

Royal Berkshire Hospital
ICS Elective Recovery Building
RIBA Stage 2 MEP Services Report



Client Royal Berkshire NHS Foundation Trust
Royal Berkshire Hospital
London Road
Reading
RG1 5AN

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Executive Summary

The Royal Berkshire NHS Foundation Trust are procuring the design for a new ICS Elective Recovery building which, is to be located adjacent to the South Block of the main building. The new facility will replace the existing South Block Annex building that is currently based in a common location within the south car park.

The facility will comprise of a single-storey building, with the design and planning flexibility to increase to a double-storey building in the future. There is also the intent to connect the South Block Waiting Area to the new premises, should it become a double-storey building, via a dedicated sky bridge.

Externally, the site will comprise of a MEP plant area that will serve the entire building. This dedicated plant area will be sized to contain the required equipment for all MEP services, including heating and cooling air source heat pumps, air handling units, packaged pump rooms for water systems, generators, packaged substation and generator fuel tank.

At stage 2, there are various options available to the Trust for the final connection of the incoming utilities;

- Power – connection into the existing campus primary and secondary power systems or provision of new from the local DNO and secondary power by a local generator
- Water – use of the current water connection serving the annex building sourced from the local utility provider
- Heating – connection into the existing campus district heating network or produced locally using air source heat pumps
- Chilled water – connection into the existing campus chilled water network or produced locally using air source heat pumps
- ICT – the existing campus fibre backbone will be extended to incorporate the new building
- Gas – no gas service required for the new building

The MEP servicing strategies within the building have been considered with simplicity and energy efficiency at the forefront of the decision making process, ensuring the future operation is both maintenance friendly and sustainable.

At Stage 2, the design is immature with most systems coming with options. The decision making on these options will be driven by economics, user preferences and operational requirements. These decisions will need to be made early in Stage 3 to allow the design to progress in accordance with the overall programme.

Summary of core services provided as part of the Design team:

- Planning Consultancy – GBS
- Architecture – GBS
- Electrical Engineering – RED
- Mechanical Engineering – RED
- Public Health Engineering – RED
- Sustainability Engineering - RED
- Structural Engineering – Stantec
- Civil Engineering – Stantec
- ICT – Trust
- Quantity Surveyors – CSA
- Acoustic Study – Hepworth Acoustics
- Fire Engineering – TBC
- Building Control Officer – TBC

Next Steps:

- Receipt of planning permission
- Confirmation of cooling and heating strategy
- Approval of the room data sheets by all stakeholders
- Finalisation of floor plan and freezing of the architect’s model
- Progress with the RIBA Stage 3 design

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Acronyms & Abbreviations

AC	Access Control
ACB	Air Circuit Breaker
ACH	Air Change
ACU	Air Conditioning Unit
AFFL	Above Finished Floor Level
AHU	Air Handling Unit
ASD	Aspirating Smoke Detection
ASHP	Air Sourced Heat Pump
BB	Busbar
BDS	Building Distribution System
BIM	Building Information Modelling
BMS	Building Management System
BOD	Basis of Design
BOM	Bill of Materials
BT	Break Tank
BV	Buffer Vessel
CAPEX	Capital Expenditure
CAV	Constant Air Volume
CCTV	Closed Circuit Television
CDP	Contractor Designed Portion
CHW	Chilled Water
CMMS	Computerised Maintenance Management System
CT	Current Transformer
CW	Condensate Water
Cx	Commissioning
dB	Decibel
DB	Distribution Board
DB	Dry Bulb
DCP	DC Panel
DCW	Domestic Cold Water
DHW	Domestic Hot Water
EIA	Environmental Impact Assessment
FCU	Fan Coil Unit
FFL	Finished Floor Level
FM	Facilities Manager
FOC	Fibre Optic Cable
GC	General Contractor
GEN	Generator
GIA	Gross Internal Area
GMC	Generator Master Controller
GNS	Earth Ground
GPS	Generator Paralleling Switchgear
GUI	Graphical User Interface

HDC	Hard Drawn Copper
HDPE	High Density Polyethylene
HL	High Level
HMI	Human Machine Interface
HTM	Health Technical Memorandum
HBN	Health Building Notes
HEX	Plate and Frame Heat Exchanger

ICR	Intercom Station
IDF	Intermediate Distribution Frame
INF	Infrastructure Fibre

JB	Junction Box
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KO	Kick Off
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LAN	Local Area Network
LL	Load Losses
LL	Low Level
LLE	Long Lead Equipment
LOD	Level of Detail
LP	Lighting Panel
LTHW	Low Temperature Hot Water

MCB	Miniature Circuit Breaker
MCC	Mechanical Control Centre
MCCB	Moulded Case Circuit Breaker
MEP	Mechanical, Electrical, Plumbing
MIAT	Manually Initiated Automatic Transfer
MMF	Multi-mode Fibre
MUW	Make Up Water
MVD	Medium Voltage Distribution Switchgear

NC	Normally Closed
NEMA	National Electrical Manufacturers Association
NO	Normally Open
NLL	No Load Losses

OLTC	On Load Tap Changers
ONAF	Oil Natural Air Forced
ONAN	Oil Natural Air Natural
OPEX	Operating Expenditures
OPS	Operations
OS	Occupancy Sensor
OWS	Operator Workstation

PB	Pull Box
PDU	Power Distribution Unit
PIDS	Perimeter Intrusion Detection Systems
PLC	Programmable Logic Controller
PF	Power Factor
PIR	Passive Infra-Red
PMS	Power Monitoring System
POE	Point of Entry
PMP	Pump

PP	Patch Panel
PQM	Power Quality Meter
PSE	Power SCADA Experts
PSO	Power SCADA Operations
PUE	Power Usage Effectiveness
PUF	Pad Utilities Foundation
PVC	Poly Vinyl Chloride
PHX	Plate Heat Exchanger

QA	Quality Assurance
QC	Quality Control

RCBO	Residual Current Circuit Breaker with Overcurrent Protection
RCD	Residual Current Device
RFI	Request for Information
ROP	Remote Operating Panel
RP	Remote Panel
RPP	Remote Power Panel
RTU	Remote Terminal Units

SAI	Systems Architecture & Integration
SCADA	Supervisory Control and Data Acquisition
SD	Smoke Detector
SLD	Single Line Drawing
SMF	Single-mode Fibre
SOO	Sequence of Operations
SOW	Scope of Works
SPD	Surge Protection Device
SFID	Service Flow Identifier
SQL	Structured Query Language
SS	Superseded

TCO	Total Cost of Ownership
TELE	Telecommunications
THD	Total Harmonic Distortion
TP	Three Pole
TPN	Three Pole & Neutral
TVSS	Transient Voltage Suppression System
TX	Transformer

U/G	Underground
UPS	Uninterruptible Power Supply
VAV	Variable Air Volume Unit
VCB	Vacuum Circuit Breaker
VM	Video Monitor
VRF	Variable Refrigerant Flow
VRLA	Valve Regulated Lead Acid (Battery)
VRV	Variable Refrigerant Volume
VT	Voltage Transformer

WAP	Wireless Access Point
WB	Wet Bulb
WC	Water Closet (Toilet)
WIP	Work in Progress
WP	Weatherproof

1.0 INTRODUCTION

1.1 Project Overview

The project comprises of the design and build of a new Elective Recovery Building, in Reading, for The Royal Berkshire NHS Foundation Trust. The new facility will be located on the site of an existing building, that is due to be demolished on the southern extremity of the site. The intent is to connect the South Block Waiting Area to the new premises via a future skybridge and future proof the building for a possible first floor extension. The images in Figure 1.1 and 1.2 below outline the overall site and highlight the area for development described in this report.

The Trust has appointed RED to undertake the RIBA Stage 2 MEP design and as such produce the Basis of Design document which describes the design principles and philosophies to be applied at the next stage of the design.



