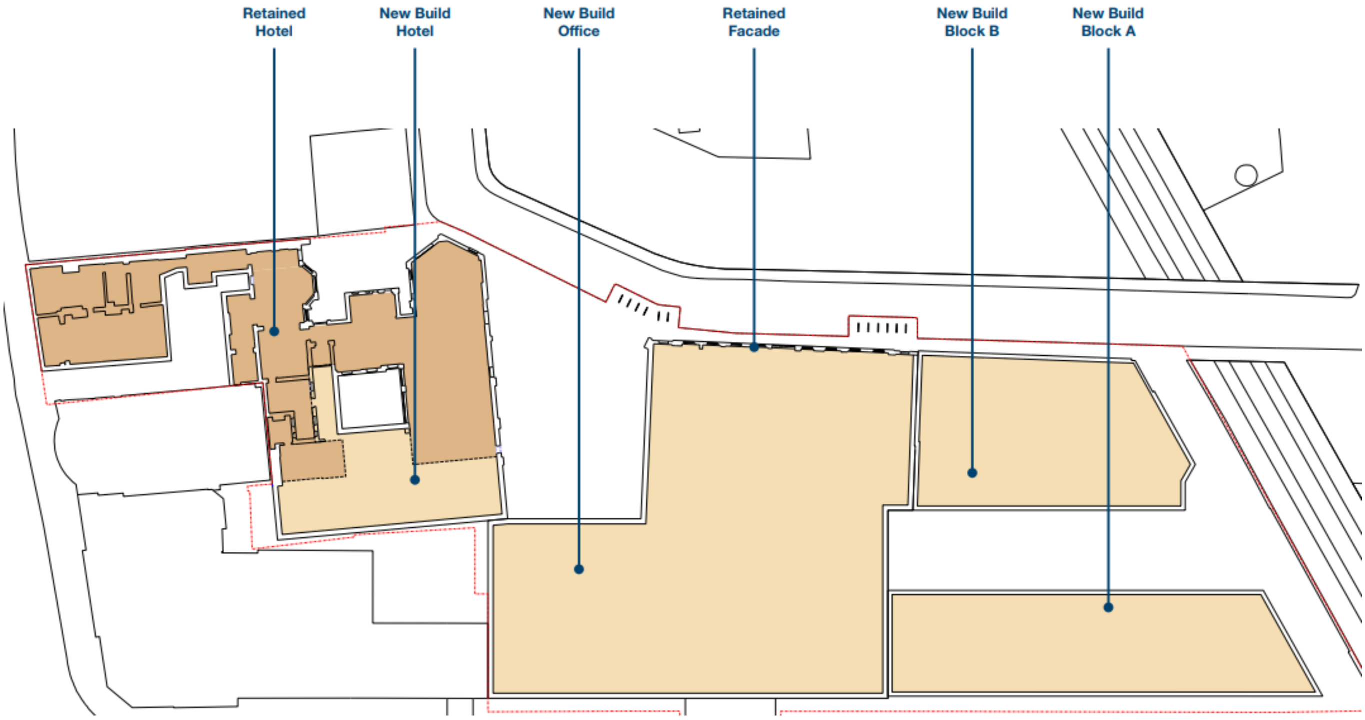


Figure 4: Scenario 2 (retain, refurbish and extend the four positive contributors)

SCENARIO 1 (THE PROPOSED SCHEME)

Scenario 1 comprises the scheme being put forward in this planning application; it includes the following works and assumptions:

- Refurbish original hospital building (330 Gray's Inn Road) including vertical storey extension – for use as a hotel.
- Demolition of all other buildings.
- Erection of a part 13 and part 9 storey building (plus upper and lower ground floors) for use as a hotel, including a café and restaurant; covered courtyard; and external terraces.
- Erection of a 7 storey building (plus upper and lower ground floors) for use as office, together with terraces.
- Erection of a 10 storey building (plus upper and lower ground floors) for use as residential on Wicklow Street; and office space at lower ground and basement floor level.
- Erection of a 5 storey building (plus upper and lower ground floors) for use as residential on Swinton Street.
- Associated residential amenity space (including gymnasium)
- New basement
- Rooftop and basement plant
- Centralised energy centre and strategy with high efficiency heat pumps alongside electric boilers.
- Fabric performance required to exceed Building Regulations Part L requirements in line with current GLA guidance and new Draft London Plan targets (10% and 15% CO_2 emission reduction for residential and commercial use, respectively).
- Retaining facades upgraded to high level performance with same u-values as new build.
- The new build will be have a specified air permeability rate of 3 m^3/m^2.h at 50 Pa while the refurbished buildings will be upgraded to have achieve an air permeability rate value of 5 m^3/m^2.h at 50 Pa.

The percentage split (new build / retained) under Scenario 1 is approximately 98% / 2%.

SCENARIO 2

Scenario 2 contemplated the retention of the four "positive contributors" However, the project's structural engineer has determined that the floor loading of the Nurses' Building (1.9 kN/m^2) is not sufficient to carry the live loads required for office use (2.5 kN/m^2). The floor slabs in this building are therefore not fit for purpose and it is only possible to retain the façade – all existing structure will need to be removed. Please refer to Appendix B: 300 Gray's Inn Road DDN ST 31 for further details on the structural assessment of the Nurses building. Scenario 2 therefore includes the following works and assumptions:

- Refurbish original hospital building (330 Gray's Inn Road) including vertical extension – for use as a hotel.
- Structural strengthening to enable vertical extension of Princess Louise Extension and Ward Building.
- Façade retention of Nurse's Building and removal and new build of all internal structure (including vertical extension).
- New build extension (to include a total of 10 floors).
- New build basement.
- Two new residential blocks.
- Refurbish existing fabric (walls and roof) to achieve best practice thermal performance and air tightness.
- Replace windows and doors to meet best practice performance (U-values and g-values) and improve air permeability.
- New cores (stairs and lifts) to meet fire regulations.
- New MEP services, including air handling units for ventilation, and air source heat pumps for heating and hot water.
- Revised internal configuration to support new building uses and accessibility (e.g. wheelchair turning circles).
- Centralised energy centre and strategy with high efficiency heat pumps alongside electric boilers.
- Fabric performance required to exceed Building Regulations Part L requirements in line with current GLA guidance and new Draft London Plan targets (10% and 15% CO_2 emission reduction for residential and commercial use, respectively).
- Retaining facades upgraded to high level performance with same u-values as new build.
- The new build will be have a specified air permeability rate of 3 m^3/m^2.h at 50 Pa while the refurbished buildings will be upgraded to have achieve an air permeability rate value of 5 m^3/m^2.h at 50 Pa.

It is important to note that although Scenario 2 does retain a greater proportion of the positive contributors, it will involve a significant proportion of new build in order to make the scheme commercially viable. The percentage split (new build / retained) under Scenario 2 is 91% / 9%[9].

SCENARIO 2A

As the Princess Louise Extension and Ward Building are inherently less adaptable than a new build alternative an additional round of refurbishment may be required over the course of the development's lifecycle. This scenario considers the effects of such a refurbishment taking place after 30 years of occupation.

An additional 46 kg CO_2e per m^2 have been added to the whole life carbon of this option [10]. All other assumptions are the same as Scenario 2.

SCENARIO 3

Scenario 3 comprises a light refurbishment of all existing buildings on site. Works and assumptions include:

- External walls: repair and make good existing external brickwork (assumed 20% of total external wall area will need repair)
- Internal wall finishes: 40% of walls to receive new plasterboard
- Internal wall finishes: new paint to all internal walls
- Windows: replace 20% of windows with new/equivalent timber windows.
- Floor finishes: new carpet and raised access flooring; new sealant to areas of exposed concrete.
- Ceiling finishes: new suspended ceilings, plasterboard and paint.
- External roof finishes: new OSB (or equivalent) to 40% of roofs; new waterproof membrane to 100% of roofs.
- No alterations to the existing energy strategy: gas boilers for heating and hot water, mechanical cooling
- Existing building fabric performance based on detailed visual inspection, technical surveys, heritage information and reference data based on year of construction.
- It is assumed that the buildings would target an air tightness value of 15 $m^3/m^2.h$ at 50 Pa.

COMPARISON OF SCENARIOS

WHOLE LIFE CARBON

WLC has been calculated for each of the above scenarios to determine the option with the lowest carbon emissions over the entire lifecycle of the development (taken to be 60 years in line with GLA guidance). The results of this analysis are shown in Figure 5 and Table 4.

The results shown below include both embodied carbon (associated with construction materials) and operational carbon (associated with building energy use). The figures have been normalised and shown on a per square metre basis to allow to comparison between scenarios with different total floor areas.

[9] Total floor area to be provided under Scenario 2: 33,021 m^2. New build = 30,023 m^2; retained = 2,998 m^2.
[10] This figure is 15% of the A1-A5 carbon of Scenario 2.