Figure 1.1 – Current South Block Annex building



Figure 1.2 - Site plan

2.0 STAGE 2 OVERVIEW

2.1 Stage 2 Deliverables

Table 2.1 – Stage 2 Deliverables

Document Number	Title	REV
General		
P.019694-RED-XX-XX-RP-Z-0001	Stage 2 Report	P01
P.019694-RED-XX-XX-RP-U-0001	BREEAM Pre-Assessment	P01
Mechanical		
P.019694-RED-XX-00-DR-M-1101	Mechanical Services – Ventilation Schematic	P01
P.019694-RED-XX-00-DR-M-1201	Mechanical Services – Heating & Cooling Schematic	P01
P.019694-RED-XX-00-DR-M-2101	Mechanical Services – Ventilation Layout 1 of 2	P01
P.019694-RED-XX-00-DR-M-2102	Mechanical Services – Ventilation Layout 2 of 2	P01
P.019694-RED-XX-00-DR-M-2201	Mechanical Services – Heating & Cooling Layout 1 of 2	P01
P.019694-RED-XX-00-DR-M-2202	Mechanical Services – Heating & Cooling Layout 2 of 2	P01
P.019694-RED-XX-00-DR-M-1901	Mechanical Services – Zoning Layout	P01
Electrical		
P.019694-RED-XX-00-DR-E-1201	Electrical Services – Single Line Diagram Schematic	P01
P.019694-RED-XX-00-DR-E-2101	Electrical Services – Containment Layout	P01
Combined		
P.019694-RED-XX-00-DR-Z-0001	Combined Services – Equipment Layout	P01
P.019694-RED-XX-00-DR-Z-0002	Combined Services – Plant Compound Layout	P01
P.019694-RED-XX-00-DR-Z-0003	Combined Services – Room Design Criteria	P01
P.019694-RED-XX-00-DR-Z-0004	Combined Services – Combined Services Layout & Sections	P01

2.2 Assumptions

To proceed with the Stage 2 design, the following assumptions have been made:

- Only the Lithotripter is be considered a “critical space” and will follow HTM guidance of adopting a resilient 2N ventilation system.
- Only the ‘Dirty Utility’ room has a dedicated extract fan. WCs, changing rooms and the cleaner’s cupboard are currently assigned to the general AHU due to mitigating the risk of cross-contaminating airflows with a plate heat exchanger.
- All circulation will be provided with 0.5 l/s/m² as per the 2021 revision of Part F
- All heating and cooling systems will have resilient pumps (duty / standby) for continuity of services during maintenance.
- Ultrasound room is to be considered a “General Treatment Room”.
- No rooms are to contain medical gases.
- No intrusive surgery is to take place within this building – only minor treatments and consultation. Therefore, all spaces are treated as “General Treatment Rooms”.

2.3 Requests for Information (RFIs) Outstanding

Project	Discipline	Raised by:	Date Raised	Action by:	Deliverable	Description	Complete	Notes
ERF - Elective Bldg	MEP	RED	09/01/2022	RBH	RFI	Confirm classification of "Treatment" rooms, as per Table 2 of HTM 03-01. Initial assumption is to base on 'General Treatment Rooms'?	Open	
ERF - Elective Bldg	MEP	RED	09/01/2022	RBH	RFI	Please provide a list of specialist equipment to be located within all 'Treatment', 'Ultrasound', 'Recovery' and 'Theatre' rooms, and their associated MEP services requirements	Open	
ERF - Elective Bldg	MEP	RED	09/01/2022	RBH	RFI	Minor Theatre / Lithotripter - room area currently adheres to requirements set out in HBN 10-1. Therefore, please provide further details of specific theatre type, ventilation rates and pressurisation requirements. Is it a lead-lined room? Current assumption is that this room will require 25ACH and dedicated duty/standby	Open	
ERF - Elective Bldg	MEP	RED	09/01/2022	RBH	RFI	Isolation Rooms - current assumption is that these are private patient rooms and not for medical isolation of infectious diseases. If this is incorrect please state which classification should be used, based on Tables 3 & 4 of HTM 03-01.	Closed	Rooms removed from latest plans
ERF - Elective Bldg	MEP	RED	09/01/2022	RBH	RFI	Please confirm which option primary heating and cooling plant option we are progress the stage 3 based upon.	Open	
ERF - Elective Bldg	MEP	RED	09/01/2022	RBH	RFI	Staff Room / Sisters Office / Research Office - confirmation of any water supplies and drainage required	Open	
ERF - Elective Bldg	MEP	RED	09/01/2022	RBH	RFI	Changing Rooms + WC - are there to be lobbies required? Prior to entering the room	Open	
ERF - Elective Bldg	MEP	RED	09/01/2022	RBH	RFI	Assumption - there aren't going to be any dedicated medical gas supplied to the building requiring central / piped systems. Please confirm	Open	
ERF - Elective Bldg	MEP	RED	09/01/2022	RBH	RFI	Please clarify if any rooms are expected to contain an anaesthetic agent.	Open	
ERF - Elective Bldg	MEP	RED	09/01/2022	GBS	RFI	Isolation Rooms - are there any domestic water and drainage requirements?	Closed	Rooms removed from latest plans
ERF - Elective Bldg	MEP	RED	09/01/2022	GBS	RFI	Isolation Room En-Suite - what will the en suite contain? Assumption WC and basin only (no shower). Please confirm	Closed	Rooms removed from latest plans
ERF - Elective Bldg	MEP	RED	15/03/2022	GBS	RFI	RDS show no design upper limit for cooling (just permissible range up to ~28deg). We are assuming users can control up to permissible range, but the cooling equipment to be designed as per HTM 03-1, section 7.19, which states 22 degrees (23 degrees for office - CIBSE). Can you please confirm this is the correct interpretation?	Open	
ERF - Elective Bldg	MEP	RED	15/03/2022	RBH	RFI	Minor Theatre - full description required. Will this room contain a scrub area? Will this be enclosed? Should the design account for general anesthetic admission? Should this room be deemed as "critical" as outlined in HTM 03-01 4.13	Open	
ERF - Elective Bldg	MEP	RED	15/03/2022	RBH	RFI	Details required with regards to what is to be in the kitchen and how this space is to be sub-divided between staffroom and seminar room.	Open	
ERF - Elective Bldg	MEP	RED	15/03/2022	RBH	RFI	Have the ADB Room data sheets been signed off by the trust? If so, can a bespoke RDS be provided for stage 3?	Open	
ERF - Elective Bldg	MEP	RED	15/03/2022	RBH	RFI	Confirmation of the IT Hub Room location required	Open	
ERF - Elective Bldg	MEP	RED	15/03/2022	RBH	RFI	Below ground service drawing doesn't show the size of the incoming water supply. This is to be confirmed or surveyed	Open	

Table 2.2 – Outstanding RFIs

3.0 CODES, GUIDES & REGULATION

In addition to the requirements stipulated by the local Building Control, Fire and Environmental Officers, the following Rules, Regulations, Standards, Codes, Guides and Best Practice will be the basis of the design. In addition to the industry documentation.

All referenced documents are deemed to be the latest edition.

Additional codes may be used for specific elements of the design that are not covered by the listed codes and standards however, these will be required to align with the design principles identified in this report.

The interaction of the various Rules, Regulations, Standards, Codes, Guides and Best Practice is summarised below:

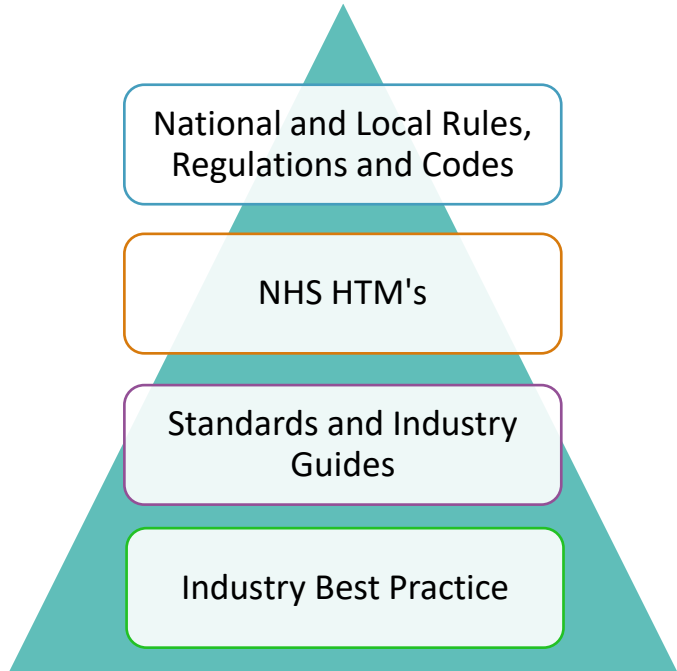


Figure 3.1 – Hierarchical application of Codes, Standards and Guidance

3.1 Acts

- The Health and Safety at Work Act
- The Equality Act
- The Clean Air Act
- The Control of Pollution Act
- Fire Precautions Act
- Disability & Discrimination Act
- Regulations under the Factories Act
- Town and Country Planning Act and associated Acts

3.2 Regulations

- Building Regulations and Approved Documents
- CDM Regulations
- Control of Electromagnetic Fields at Work Regulations

- Control of Major Accident Hazards Regulations
- Control of Noise at Work Regulations
- Control of Substances Hazardous to Health Regulations
- Control of Vibration at Work Regulations
- Dangerous Substances and Explosive Atmospheres Regulations
- Electricity and Work Regulations
- Gas Safety Regulations
- Management of Health and Safety at Work and Fire Precautions Regulations
- The Electricity Supply Regulations
- The Water Supply Regulations
- Ecodesign of Energy Consuming Products Regulations

3.3

Standards, Codes & Guides

Abbreviation/Heading	Title
HTM	Health Technical Memorandum
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
BCO	British Council for Offices
BICSI	Building Industry Consulting Service International – Data Centre Design & Implementation Best Practice
BS	British Standard
BS EN	British & European Standard
BSRIA	Building Services Research and Information Association – Guides & Application
CEN	European Committee for Standardization
CIBSE	Chartered Institute of Building Services Engineers
CPNI	Centre for the Protection of National Infrastructure
IET	Institute of Engineering and Technology

The following are particular to the mechanical engineering design

Abbreviation/Heading	Title
HTM 00	Building engineering in the health sector
HTM 03-01	Specialised ventilation for healthcare premises
HTM 05-02	Fire safety in t the design of healthcare premises
HTM 07-02	Making energy work in healthcare
BESA	Building Engineering Services Association Guidance
BS EN 378-1	Refrigerating Systems and Heat Pumps – Safety and Environmental Requirements
BSRIA	Building Services Research and Information Association
BSRIA BG6	Buildings Guide 6
CIBSE	Charters Institute of Building Services Engineers Guides

The following are particular to the public health engineering design

Abbreviation/Heading	Title
BS EN 12056	Above ground drainage (Foul and Rainwater)
BS EN 806	Water systems
HSE L8	Legionella
HTM 04-01	Safe water in healthcare premises
HTM 07-04	Water management and water efficiency

The following are particular to the electrical engineering design

Abbreviation/Heading	Title
BS 7671	British Standard - IET Wiring Regulations
BS EN 60034-22	Rotating Electrical Machines Standby Power Systems

BS 5839-1	Fire Detection and Fire Alarm System for Buildings
BS 7430	Code of Practice for Earthing
BS 5266	Code of Practice for Emergency Lighting
BS 62305	Code of Practice for Lightning Protection
CIBSE	Guide F: Energy efficiency in buildings
CIBSE	Guide K: Electricity in Buildings
SLL CIBSE	SLL Code for Lighting
SLL CIBSE	SLL Lighting Handbook
SLL CIBSE	SLL Lighting Guide LG1: The industrial environment
SLL CIBSE	SLL Lighting Guide LG2: Lighting for healthcare premises
SLL CIBSE	SLL Lighting Guide LG7: Offices
	Electromagnetic Compatibility Regulations 2016
HTM 06-01	Electrical Services supply and distribution
HTM 06-02	Electrical safety guidance for low voltage systems
HTM 06-03	Electrical safety guidance for high voltage systems in healthcare premises

3.4 Plant Design Life

The design economic life of plant & systems, subject to proper and adequate maintenance, and life cycle replacement of critical components, will be as follows:

Element	Design Life (Years)
Chillers	15-25
Fuel oil storage tanks (above ground)	25-35
Water storage tanks (plastic)	30-35
Ductwork (galvanised)	25-35
Fans (centrifugal)	15-20
Cooling coils	15-20
Dampers (automatic)	15-20
Air handling units	15-20
Fan coil units (offices)	12-15
Closed circuit steel pipework	25-30
Refrigerant pipework	20-30
Expansion vessels	15-20
Water treatment plant	15-20
Pumps	15-20
Heat exchangers	20-25
Drainage systems (plastic)	25-30
Fire alarm	20-25
Switchgear & distribution equipment	20-25
Transformers	25-30
Main cabling systems	25-30
Lighting installation	15-20
Generators	25-30
Electronic controls	12-18
Batteries	5-10
CCTV & security systems	5-10

4.0 ARCHITECTURAL DESIGN

4.1 Introduction

The RIBA Stage 2 MEP design has been based on the following approved architectural masterplan that has been developed to date. For full size, scaled drawings, refer to the architectural general arrangement drawings.

The MEP services described in this report align to this architectural masterplan.

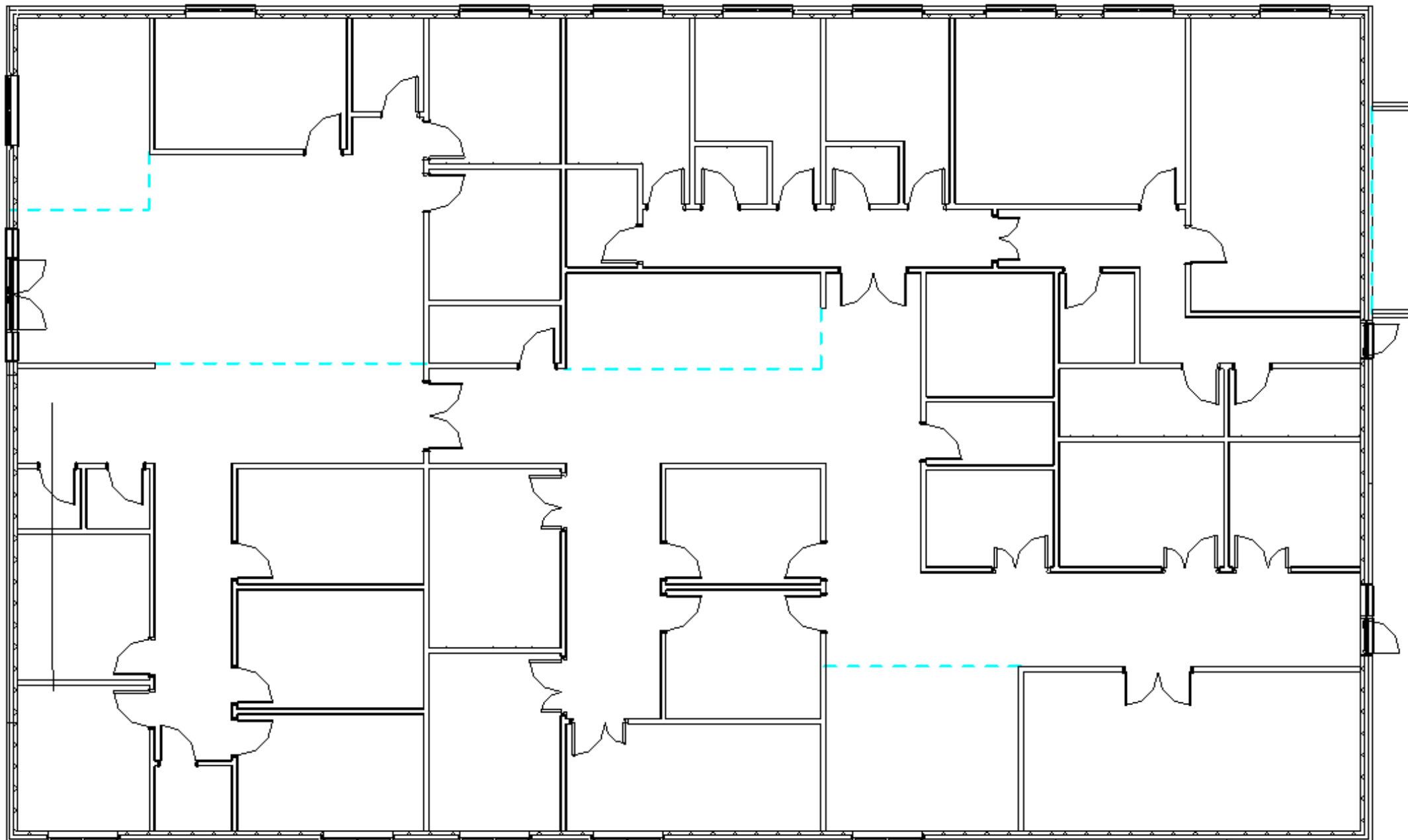


Figure 4.1 - Architectural Masterplan

5.0 SITE UTILITY CONNECTIONS

5.1 Electrical Services

The below figure identifies the incoming power supply into the existing annex building.