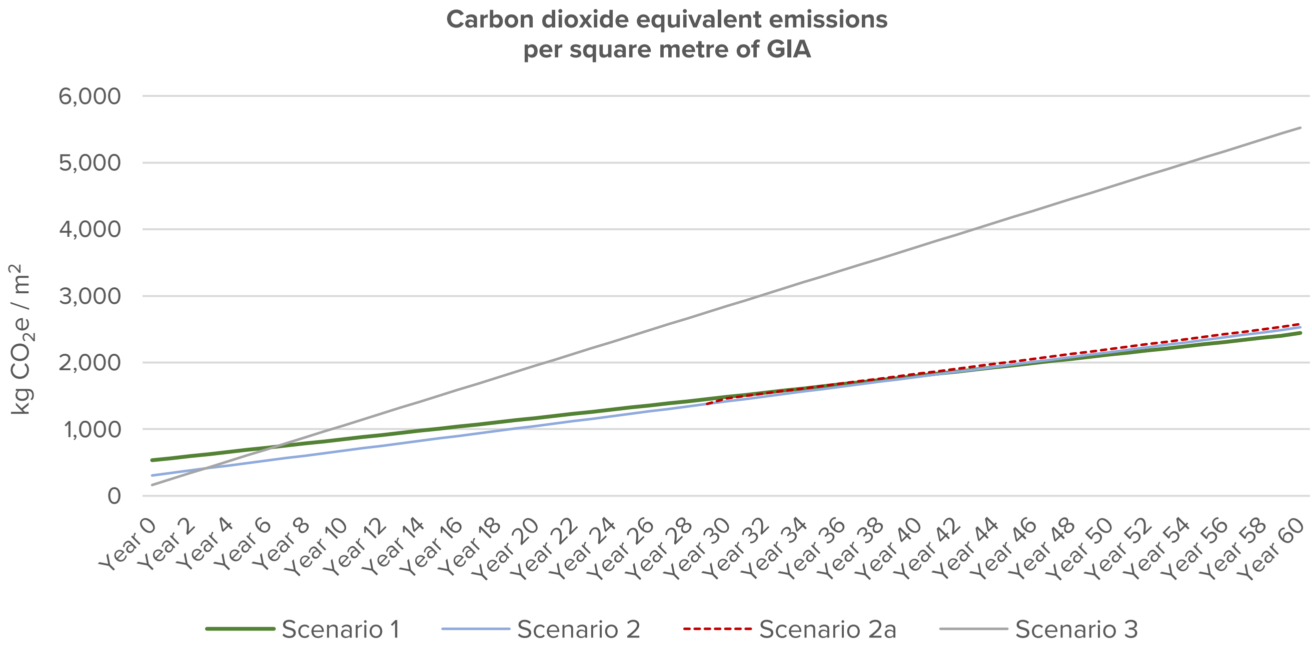


Figure 5: Comparison of WLC emissions over 60 years (proposed development is Scenario 1)

Table 4: WLC (kg CO_2e per m^2) for three scenarios

Whole life carbon	Scenario 1 (proposed scheme)	Scenario 2	Scenario 2a	Scenario 3
A1-A5: Upfront carbon	532	307	353[11]	163
B1-B7: Use stage carbon	1,902	2,218	2,218	5,362
C1-C4: End of life carbon	11	6	6	1
Total	**2,445**	**2,531**	**2,577**	**5,362**

Over a 60 year period, carbon emissions associated with a light refurbishment (Scenario 3) significantly exceed both other scenarios.

Carbon emissions associated with Scenario 3 exceed Scenario 1 after 7 years and Scenario 2 after 3 years. This is because the light touch refurbishment scenario has significantly higher operational energy use than the other scenarios.

Scenario 3 has therefore been discounted as a viable option. Not only would light refurbishment result in greater whole life carbon than either major refurbishment or new build, it would also result in a poor scheme from an accessibility, health and wellbeing and townscape perspective and does not

[11] Additional 46 kg CO_2e per m^2 added for major refurbishment works at some point over the building's 60 year lifecycle.

provide an exemplar set of buildings that can be adapted to a change of use as part of the mixed-use proposals which bring wider benefits to Camden.

The difference between Scenarios 1 and 2 is less pronounced. As shown in Table 6 Scenario 1 includes greater upfront carbon as more material will need to be brought to site. However, over 60 years, the cumulative carbon emissions for the two scenarios begin to converge, as the fabric of the retained buildings will not perform as well as a new build alternative.

After 60 years, Scenario 1 (the proposed scheme) outperforms Scenario 2 by 86 kg CO_2e per m^2.

In total, the proposed scheme achieves a 3% reduction in whole life carbon compared to Scenario 2. Total whole life carbon is as follows:

- **Scenario 1**: 80,997,066 kg CO_2e
- **Scenario 2**: 83,582,444 kg CO_2e.

Furthermore, it is highly likely that under Scenario 2 additional refurbishment and/or remodelling work would be required over the 60 year study period. This is due to the fact that the spaces provided will be inherently less adaptable and flexible than those provided under Scenario 1.

Scenario 2a demonstrates the effects of a major refurbishment after 30 years [12]. Should such a refurbishment be required this scenario would result in an additional 132 kg CO_2 per m^2 compared to the proposed scheme (scenario 1).

The proposed scheme (Scenario 1) has been shown to deliver a saving in whole life carbon compared to both a light refurbishment and a major refurbishment or the Ward Building and Princess Louise Extension.

There are several other key reasons why Scenario 1 is the preferred solution for the site and these are explored in more detail the following sections.

EMBODIED CARBON

A breakdown of the embodied and operational cabon for Scenarios 1 and 2 is shown in Figure 6. This figure shows that although the embodied carbon is higher for Scenario 1, there is a minimal difference in whole life carbon over the 60 year study period.

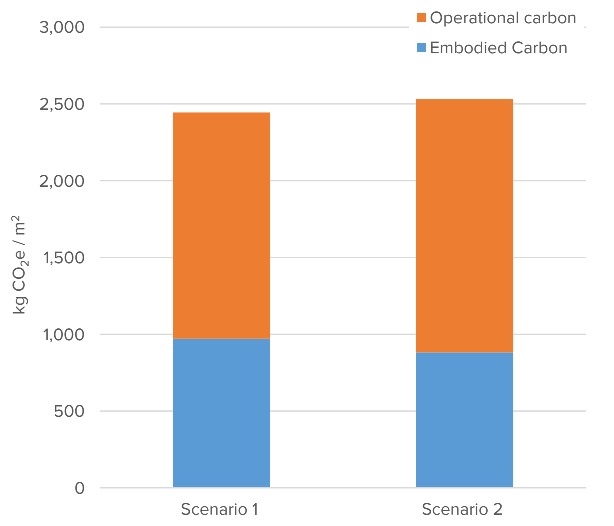


Figure 6: Operational and embodied carbon for Scenarios 1 and 2

OPERATIONAL CARBON

To inform the design strategy and the whole life carbon assessment the energy consumption associated with the buildings performance of each scenario was calculated.

Table 5 and Figure 7 below shows a summary of the results, including an estimation of the energy consumption by end use for different modelled scenarios. As per WLC methodology it includes both regulated and unregulated energy. Regulated CO_2 emissions refer to emissions arising from energy used by fixed building services, as defined in Approved Document Part L of the Building Regulations. These

[12] It has been assumed that this would account for additional 15% of the original A1-A5 carbon associated with Scenario 2 (46 kg CO_2e per m^2).

include fixed systems for space heating/cooling and hot-water systems, ventilation, and internal lighting.

The energy strategy for the proposed scheme (Scenario 1) entails the use of high efficiency heat pumps alongside electric boilers in a centralised strategy for the supply of space heating, cooling and hot water to the whole development (cooling only for non-residential spaces). This strategy is "combustion-free", thereby designing out the need for gas boilers. Solar PV have also been maximised in the available roof space.

For full details of the proposed energy centre, including heat pump systems and any supporting renewable technologies please refer to the Energy Statement.

It is assumed Scenario 2 would be served by a similar strategy as Scenario 1. Scenario 3 which simulates a light refurbishment does not account for changes to building services from the previous hospital operation – gas boilers for heating and hot water, ASHP for cooling.

The results show that a light refurbishment only (Scenario 3) would keep the buildings operating in a non-efficient way with large energy consumption – the calculated performance has been verified against the building EPC and modelled results are aligned, even slightly lower.

Both scenarios 1 and 2 show a substantial energy reduction. The difference between the two is not significant as both offer a large proportion of new building for viability reasons. The significant improvements in heating are largely due to the large improvement in the building fabric new buildings can offer as well as improving the existing building fabric to high performance best practice levels – the feasibility of it is discussed in the next section.

Cooling loads have also been substantially reduced by implementing the cooling hierarchy as defined in "Intend to Publish" London Plan cooling hierarchy. For more details please refer to the Energy Statement submitted with this planning application.