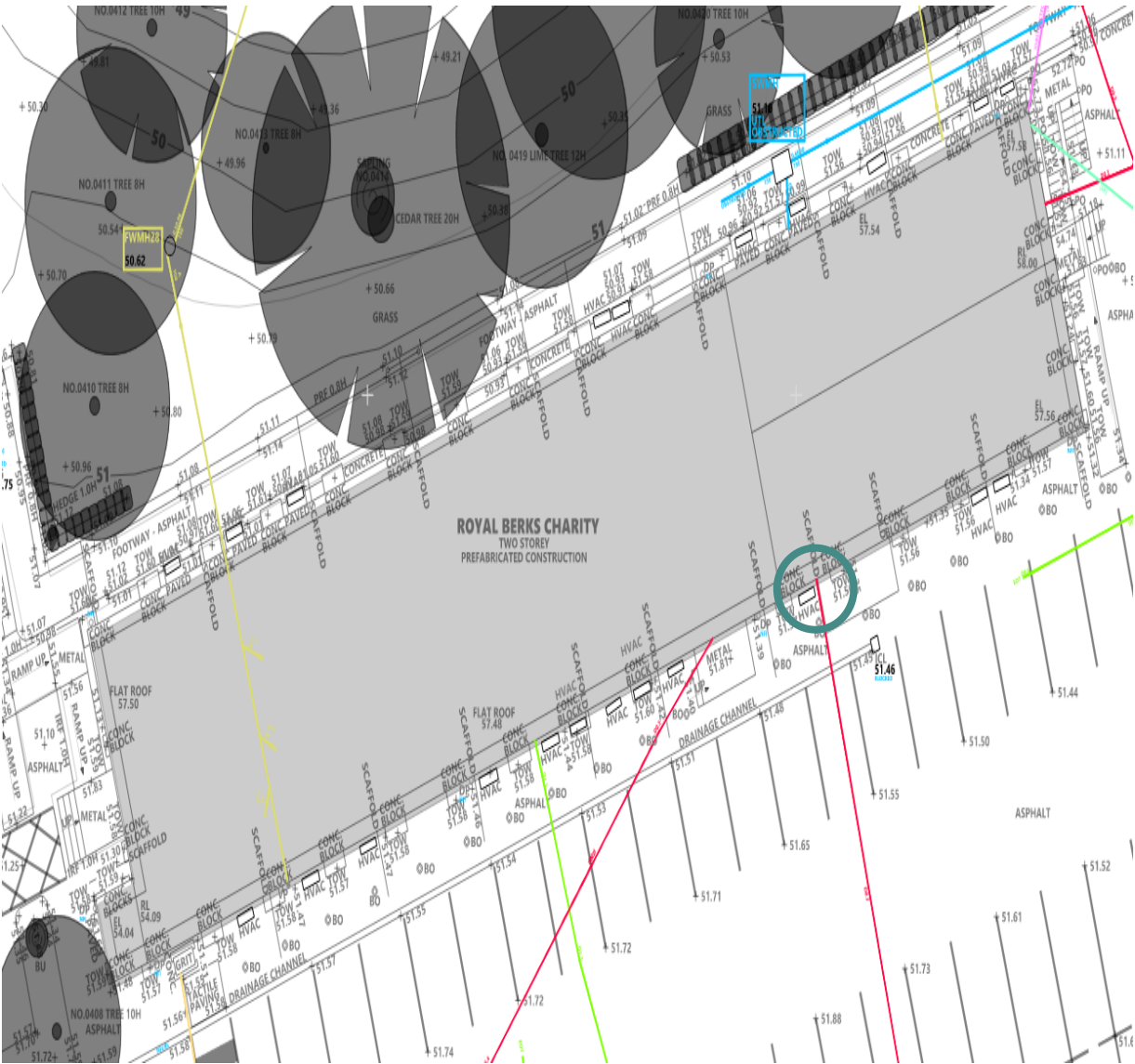


Figure 5.1 – Existing Main incoming supply

Currently, the south block annex building is supplied direct from the District Network Operator (DNO) SSE at 400 V. Due to the calculated maximum demand for a two-storey building, a new upgraded main incoming supply will be required to serve the new building. The new supply will be at either 400 V or 11 kV depending on the outcome of final detailed maximum demand calculations and the chosen connection option.

Options have been considered to supply the new building from the existing RBH electrical infrastructure or from the SSE network.

The maximum demand calculation has been completed based on HTM 06-01 as tabled in 5.1.

Items	HTM 06-01		Building			
	Low W/m²	High W/m²	Area		1608 m²	
			Connected Load		Diversified Load	
			Low W/m²	High W/m²	Low W/m²	High W/m²
AHU Fan's	15	25	24120	40200	16884	36180
Building Services Pump	1	3	1608	4824	1126	4342
Lifts	5	8	8040	12864	2412	6432
Chillers	25	35	40200	56280	36180	53466
General Power	9	25	14472	40200	10130	34170
Information Systems	3	6	4824	9648	4824	9648
Medical Equipment	6	16	9648	25728	4824	18010
General Lighting	9	15	14472	24120	10130	21708
Specialist Lighting	1	2	1447	2412	724	2171
Task Lighting	1	2	1608	3216	1206	2894
Medical Lighting	1	1	1608	1608	1126	1447
Total kW	0.08	0.14	122.05	221.10	89.57	190.47
Total kVA	0.08	0.14	128.47	232.74	94.28	200.49

Table 5.1 1 – Building Electrical Demand

Stage 2 Estimated Building Load – 200 kVA

Options available to supply the new building from the existing RBH electrical infrastructure:

Option 1: New LV connection from the existing hospital LV infrastructure. The suitable LV switchboard is the CHP Substation. Due to the distance between this substation and the location of the Elective Building, the cable size and route will be challenging.

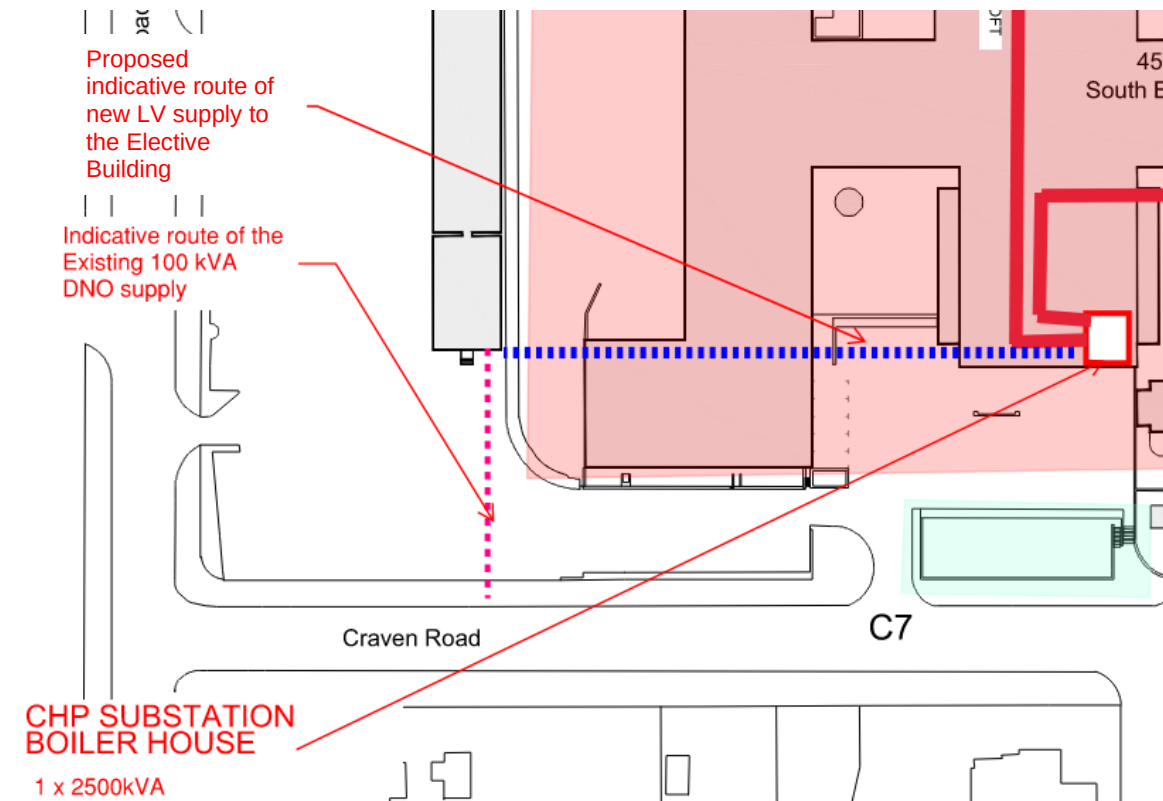


Figure 5.2 – Indictive route for the proposed LV supply

Option 2: New Transformer with new HV ring main extended from Substation D (South Block), this will require a new 11000/400 V transformer to be located within the external plant compound serving the Elective Building.

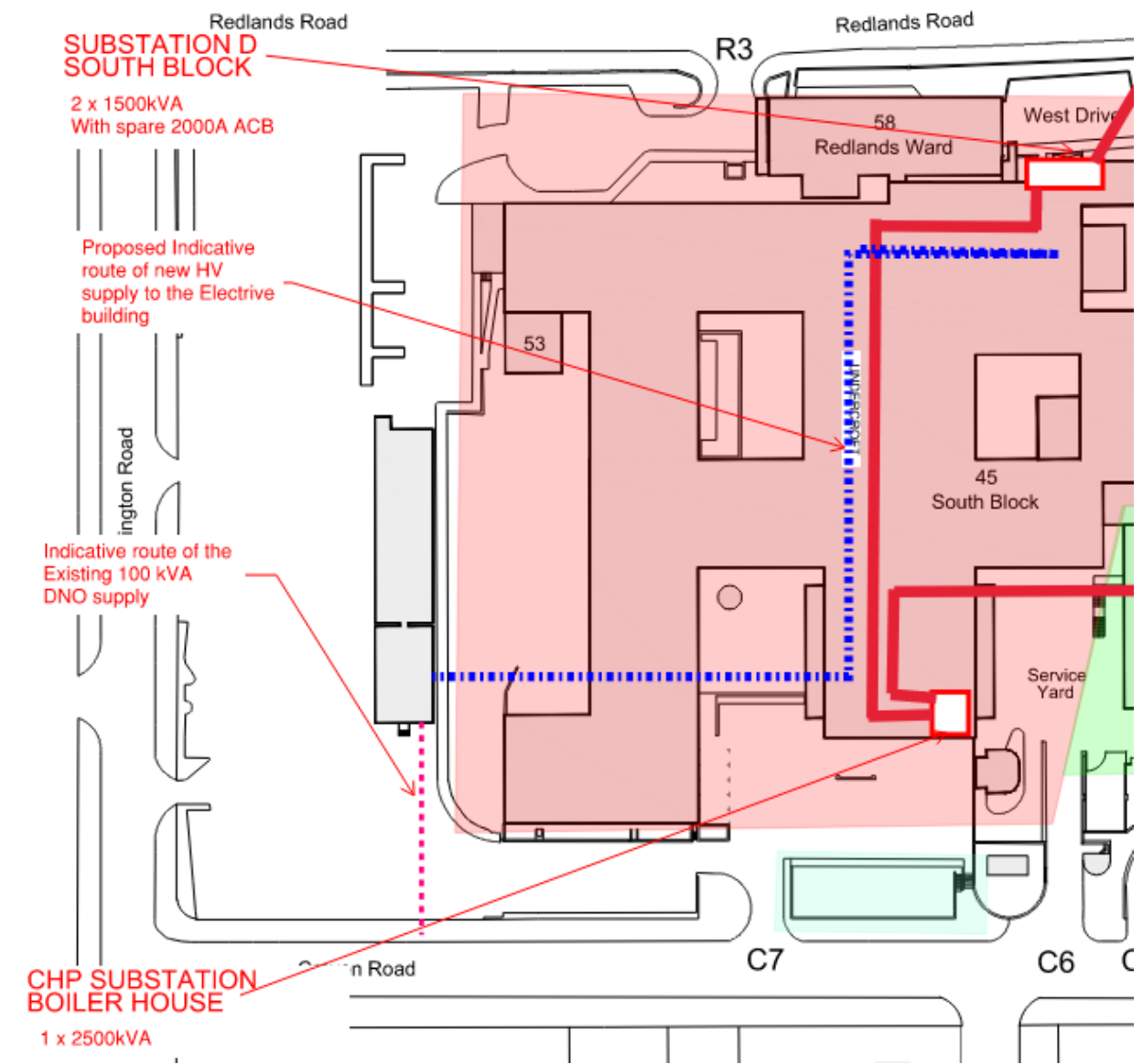


Figure 5.3 – Indictive route for the proposed HV supply

5.2 Generator Supply

The new building will require a generator back up to provide resilience against outages of the main electrical supply.

Generally, there are two options available to provide this back up.

Option 1 – supply the new building from the existing RBH site generator system serving the south of the site. Due to reports by the Trust electrical AE, it is understood that there is no spare capacity in the south generator system to serve the new building.

Option 2 – provide a new standalone generator system, sized for the duty of the new building. The stand-alone generator will be located in the plant compound.

Option 2 is expected to be the option progressed with due to the costs and technical challenges associated with upgrading the south generator system.

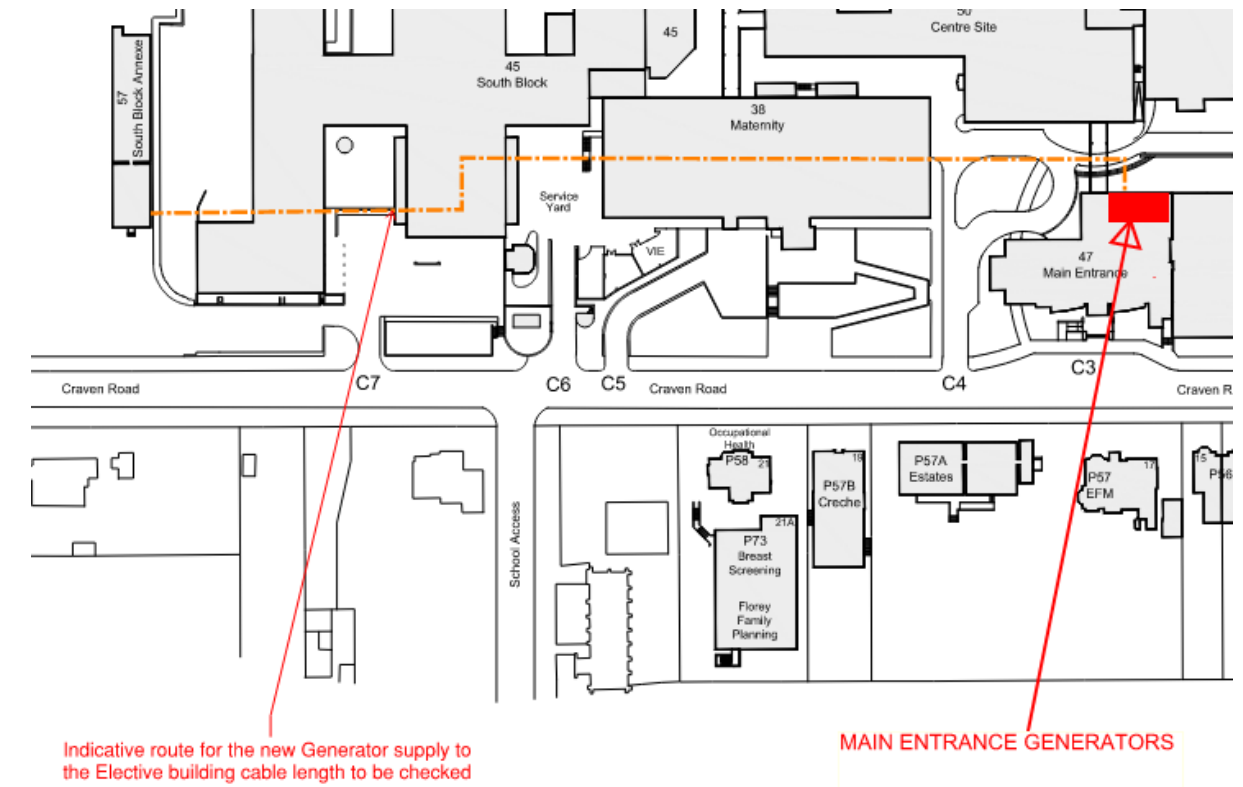


Figure 5.4 – Indicative route for the proposed LV supply

5.3 Water services

The existing mains water connection is to be retained and diverted/extended to suit the new building configuration. The existing mains water connection comes from the pedestrian footpath along Addlington Road, as highlighted in the image below. The existing water supply capacity is subject to further calculations at stage 3.