Table 5: Summary of energy performance for different scenarios

End Use	Scenario 3	Scenario 2	Scenario 1
	Energy Consumption (kWh/m^2)		
Heating	163.3	4.2	4.3
Cooling	34.9	7.5	5.4
Auxiliary	13.9	7.1	5.8
Lighting	34.6	12.9	10.8
Hot Water	77.8	35.0	33.5
Equipment (unregulated)	77.5	51.4	45.6
Total Regulated Energy Consumption (kWh)	**402.0**	**118.0**	**105.4**

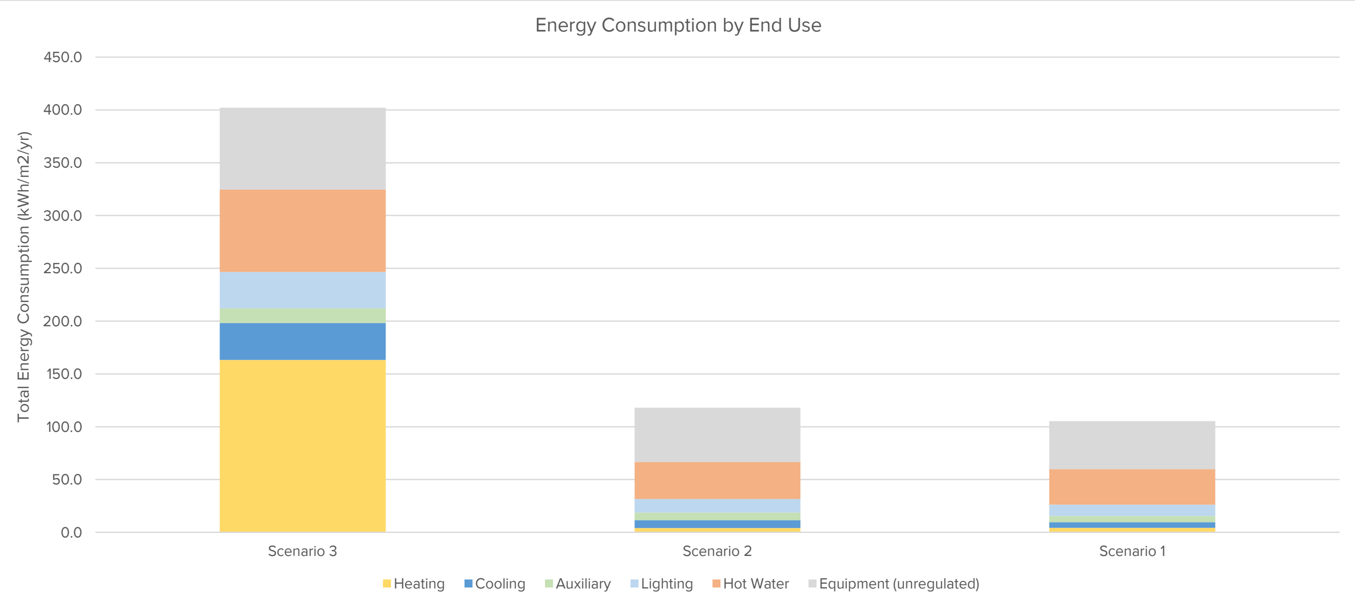


Figure 7: Estimated energy consumption by end use for the three scenarios, including unregulated (Equipment).

HEALTH AND WELLBEING OF OCCUPANTS

DAYLIGHT

The proposed development (Scenario 1) will provide good levels of daylight access subject to site constraints. The inclusion of new buildings enables the design team to optimise daylight access whilst minimising risk from overheating.

NOISE, AIR QUALITY AND OVERHEATING

The Noise Assessment and Air Quality Assessments (submitted as part of this planning application) have identified both noise and air pollution issues at the site. Significant mitigation measures will be required to ensure that the proposed buildings can provide a suitable internal environment to the building users based on current planning policies and modern expectations of building performance.

Acoustic glazing and mechanical ventilation will be implemented as part of the mitigation measures within the proposed development, which could not be effectively incorporated if the buildings are retained in Scenarios 3 and would need to be carefully considered in Scenario 2 with implications to building fabric.

ADAPTABILITY AND LONGEVITY

The typical lifespan of buildings is considered to be circa 60 years, where at the end of life the buildings are likely to be in need to major refurbishment and rebuild. Having been constructed over 70 years ago, the positive contributors are currently at the end of life. With the focus of modern building design being upon maximising adaptability and longevity, the retention of the positive contributors poses a notable constraint with regards to the level of adaptability and flexibility that could be offered by the development.

Where in the near/medium future a new building usage is required due to potential change in building demand, there will likely to be a need of major refurbishment/re-build to meet the future use, rather than the possibility of being able to adapt to the change in use with minor adjustments which could be more readily achieved by Scenario 1.

The reduced adaptability and flexibility of the existing buildings both in Scenario 2 and 3 create constraints in the buildings' suitability to meet the commercial expectations of non-domestic tenants.

The proposed scheme (Scenario 1) is considered to have notably better adaptability and longevity compared to Scenarios 2 and 3.

ACCESSIBILITY

Escape stairs and an external lift has been 'bolted' onto the Ward building extension to the hospital since it has been originally constructed in 1916.

Retention of the positive contributors will result in accessibility concerns related to the provision of accessible lifts and escape stairs that are compliant with current building regulations, and to meet expectations of commercial tenants who the developer are looking to target. Notable changes to the internal arrangements of the building will be required to enable the development to be fully accessible. Scenario 1 presents the best opportunity to integrate accessibility into the buildings.

STRUCTURE

The existing buildings show limitations on the existing structural capacity of the buildings to accommodate rooftop extensions and underpinning for a connected basement. Furthermore, a preliminary structural analysis the project's structural engineer has determined that the floor loading of the Nurses' Building (1.9 kN/m^2) is not sufficient to carry the live loads required for office use (2.5 kN/m^2), hence it being removed from Scenario 2. Please refer to Appendix B: 300 Gray's Inn Road DDN ST 31 for further details.

It's also worth noting that vertical extensions will require extensive additional strengthening works, which will reduce the extent of original fabric, require additional underpinning and/or new piles and increase cost/ risk and complexity by a minimum of 2-3 times.

BUILDING FABRIC

In both Scenarios 1 and 2 it is proposed that there will be the addition of insulation to retained positive contributors to ensure that these buildings exceed the minimum thermal performance stated in Building Regulations Approved Document Part L2B. To preserve the external appearance of the buildings, insulation will be located internally reducing the available internal floor space.

Improving the existing thermal fabric raises significant risk of interstitial condensation. The existing fabric is naturally breathable, meaning water vapour moves freely through the fabric. Adding insulation will change this and internal insulation will make the wall colder which could mean water to condensate inside the wall, behind the insulation eventually leading to damp problems.

The type of insulation has also been considered. Breathable materials can be used to reduce the likelihood of these problems however they usually have a lower thermal conductivity and will require more thickness to achieve a better u-value. This would have a strong impact on detailing and will also reduce the internal floor area.

Furthermore, the external wall has existing connections to floors and walls. This increases the risk of thermal bridging as the internal insulation cannot be installed consistently; thermal bridging in existing buildings can be difficult to rectify, and interstitial condensation within the envelope may be detrimental to existing steelwork.

Given the amount of different types of wall construction, it was not deemed feasible, at the current design stage, to carry out detailed construction details to determine thermal bridging and interstitial condensation for all positive contributors.

In terms of building fabric performance, it is understood that scenario 1 offers a better option as it provides better guarantee of the performance of the building fabric and structure for the next 60 years (lifespan of building).

AIRTIGHTNESS

In both Scenarios 1 and 2 the air permeability has been assumed to be maximised and at this stage assumed to be of $3m^3/m^2.h$ at 50 Pa for new buildings and $5m^3/m^2.h$ at 50 Pa for a best practice refurbishment.

The design team appreciates that the existing buildings could potentially achieve an air permeability of $3m^3/m^2.h$ at 50 Pa or less however it was deemed that assuming a value of $5m^3/m^2.h$ at 50 Pa was a more conservative assumption to make at this stage before a full survey of the fabric performance is evaluated and a contractor is appointed.

BUILDING SERVICES

In line with GLA guidance the proposed scheme (Scenario 1) and Scenario 2 are served by a single energy centre connected to all uses on site. The current design strategy to service the site entails a large basement broken down into a double height space to enable locating the equipment items required for the energy centre and other plant, whilst looking to minimise disruption at roof level.

In the case of Scenario 3, keeping the existing buildings would create strong challenges to work with the current basement levels of all positive contributors as well as floor levels discrepancies, impacting the service distribution. This would result in decentralised systems per building, more complexity, and less efficiency which goes against the new London Plan policies and GLA guidance.

A centralised plant capitalises on diversities, economies of scale and mixed use operation profiles to maximise the peak operation of plant leading to higher running efficiencies.

Scenario 1 proposes the retention of the RNTNE original building. Although this building has architectural value and is deemed to create value to the proposed development, its integration in the development was not without some critical adaptation.

Due to limited floor to floor heights, there were limits to the type of use the building could have, for example, a commercial kitchen was inviable. While heating, cooling and water were able to be linked to the new building, the ventilation required a dedicated system. Accommodating special requirements for one building was deemed acceptable considering the benefits of keeping the original building. However, if considering the retention of more buildings, the integration of building services would significantly increase the complexity of the system and its inefficiency.

A preliminary MEP study was undertaken to understand the impact of adding new services to the Nurses building. These sketches can be found in Appendix A: MEP preliminary study.

This study shows the indicative spatial requirements for the MEP services for a notional office space compliant with British Council for Offices guidelines. In summary:

- There is a requirement for Mechanical Ventilation because natural ventilation is deemed not suitable due to air pollution levels and background noise in the area. The AHU plantroom has been assumed to be located in the basement.
- It is assumed that heating, cooling, cold and hot water is supplied to the building from the centralised energy centre and water tank room which would be located elsewhere in a new built portion of the development.
- The sketches show the impact on the floor plate and floor to ceiling. The basement is largely impacted as well as floor to ceiling heights and it is shown that most floor to ceiling heights cannot accommodate the services distribution.
- There is also loss of floor areas due to larger riser requirements for a new/modern building with mechanical ventilation and cooling;
- The incorporation of the riser requirements would create structural implications to the existing building with the likely requirement for additional strengthening and increased costs;

This exercise demonstrates the complexity of adapting the existing buildings to modern day requirements and commercial expectations of office or hotel buildings and supports the reasoning why Scenario 3 would not be a viable option to pursue. In addition to the Structural assessment this exercise also supported the decision to assume only the façade retention of the Nurses building in Scenario 2.