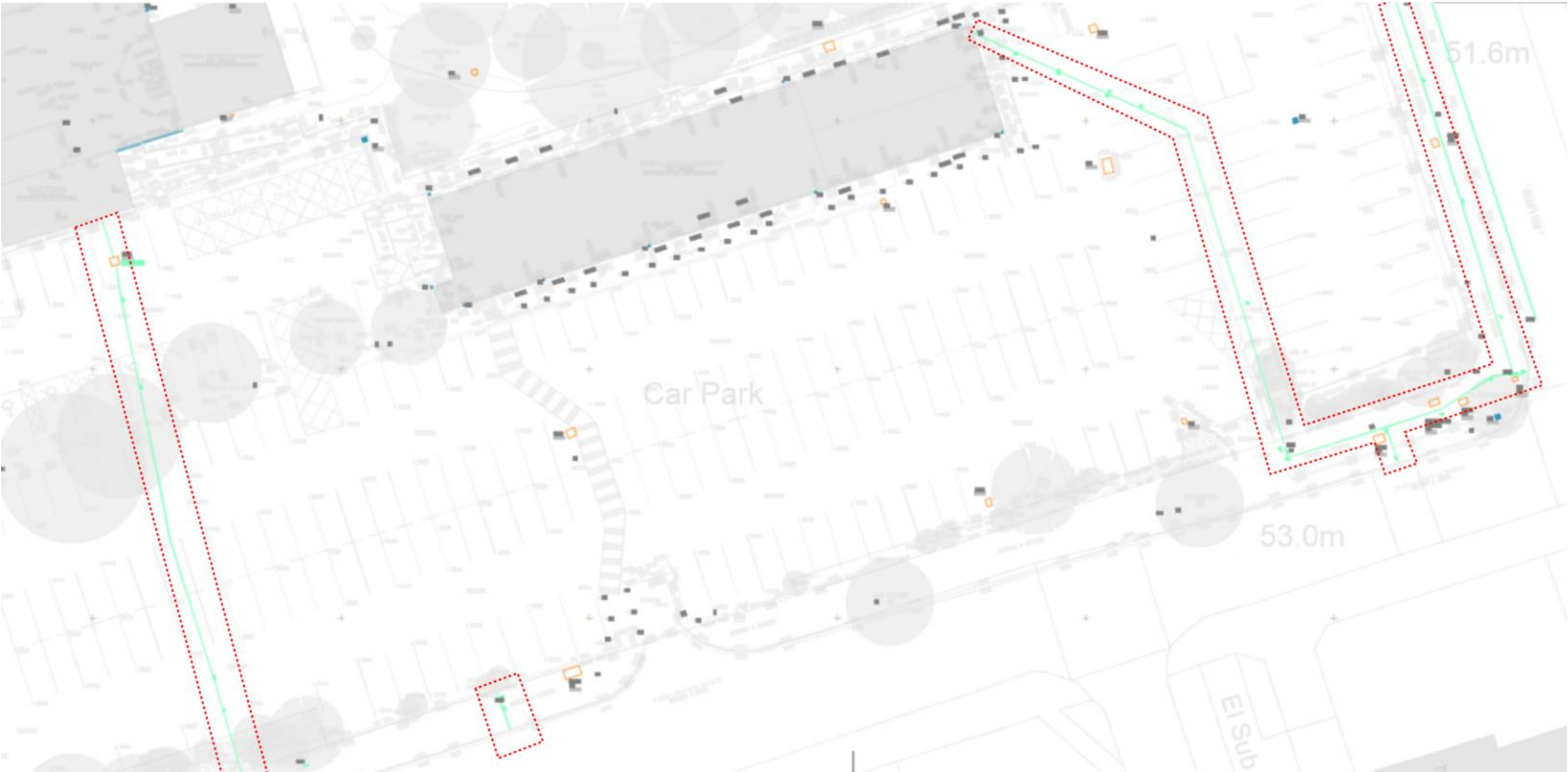


Figure 5.5 - Utility map of water services on site

5.4 Foul Drainage

The below ground drainage systems serving the area will be utilised to service the new development for foul and surface water drainage, the details of which, are to be confirmed by the civil engineer. The existing below ground storm water (blue) and foul water drainage (brown) is shown in the image below. The existing foul drainage capacity is subject to further calculations at stage 3 by the civil engineer.

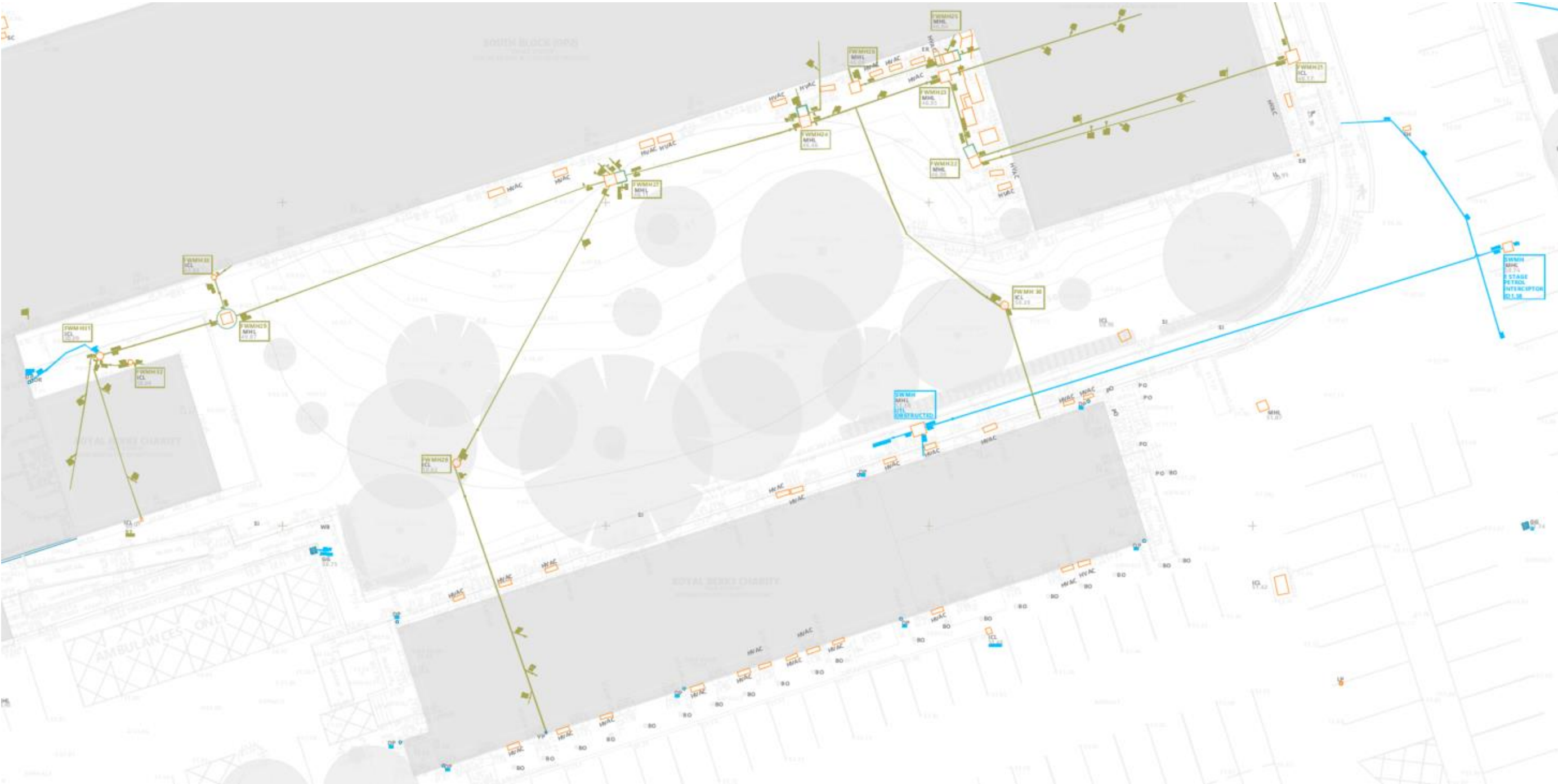


Figure 5.6 – Existing Storm Water and Foul Drainage on site

5.5 ICT Data, Telecoms, Fire Alarm & BMS

Due to the location of the new building, the following fibre connections will be required to connect the new building systems to the main hospital systems:

- New fibre connection between the hospital ICT system network and the new building IT room
- New fibre connection between the hospital telecoms system network and the new building IT room
- New fibre connection between the hospital fire alarm system network and the new building fire alarm panel, this must be a two way signal
- New fibre connection between the hospital BMS system network and the new building BMS panel
- New fibre connection between the hospital security system network and the new building security network switch

The new fibre connection cables will follow the bridge crossing supported by containment systems.