CLIMATE CHANGE MITIGATION

Through provision of high efficiency building fabric and systems, the new buildings offer a lower cooling demand and subsequently lower operational CO_2 emission throughout its lifetime. The application of a full electric heating and hot water system also negates the use of gas/combustion onsite reducing onsite sources of air pollution, in relation to heating, cooling and hot water.

COMPARISON WITH WLC BENCHMARKS

The scheme being taken forward in this application utilises the strategies outlined below to meet or exceed the GLA's whole life carbon aspirational benchmarks, as shown in Table 6. Benchmarks are shown for office, hotel and residential uses as these represent the majority of the scheme.

Table 6: Comparison with GLA benchmarks (kg CO_2e / m^2)

	Aspirational WLC benchmark		Modelled performance
	Office	Residential & hotel	
A1-A5	550 – 600	250 - 300	532
B-C[13]	450 - 500	180 - 240	428

Overall the proposed development shows a better performance compared to the GLA aspirational benchmarks which demonstrates the project team commitment to a sustainable development.

[13] Excluding B5 (operational energy use) and B6 (operational water use).

ACTIONS TAKEN TO REDUCE WLC EMISSIONS

This sections summarises the steps taken by the team to reduce whole life carbon and ensure that the proposed scheme achieves the GLA's performance benchmarks.

REUSE & RETROFIT OF EXISTING BUILDINGS

The existing Royal National Throat, Nose and Ear Hospital building on Gray's Inn Road will be retained and refurbished, thereby reducing the scheme's embodied carbon and protecting a valuable historic building for future generations.

USE RECYCLED OR REPURPOSED MATERIAL

As noted above, the existing hospital building on Gray's Inn Road will be retained, refurbished and extended. The existing foundations, ground floor, upper floors, façade and structure will be retained and reused.

Where possible waste materials from the demolition process will be reused and repurposed on site. This will include the use of crushed brick and concrete within the basement sub-base.

At the point of specifying internal & external materials for the development, we will seek to use recycled bricks where practical on each building, and use products which provide a high recyclable content.

Brick from demolished buildings will be cleaned and reused in the landscaping design, subject to a technical review on their appropriateness as external floor surfacing. As noted in the accompanying Circular Economy Statement no topsoil will be removed from the site.

Existing basement walls will be reused, along with some of the existing piles. The extent of reuse will be determined by structural surveys.

New concrete will include at least 40% ground granulated blast furnace slag (GGBS), a waste product from industrial processes.

New steelwork will include a high percentage of recycled steel.

At least 95% of non-hazardous waste materials generated by both construction and demolition works will be diverted from landfill, either via direct reuse on site or via off site recycling and recovery.

MATERIAL SELECTION

The project will utilise three key principles, with regards to material selection: efficiency; durability; and responsible sourcing. These are discussed in more detail in the accompanying Circular Economy Statement.

The team have incorporated measures and strategies to ensure that materials are used in an efficient manner. This includes optimising the façade design to accommodate a standard sized cladding panel. This ensures minimal wastage during construction.

The project will utilise durable materials within the superstructure and façade. These will be specified to a predicted lifespan of 60 years or greater. This will reduce the need for repair, replacement and refurbishment throughout the lifecycle of the building.

Finally, materials will be sustainably sourced in accordance with the BREEAM requirements. This will include:

- All new concrete, including concrete blocks should be sourced from BES 6001 Very Good accredited suppliers;

- All reinforcing bar and mesh should be sourced from Eco Reinforcement or CARES Sustainability Standard certified suppliers;
- All steel, glass and aluminium should be sourced from suppliers holding ISO 14001 accreditation;
- All plasterboard should be sourced from suppliers holding BES 6001 Very Good;
- All insulation should be sourced from suppliers holding BES 6001 Very Good and/or ISO 14001 accreditation;
- Key building services (e.g. pipework, ductwork and key plant) should be sourced from suppliers holding ISO 14001;
- All timber products should be FSC / PEFC certified.

MINIMISE OPERATIONAL ENERGY USE

As shown in the accompanying Energy Strategy a fabric-first approach has been adopted to minimise operational energy use and carbon emission, in accordance with the energy hierarchy.

The scheme achieves a 40.9% site wide reduction of in carbon emissions over Building Regulations; this includes a 17% and 9.6% reduction via improvements to the building fabric to the residential and commercial portion of the development respectively.

MINIMISE OPERATIONAL WATER USE

Water efficient fittings have been specified throughout the development to minimise operational water use.

Water systems will be suitably durable to avoid leaks; furthermore, as part of the BREEAM assessment the office and hotel buildings will include water leak detection systems.

DISASSEMBLY & REUSE

All buildings will be designed to include features that allow for disassembly and reuse. Further details on end of life strategies are provided in the accompanying Circular Economy Statement.

The proposed terracotta cladding on the hotel building will be demountable at the point of demolition and will also enable local replacement should this be required. The external masonry systems for the office and residential buildings will be designed to enable the ability to remove and replace as a unitised system.

BUILDING SHAPE & FORM

Within the complexities of the site shape, and through dialogue with Planning Authorities, the shape of each building has been designed to be as efficient as possible. Where possible, regular shaped plans have been designed to enable efficient structural framing.

As the designs have developed for this specific site, a number of floors are non-repetitive. Taking an average mid-level floor, the following wall to floor rations apply:

- Hotel: 0.57
- Office: 0.45
- Residential (Block A): 0.79
- Residential (Block B): 0.69

REGENERATIVE DESIGN

The development will include an extensive green roof, in addition to planting within external landscaped areas to directly remove CO_2 from the atmosphere.

DESIGN FOR DURABILITY & FLEXIBILITY

By demolishing and rebuilding durability and flexibility of space will be enhanced. The office building has been designed to have the potential to provide lab enabled spaces and there is a degree of adaptability built in for that. The office building also has been designed with generous floor to floor heights to enable adaptation to future requirements.

The hotel building's structure will be designed to allow for internal reconfiguration to suit a number of operators & designs.

Within the residential building, party walls will be non-structural enabling for future reconfiguration if required.

Internal spaces within the core areas of all buildings will be designed, and materials selected for their robustness and durability (tiling, concrete, timber finishes).

Building specific plant is located within the shared basement level, where it can be replaced without the need to remove structure. A central energy centre in the form of ASHP is located on the roof of the office building, and these can be replaced easily.

OPTIMISATION OF THE RELATIONSHIP BETWEEN OPERATIONAL & EMBODIED CARBON

Insulation will be optimised to ensure that carbon cost of manufacture and installation is considered as well as U-values. Glazing will be optimised to reduce cooling demand.

A high level of airtightness will be achieved by ensuring good detailing and good construction practice to minimise energy loss. Mechanical Ventilation with Heat Recovery is being specified for optimal balance between adequate ventilation rates and energy efficiency.

Lighting design will be optimised to provide adequate levels of lighting in the most energy efficiency manner by specifying sufficient amount of high energy efficient lamps.

Use of carbon intensive / high carbon materials will be reduced.

BUILDING LIFE EXPECTANCY

A 60 year study period will be utilised (in accordance with GLA guidance). However, all buildings will be designed with a long life expectancy of greater than 60 years.

As outlined in the accompanying Circular Economy Statement the project will utilise the principle of 'designing in layers', whereby building elements that have different expected lifespans (e.g. finishes and structures) will be designed to be independent from one another to facilitate refurbishment and replacement.

LOCAL SOURCING

The main contractor will be required to reduce carbon emissions associated with transport of construction materials.

As part of the BREEAM assessment the contractor will be required to utilise a Sustainable Procurement Policy, which will include a preference for local sourcing.

This principle will be reviewed in more detail once a main contractor has been appointed. Further information will be provided at post-construction stage.

MINIMISING WASTE

As noted in the accompanying Circular Economy Statement the project team have sought to minimise waste as far as possible. Demolition waste will be minimised by promoting reuse and recovery; construction waste will be minimised by utilising efficient design principles.

Where waste generation is unavoidable rigorous targets have been set for recycling of excavation, demolition and construction waste (at least_95% of waste will be diverted from landfill). The contractor is required to ensure that no more than 6.5 tonnes of construction waste will be generated for every 100m^2 GIA. Further detailed on how this target is expected to be achieved can be found in the Circular Economy Statement.

EFFICIENT FABRICATION

The development will make use of off-site modular construction to improve build quality, reduce construction waste and reduce the need for repairs during post completion and the defects period.

Façade cladding panels and hotel bathroom pods will both be manufactured off-site thereby reducing energy consumption and waste, and facilitating disassembly and reuse.

LIGHTWEIGHT CONSTRUCTION

The structural design has been optimised as far as possible to drive down the weight of materials used; this has been considered alongside both material durability and the need to deliver a multi-storey development, whilst allowing for a flexible floorplate that can deal with adaptation in the future.

Although a lightweight construction method was considered in the form of timber (glulam/CLT) this had to be ruled out for fire safety reasons.

CIRCULAR ECONOMY

Circular economy principles have been incorporated into the design. Please refer to the accompanying Circular Economy Statement for further detail.

POST-CONSTRUCTION STAGE

This section summarises the actions that will be carried out by the team at post-construction stage.

The applicant has committed to completing the post-construction tab of the WLC assessment template and submitting this document to the GLA upon commencement of RIBA Stage 6, prior to handover.

The post-construction WLC assessment will include an update of the information provided at planning submission stage; this will include the actual WLC emission figures.

The information presented at post-construction stage will include:

- Total construction site energy use (including electricity and fuel consumption)
- Confirmation (provided by the main contractor) of as-built material quantities and specifications
- Records of material delivery, including distance travelled and transportation mode
- Waste transportation records, including waste quantity, distance travelled, and transportation mode.

Post-construction results will be compared with the results presented at planning submission stage. An explanation will be provided for any differences between the two data sets. Post-construction results will also be compared with WLC benchmarks.

The final ‘building element category’ table (and modules C and D of the GWP reporting table) will be informed by the post-construction Circular Economy Statement.

CONCLUSION

This report has demonstrated that there is limited argument for retaining and extending the existing buildings on site, with the exception of the original hospital building on Gray's Inn Road; consequently, it is recommended that the team pursue with a low carbon development that includes the retention of the original hospital building and new build to accommodate hotel, office, gym and residential uses.

Three scenarios have been analysed in order to determine the most appropriate development route for the existing site:

1. Proposed development: Retain original hospital building, demolish all other buildings on site and erect new buildings to accommodate offices, gym, hotel and residential uses;
1. Refurbish and extend three positive contributors, retain façade of nurses' building, and erect new infill buildings;
2. Light refurbishment of all existing buildings on site with no new construction.

There are several key problems associated with scenario 3. Insufficient external space would be provided. There are issues with accessibility and particularly disabled access. There is a fire risk associated with the existing structures that would not be addressed under this scenario. The structural loadings of several of the existing buildings (including the nurses' building) are not fit for purpose.

In addition to these arguments this report has demonstrated that over a 60 year study period Scenario 3 would generate more whole life carbon than either of the other two scenarios. It has therefore been discounted as a viable option.

This report has shown that the proposed scheme (Scenario 1) will result in lower whole life carbon emissions than an alternative proposal that seeks to retain the Princess Louise Extension and the Ward Building (Scenario 2).

On a per square metre basis the proposed scheme (Scenario 1) delivers 86 kg less CO_2e compared to Scenario 2.

In total, the proposed scheme (Scenario 1) delivers a 3% saving of 2,605,378 kg CO_2e compared to Scenario 2

These savings would be further increased should Scenario 2 require an additional refurbishment during the 60 year study period.

The proposed scheme (Scenario 1) is preferable to the alternatives as it is able to deliver more flexible spaces and also provides better working conditions for building users, in terms of air quality, daylight and thermal comfort.

Scenario 1 would also have a significantly longer lifecycle than Scenario 2. It is the team's intention to deliver valuable buildings that will remain in situ, delivering high quality space for a substantial length of time.

The Heritage Statement, submitted in support of this application, also concluded that, in their professional opinion, the Princess Louise Extension and the Ward Building were not of architectural interest and that their positive contribution to the conservation area could not be made as well or better by a replacement building.

Furthermore, there are potential issues around construction methodology for Scenario 2, in particular around the installation of new columns within an existing building and the need for additional piles.

The following conclusions can be summarised from the Whole Life Carbon assessment:

- The proposed scheme (Scenario 1) shows increased building longevity (beyond the 60 year study period) with increased durability of materials;
- New buildings can provide a far better internal environment for future users with enhanced thermal, daylight, air and noise qualities, in comparison to Scenarios 2 and 3 where change of room layouts, window configuration and

application of air and noise pollution mitigation measures will be challenging;
- Scenario 1 is anticipated to enable a more flexible and long-lasting development that can adapt to future changes in building uses;
- Accessibility measures (stairs and lifts) can be more readily integrated within the architecture of the new buildings as part of Scenario 1;
- There are potential issues with thermal bridging and interstitial condensation with upgrade of thermal elements[14] of existing buildings through internal insulation, leading to potential degradation of the building structure and fabric.
- The integration of building services on existing buildings to meet current energy and environmental expectations is complex to achieve in existing buildings likely requiring additional structural strengthening and increase costs.
- Scenario 2 would incur additional cost, risk and complexity over scenario 1.
- The quality of the spaces created through implementation of Scenario 1 will be far superior to those offered by Scenarios 2 and 3. It is not considered commercially viable for the applicant to retain the amount of buildings presented under Scenarios 2 and 3 as the quality of the buildings is not in line with their quality expectations and the aspiration to bring forward a set of exemplar buildings that will enhance the local economy and the built environment.

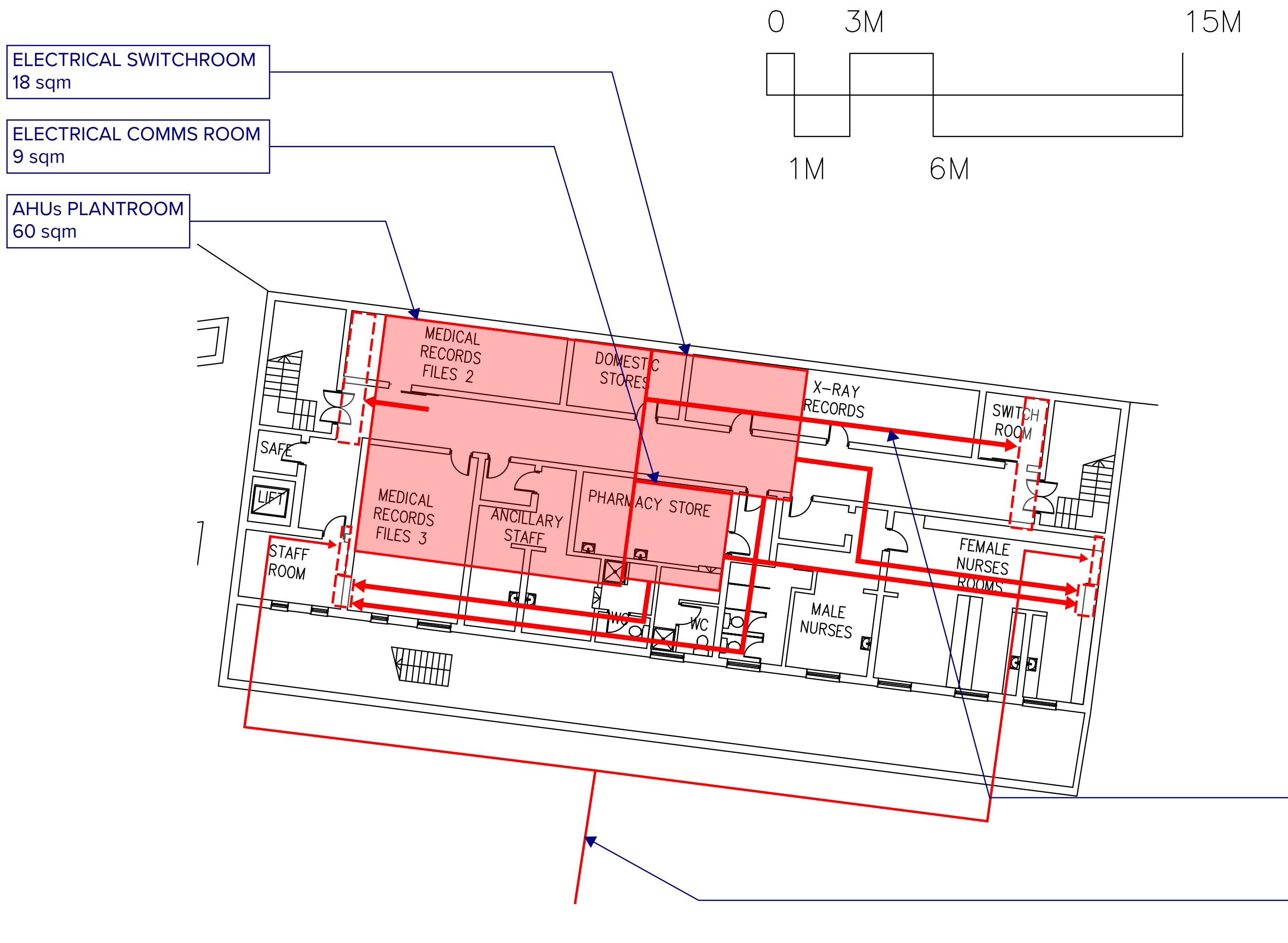
This report therefore recommends implementing Scenario 1: retain, refurbish and extend the original hospital building; demolish all other buildings (reclaiming, recovering and recycling demolition materials); and construct new buildings to accommodate residential, office, gym and hotel uses.

The preferred Scenario 1 is expected to perform notably better than the GLA WLC benchmarks and therefore the development is in line with GLA policy on WLC aspects.

For a holistic appreciation of the benefits of the proposed scheme, this report should be read in conjunction with the Design and Access Statement, Heritage Assessment and other reports submitted as part of the planning application.