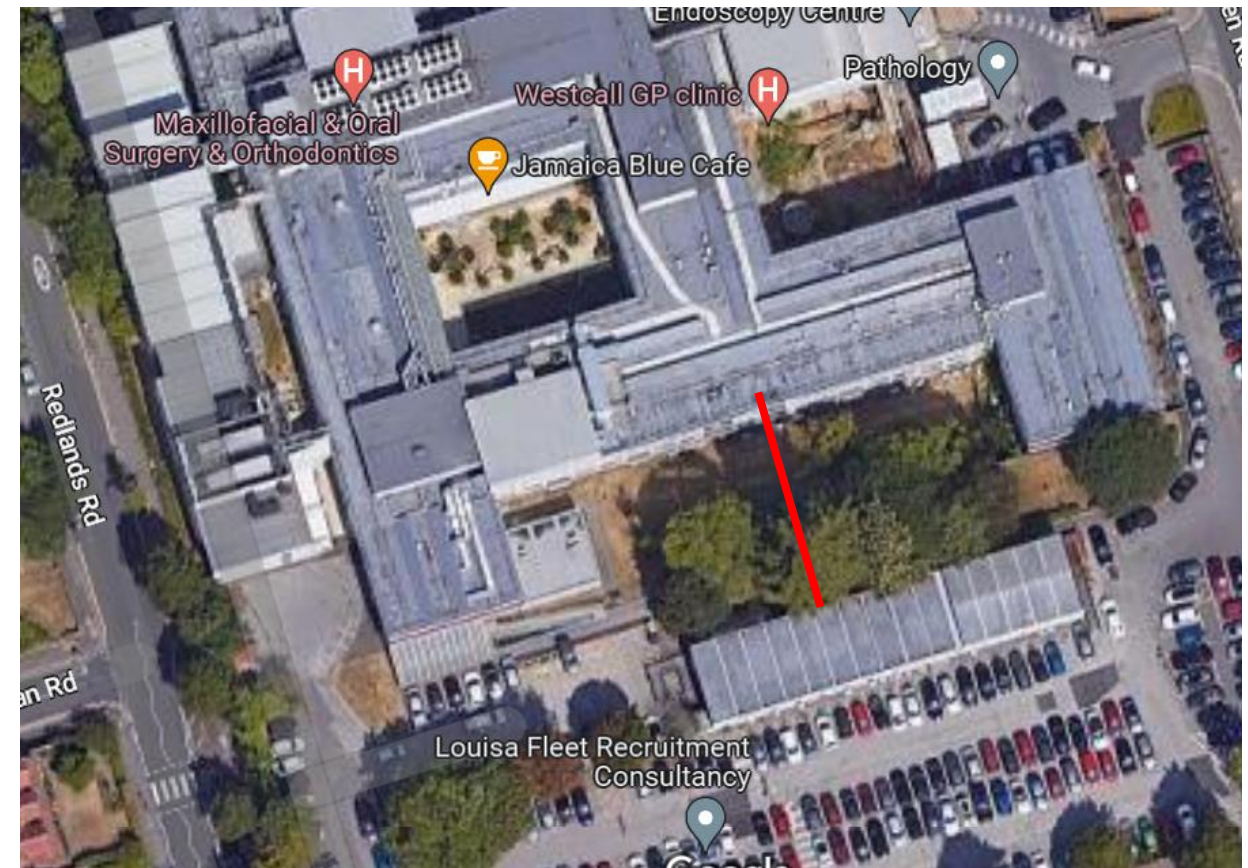


Figure 5.7 - Diagram showing concept of proposed route of the new Fibre connection

6.0 ELECTRICAL SERVICES DESIGN

6.1 Introduction

The electrical services for the project will comprise of the following:

- high voltage substation – utility hv and client hv switchgear
- HV / LV transformers
- HV / LV distribution
- LV generator systems and ancillaries
- UPS and specialist clinical power systems
- Earthing & bonding
- Building management system
- Energy management system
- Power management system
- Metering
- General and emergency lighting
- Small power distribution
- Mechanical services power supplies
- Public health power supplies
- Diesel distribution system
- Fire protection and life safety power supplies
- Fire alarm and pave systems
- Security systems – intruder, access control, CCTV
- Emergency call systems
- Containment systems
- External lighting
- Lightning protection and surge protection system

6.2 Electrical Distribution

If the new building is supplied at 11 kV, regardless of a DNO or RBH supply, the new supply will terminate into a packaged substation located within the plant compound. The packaged substation will contain the 11 kV switchgear to terminate the incoming supply cable, metering, transformer and outgoing LV switchgear. If the building is supplied at 400 V, the supply will terminate directly into the main LV switchboard located within the main electrical intake room within the new building as described below.

LV cabling from the outgoing LV switchgear located within packaged substation will terminate into a switchboard located within the main electrical intake room within the new building. The switchboard will incorporate the protective devices serving final circuit distribution boards, specialist equipment and mechanical plant. The switchboard will also incorporate the termination of the generator LV cabling.

Separate final circuit distribution boards will be provided for lighting, small power and mechanical services incorporating RCBO and MCB protection devices.

All outgoing circuits from the switchboard will incorporate energy monitoring metering in accordance with Part L and MCCB protection devices.

The generator is expected to parallel with the main power supply. The generator control system will enable the following modes of operation of the generator system:

- Mains Failure – The generators will start automatically when the incoming supply is lost. Mains incoming breakers will open until a stable mains supply has returned.
- Mains Return - No-break Transition. Soft transition between supplies by the synchronising, paralleling, and ramping the load.

Emissions

Generator radiator system will be mounted in line with the Generator engine within the enclosure discharge exhaust air to the atmosphere via a vertical duct, each generator is to be fuel optimised to reduce emissions.

Acoustics

All MEP plant will be specified to achieve certain noise and vibration requirement (exact requirement to be determined), so a mix of inline attenuation within the air path and acoustic louvres and external acoustic enclosures to MEP plant, limiting the noise rating.

The general noise criteria for a standby generator is 75dBA @ 1m, which is to be further confirmed. It is to be maintained during operation.

UPS Power Supplies will be provided to clinical equipment serving critical spaces.

Cable Distribution

Main Distribution of power from the electrical switchboard throughout the building will be via XLPE/SWA/LSF cables on proprietary containment systems routed at high level.

All LV final circuit cabling will be LSF singles.

All other cabling serving security, ICT, BMS, fire, ancillary services etc. will be LSF sheathed.