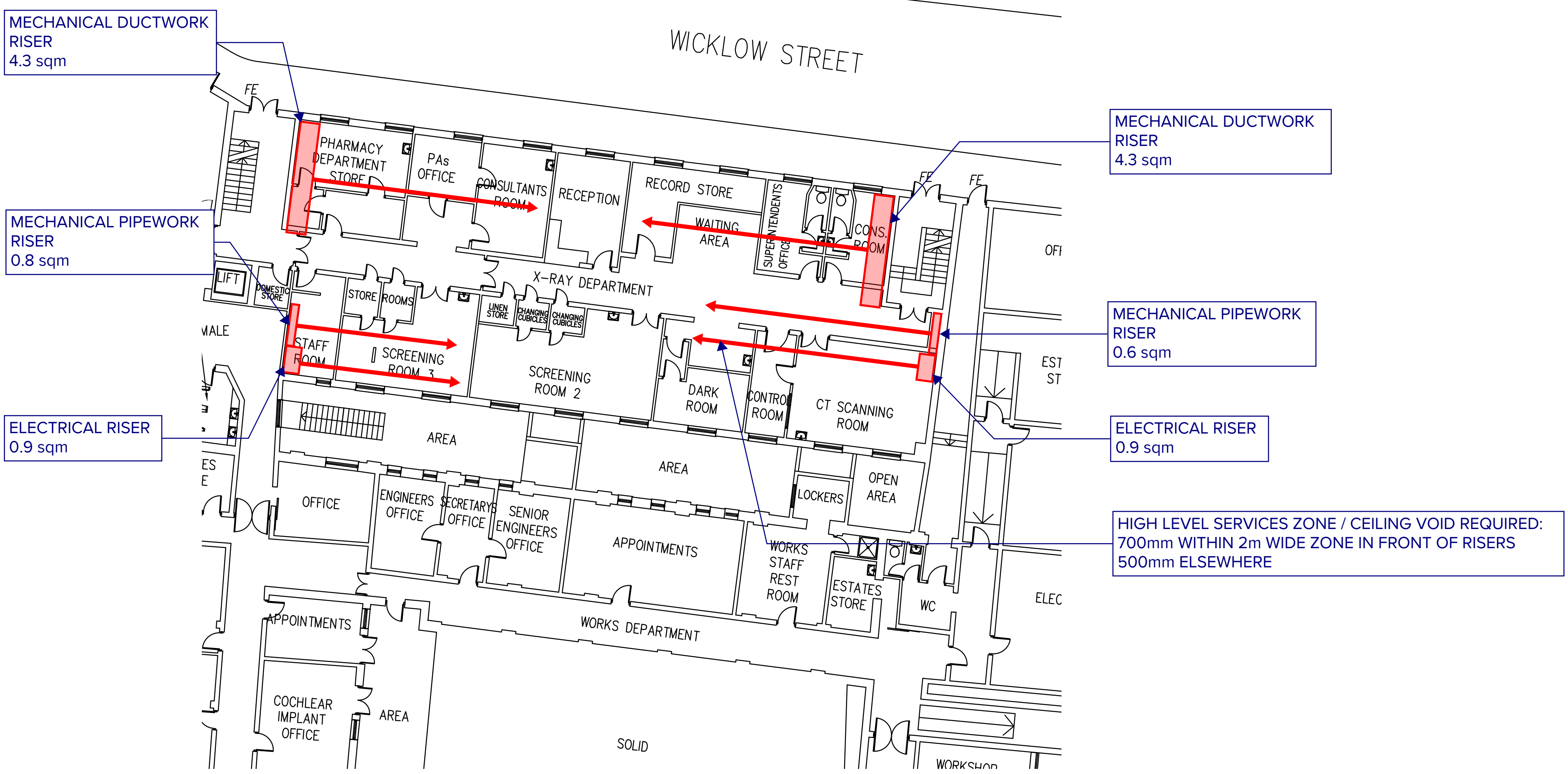
[14] It was not possible to fully investigate the existing buildings' fabric by carrying out an intrusive survey as the buildings were in use until very recently.

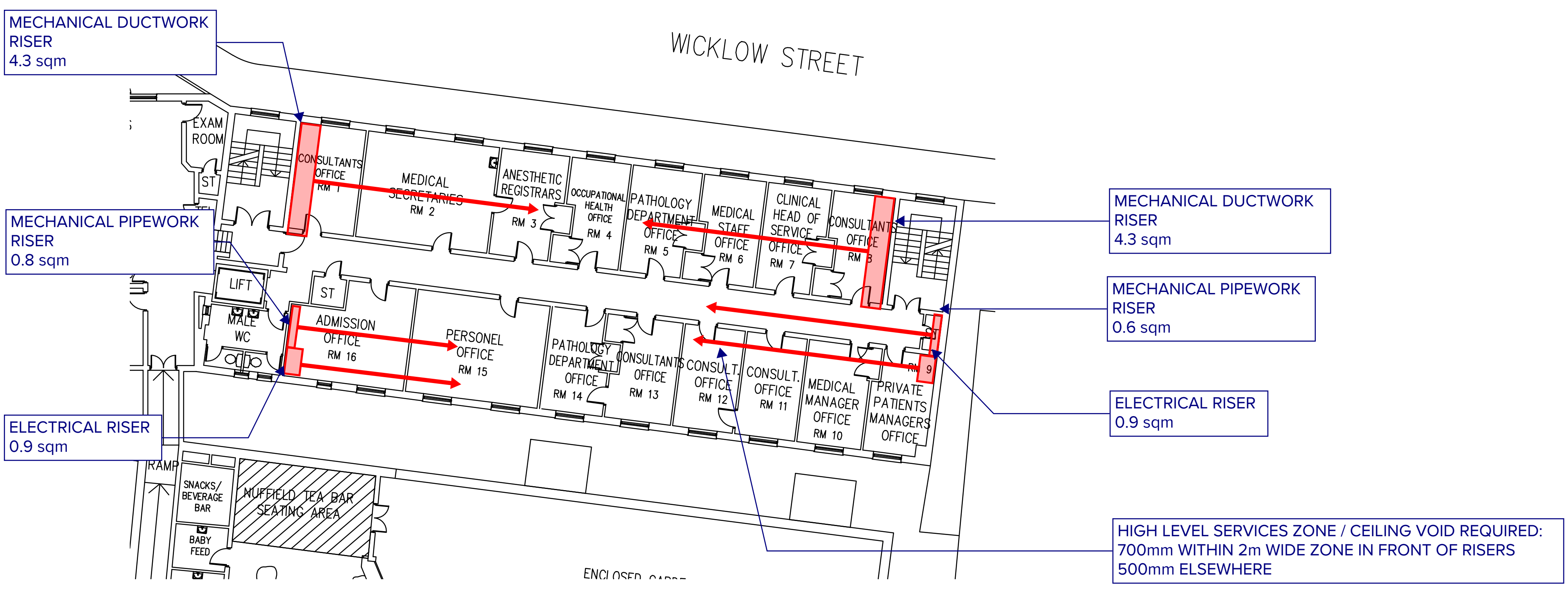
APPENDIX A: MEP PRELIMINARY STUDY



SUMMARY OF ISSUES AND CONSTRAINTS:

- LOSS OF FLOOR AREAS DUE TO LARGER RISERS REQUIRED FOR A CONTEMPORARY BUILDING WITH MECHANICAL VENTILATION AND COOLING. NATURAL VENTILATION IS DEEMED NOT SUITABLE DUE TO BACKGROUND NOISE IN THE AREA.
- STRUCTURAL IMPLICATIONS TO INCORPORATE LARGER RISERS MEANS LIKELY REQUIREMENT FOR STRUCTURAL STRENGTHENING/ALTERATIONS AND INCREASED COSTS;
- THE FLOOR TO CEILING HEIGHTS ARE NOT SUITABLE ON MOST LEVELS ONCE THE HIGH-LEVEL SERVICES ZONE REQUIREMENTS ARE TAKEN INTO CONSIDERATION.
- POTENTIAL REDUCED MARKETABILITY;
- POTENTIAL RISKS TO PROJECT FEASIBILITY.





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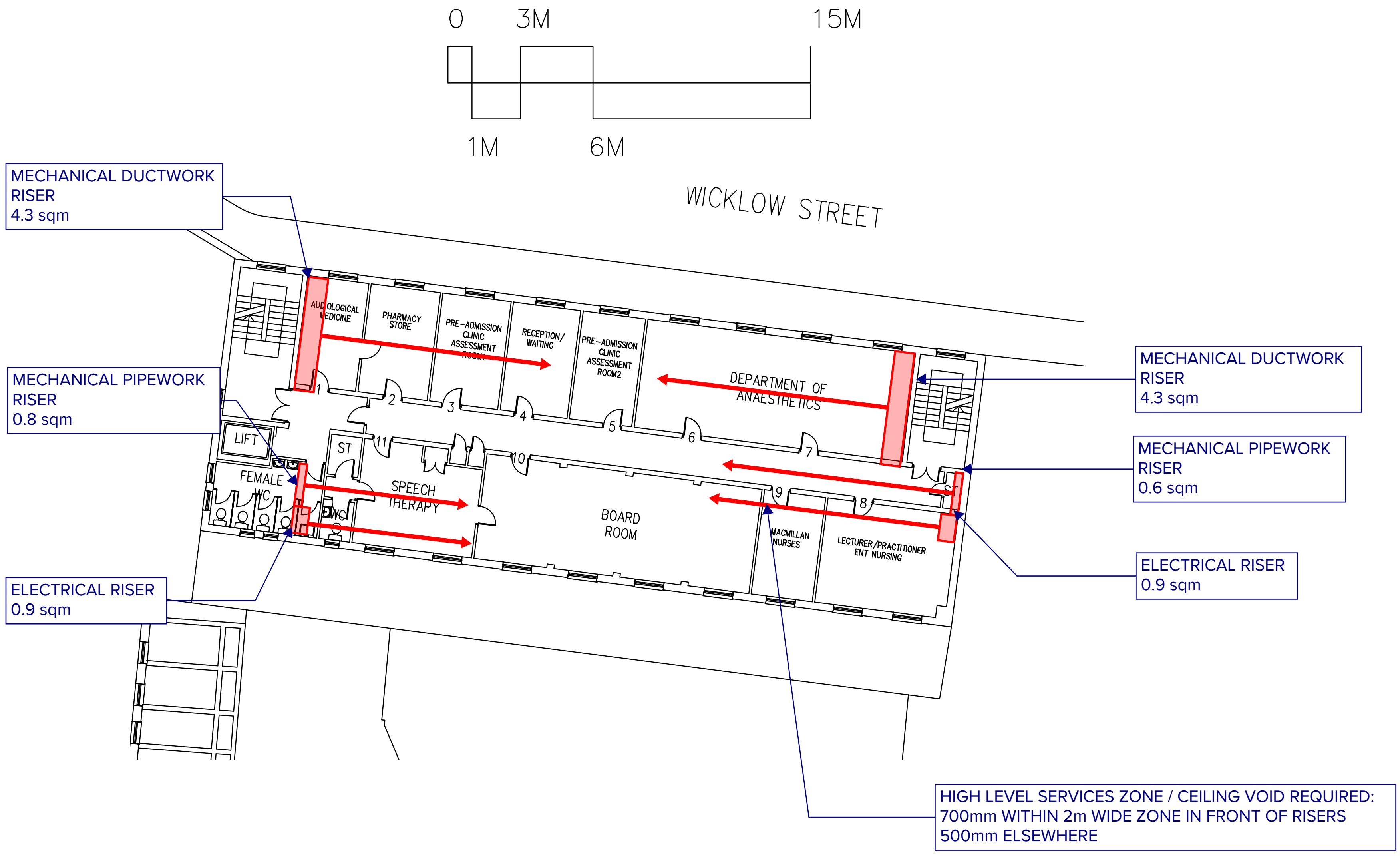

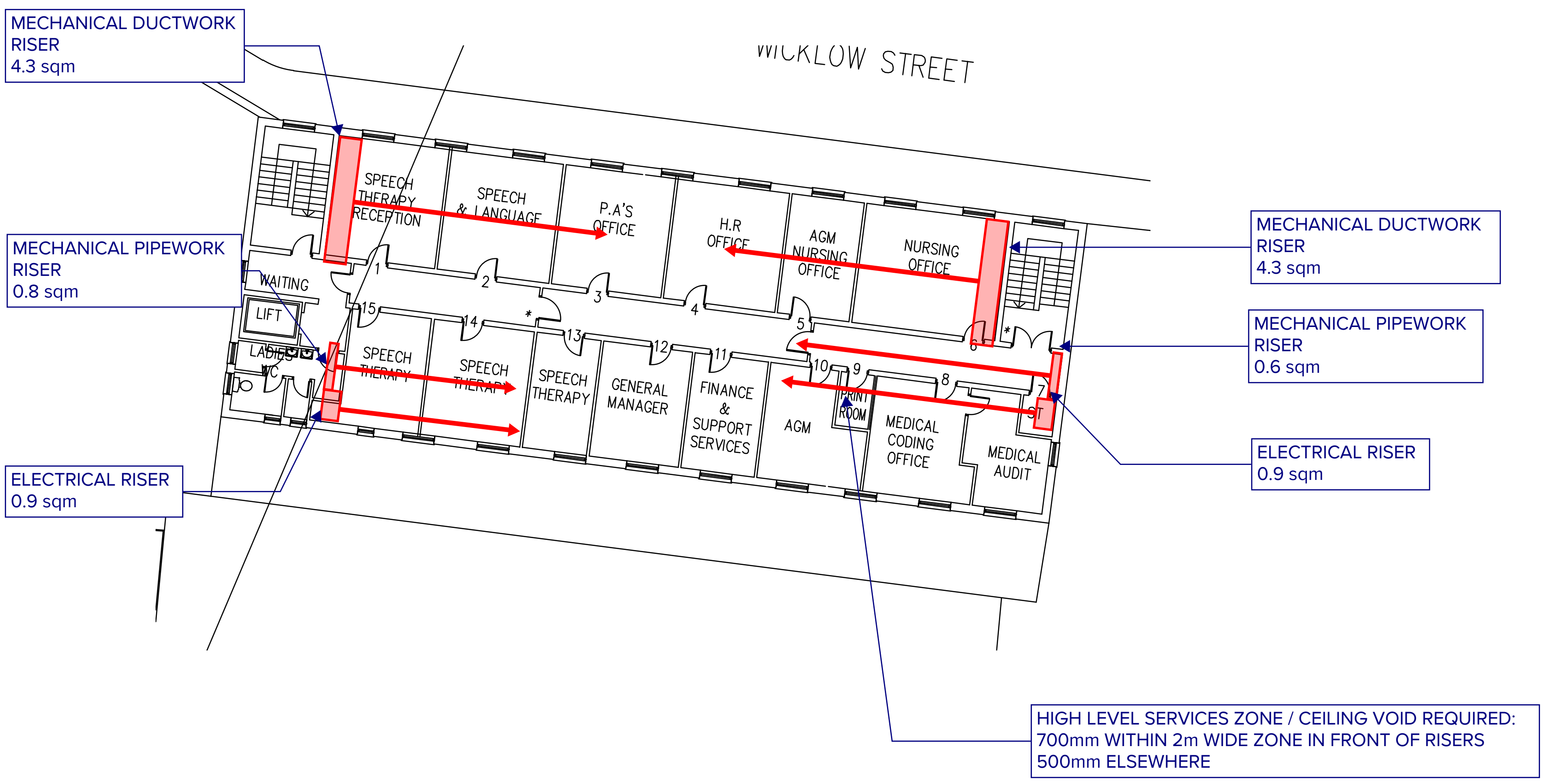

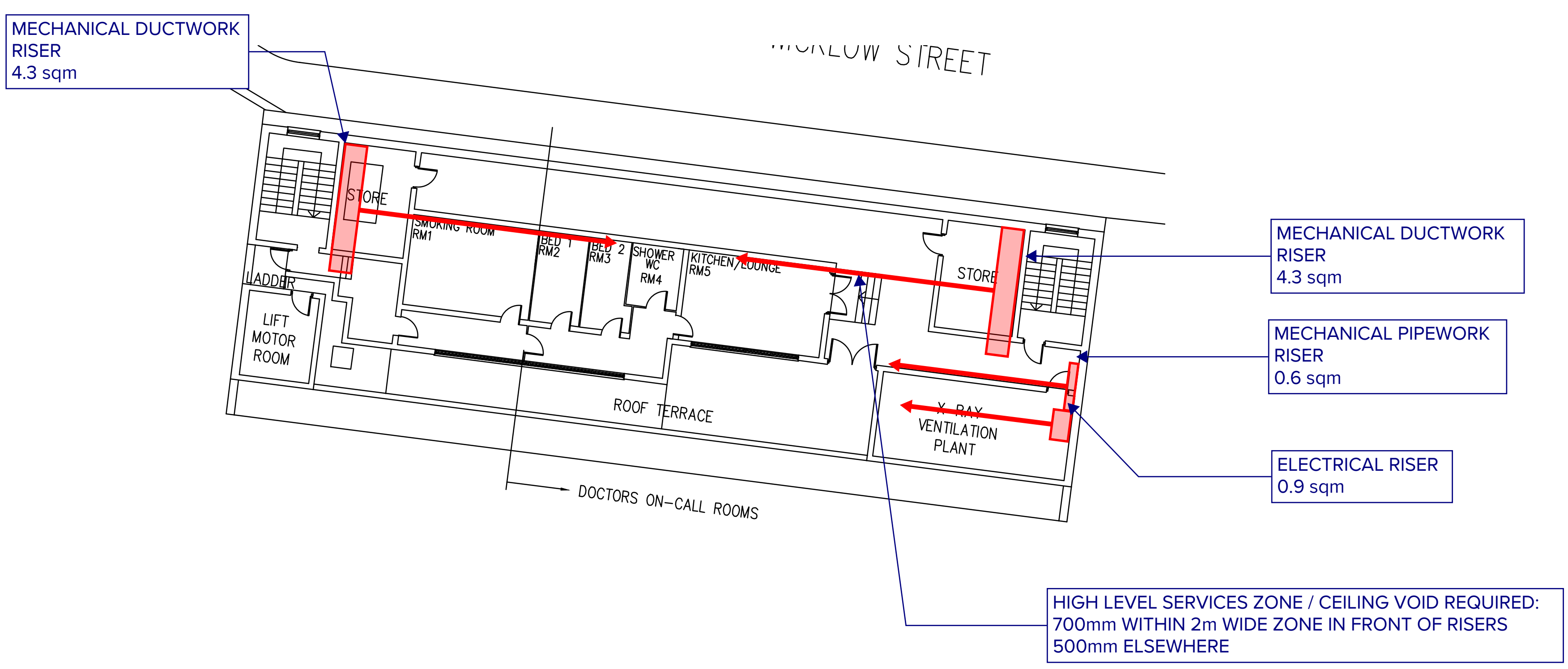

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Building 05
Nurses Building

700mm SERVICES ZONE REQUIRED IN PROXIMITY TO RISERS.
500mm ELSEWHERE.
ASSUMING 300mm THICK SLAB, GIVES A FLOOR TO CEILING HEIGHT OF:
- 2165mm NEAR THE RISERS AND
- 2365mm ELSEWHERE

700mm SERVICES ZONE REQUIRED IN PROXIMITY TO RISERS.
500mm ELSEWHERE.
ASSUMING 300mm THICK SLAB, GIVES A FLOOR TO CEILING HEIGHT OF:
- 2390mm NEAR THE RISERS AND
- 2590mm ELSEWHERE

700mm SERVICES ZONE REQUIRED IN PROXIMITY TO RISERS.
500mm ELSEWHERE.
ASSUMING 300mm THICK SLAB, GIVES A FLOOR TO CEILING HEIGHT OF:
- 2000mm NEAR THE RISERS AND
- 2200mm ELSEWHERE

700mm SERVICES ZONE REQUIRED IN PROXIMITY TO RISERS.
500mm ELSEWHERE.
ASSUMING 300mm THICK SLAB, GIVES A FLOOR TO CEILING HEIGHT OF:
- 1880mm NEAR THE RISERS AND
- 2080mm ELSEWHERE

1000mm SERVICES ZONE REQUIRED AT HIGH LEVEL.
ASSUMING 300mm THICK SLAB, GIVES A FLOOR TO CEILING HEIGHT OF 1840mm

APPENDIX B: 300 GRAY'S INN ROAD DDN ST 31

330 GRAY'S INN ROAD DDN ST 31

Floor Loadings for the Nurses' Home, Wicklow ST

INTRODUCTION

This note summarises the likely imposed floor load for which the Nurses' Home on Wicklow St was designed and provides a comparison with current office floor loadings.

HISTORY OF THE NURSES HOME

Study of historical Ordnance Survey (OS)maps shows the site of the Nurses' Home to be occupied by terraced residential properties until at least 1921. An aerial photograph from 1946, see below, clearly shows the Nurses' Home, as do all subsequent OS maps.

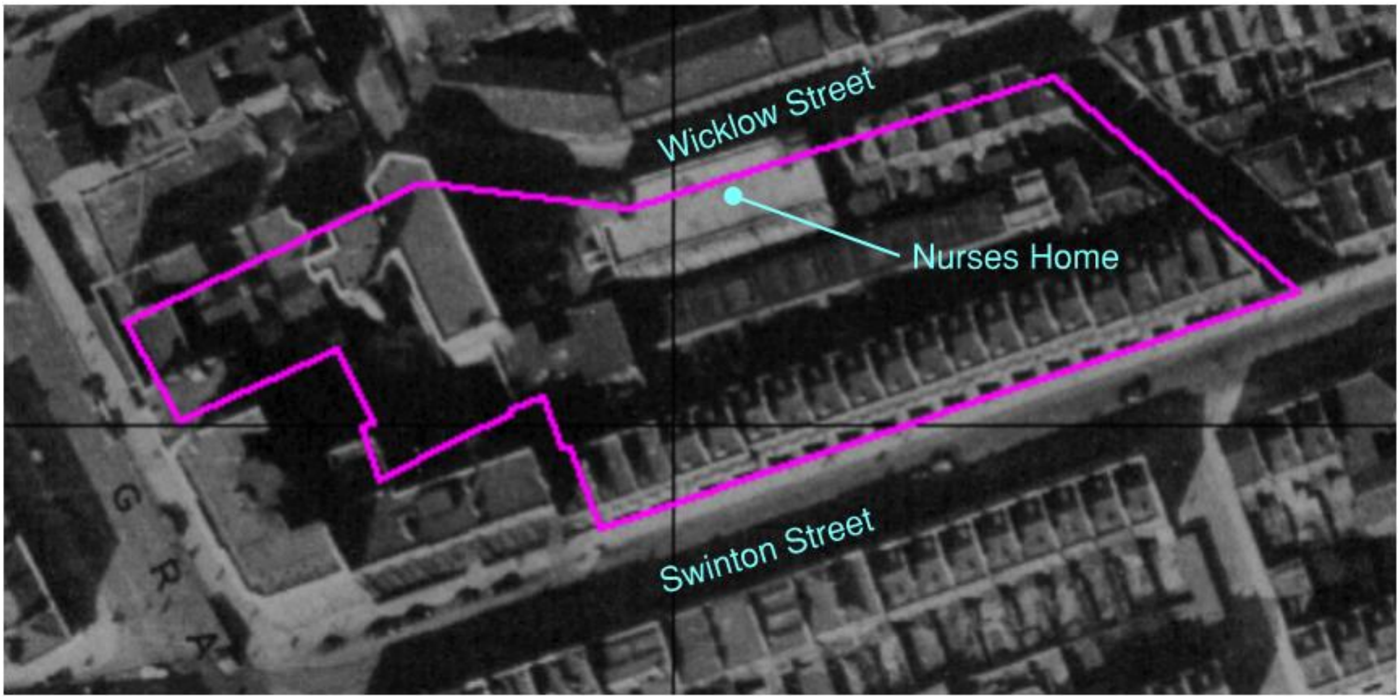

FIGURE 1. Arial photograph dated 1946 showing the Nurses' Home

Dating the construction of the Nurses' Home has been further assisted through internet-based research. The website ezitis.myzen.co.uk gives details of 'Lost Hospitals of London'. The entry under the Royal National Throat Nose & Ear Hospital records that nos. 57-67 Wicklow St 'were purchased in 1903 for eventual use as a Nurses' Home'. It then goes on to say that 'Thirty years after purchase, plans were made to convert the Wicklow Street houses ……..into a Nurses' Home' noting that it opened in 1935. From this, it seems plausible that the Nurses' Home was constructed between 1933 and 1935.

CODES OF PRACTICE FOR IMPOSED LOADING ON FLOORS AND ROOFS

The Institution of Structural Engineers (IStructE) produced a report in in 1927 which recommended a floor live load allowance of 40lbs/ft^2 this equates to 1.9kN/m^2 for 'tenements and upper floors of houses not exceeding 4 storeys'. This document was revised in 1933 and continued with 40lbs/ft^2 (1.9kN/m^2) for 'Living rooms, etc., in private houses, residential flats, hospitals, tenements…….' and the such like. For the purposes of this note comparison will be made between current office loadings and the loadings derived from the IStructE reports.

Imposed loads for roofs with access, which is the case here, are given as 50lbs/ft^2 (2.4kN/m^2), 1927 report and 30lbs/ft^2 (1.43kN/m^2), from the 1933 report.

CURRENT OFFICE FLOOR AND ROOF LOADING REQUIREMENTS

Current imposed load guidance is given in BS EN 199-1-1:2002 Actions on structures. General actions - Densities, self-weight, imposed loads for buildings, modified by the National Annex.
Office imposed loads (Category B1): 2.5kN/m^2 and, for open plan offices, it is usual to have an allowance of 1.0kN/m^2 for demountable partitions.

Furthermore, an allowance should be made for a superimposed dead load of 0.85kN/m^2, this takes account of raised access flooring, ceilings and floor and ceiling services. However, for comparative purposes, it will be assumed that existing ceilings will either be kept and re-used or replaced,so the superimposed dead load will be taken as an addition of 0.45kN/m^2.

Future imposed roof loadings are likely to be required to accommodate roof plant loading of 7.5kN/m^2.

ASSUMED SELF WEIGHT

In order to make a comparison of the percentage increase in loads, it is necessary to take account of the structural self-weight. The floors will be assumed to comprise a 6" (150mm) thick slab with 1" (25mm) hard finish giving a dead load of 4.2kN/m^2. The original roof will have had a screed laid to falls to allow drainage. The Nurses' Home has subsequently had a lightweight roof extension added, it is most probable that the original screed will have been removed to provide the capacity to support the extension. As the extension will be removed, and the screed not replaced, this weight saving can be added to the existing roof capacity. The screed taken as an average of 75mm thick and load as 1.8kN/m^2. Roof structure taken as a 6" (150mm) thick slab, weight 3.6kN/m^2.

LOAD COMPARISON

Load Type	Original Imposed Load (kN/m^2)	Original Self Weight (kN/m^2)	Original Total Load (kN/m^2)	Required Imposed Load (kN/m^2)	Required Imposed Dead Load (kN/m^2)	Required Total Dead + Live Load (kN/m^2)	% Increase
Floor 1	1.9	4.2	6.1	2.5 + 1	0.45	3.95 + 4.8	43%
Roof (1927)	2.4 + 1.8 Screed	3.6	7.8	7.5	-	7.5 + 3.6	42%
Roof (1933)	1.43 + 1.8 Screed	3.6	6.83	7.5	-	7.5 + 3.6	62%

SUMMARY

While modest percentage increases in load, less than 10%, may be supported by the existing floor and roof structures without any intervention, increases in excess of 40% most certainly cannot. To support these increased loads either very significant strengthening measures will need to be introduced or existing elements will require demolition and rebuilding. From the topographic survey drawings, it seems likely that the internal structures are a combination of framed construction, either steel or reinforced concrete, in combination with load bearing masonry. Internal load bearing walls will disrupt the space planning of open plan offices and so will require replacement with steel frames and associated piled foundations and pile caps.
The load increase from retained vertical loadbearing structure on the internal foundations will also require significant intervention anticipated to be either inclined piles (Pale Radici) or piles and pile caps supporting pin beams beneath existing foundations.

HEALTH AND SAFETY

While the interventions described in the previous summary can be introduced and the work undertaken safely, the processes and methods involved are inherently more hazardous than new build.

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