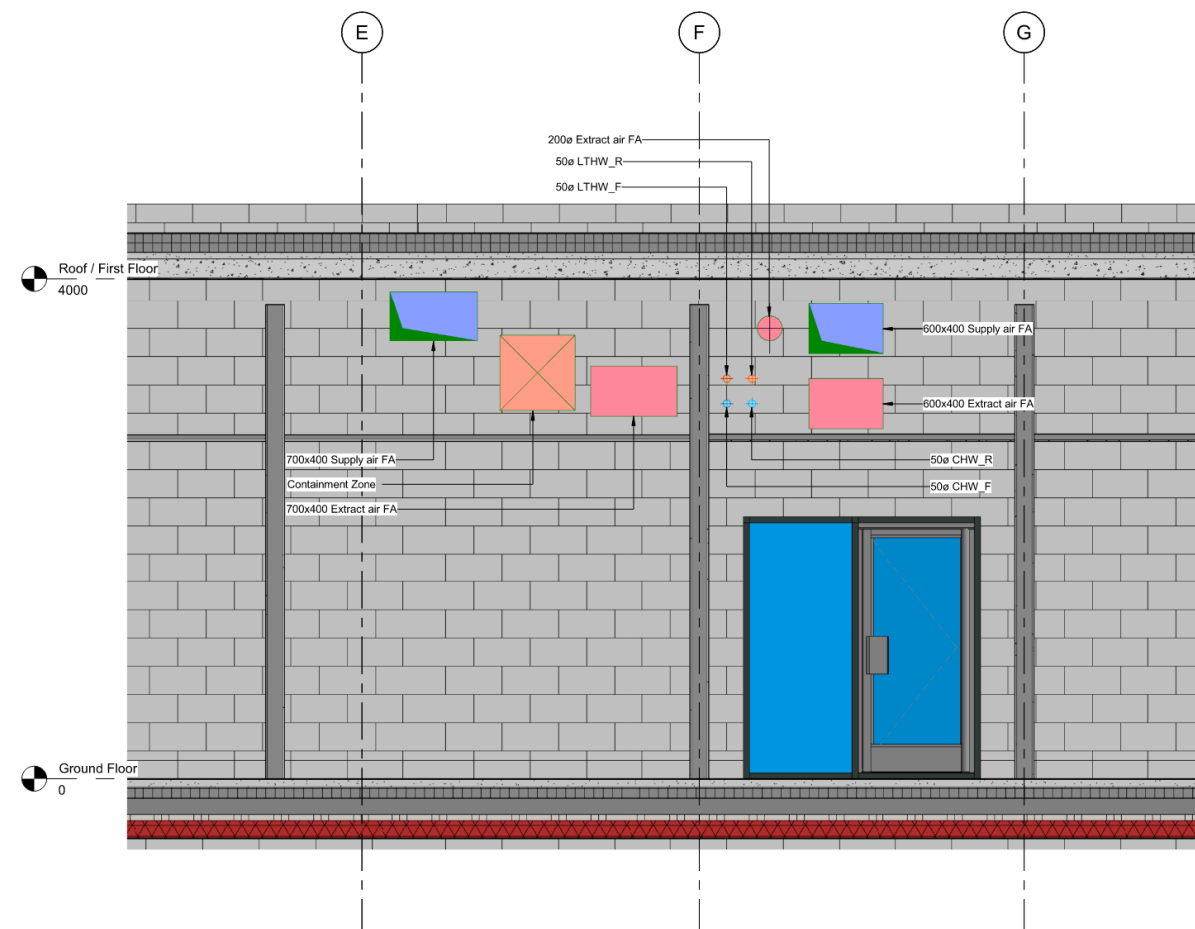


Figure 6.1 – Services Distribution Zones from Revit Model

Earthing & Bonding

Four (4) separate earthing systems will be provided:

- Power System Earthing
- Equipotential Earthing & Bonding
- Data Equipment Earthing
- Lightning Protection Earthing

6.3 Solar Photovoltaic (PV) systems

To support the BREEAM assessment and energy performance criteria, the installation of a PV system will be considered. The PV panels will be either located on the roof of the new building or on the roof of the south block in the main building.

A specialist PV designer will design the solar PV system in accordance with:

- BS EN 62124,
- BS 7671,
- IET Code of Practice for Grid-Connected Solar PV systems
- Relevant ENA Engineering Recommendations

Solar PV systems with integral storage batteries will also comply with the requirements for electrical energy storage systems (EESS).

The EESS will comprise, as a minimum a storage battery, power converting equipment, battery management system, along with associated switchgear, protective devices and means of control.

6.4 Lightning Protection

A lightning protection system to BSEN 620305-3 will be installed to protect the structure.

The installation will comprise:

- Non-isolated roof tapes and bonds to all roof areas
- Separate dedicated earth pits & electrodes around new plant compound
- Coordinated surge suppression to IEC 62305-4

The lightning protection system will be bonded to the Main Building Earth bar.

The zone of protection provided by the lightning protection system will be extended to protect:

- External plant compound
- Containerised generator
- Bulk fuel tank
- All associated electrical containment, pipework, and support structure

6.5 Earth Nests & Electrodes

Dependent on power utility requirements and site soil resistivity:

- Combined HV & LV earth nests
- Resistance of electrodes <1.0 Ohm at each HV/LV earth nest.

6.6 Surge Protection

Surge protection will be provided within the electrical switchboards including main LV switchboards and coordinated with the lightning protection system.

6.7 Small Power

- Small power for cleaner's sockets, mechanical services and ancillary use will be provided, as necessary.
- All small power will be generator backed.
- Separate wall mounted socket outlets will be provided for the use of cleaners.
- Socket outlet requirements will be as the agreed room data sheets.
- Power for critical services will be separated from general lighting and power, i.e. dedicated DBs will be provided.

Generally, all small power circuit wiring will be LSF singles in trunking and conduits.

6.8 General and Emergency Lighting

Internal lighting will be provided in accordance with the HTM's, CIBSE Lighting Guides and best practice guidance. For lighting levels, refer to the room data sheets and associated environmental conditions layout supporting this report.

Internal lighting will also be provided to meet the recommendations of the energy strategy and support the BREEAM assessment criteria.

Emergency lighting will be provided throughout in accordance with the HTM’s and British Standards. The emergency lighting will be provided using self-contained emergency battery packs housed within the body of the general lighting luminaires.

Generally, all lighting circuit wiring will be LSF singles in trunking and conduits.

6.9 External Lighting

The function of the external lighting is to provide a safe and secure night-time environment for movement of pedestrians and vehicular traffic. External lighting will be designed in consultation with the client to agree project lighting criteria from the standards identified. Figure 6.1 is an extract from the early external lighting calculations prepared to support the planning application.

The external lighting will be designed to comply with the following:

- ILP Guidance on Obtrusive Light
- BS EN 13201 Road Lighting
- BS EN 12464 Lighting for Workplaces Pt 2 Outdoor Spaces.
- Secured by Design (planning condition).
- CIE 154 Maintenance of Outdoor Lighting systems

The external lighting will be provided using wall mounted bulkhead luminaire and liner LED strip lighting on the external walkways.

Generally, all lighting circuit wiring will be LSF singles in trunking and conduits with the exception of lighting serving the walkways, where SWA cables will be utilised.

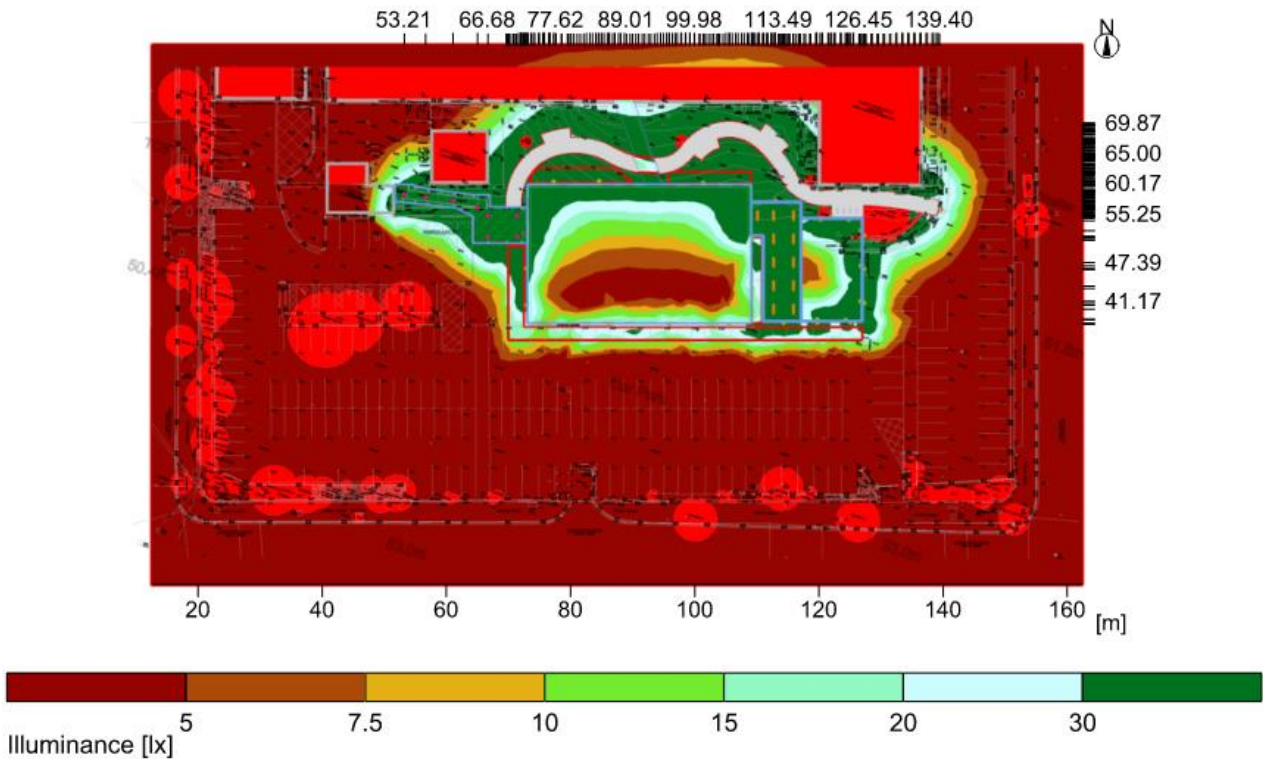


Figure 6.2 – External lighting levels

6.10 Containmentment

Cable containment will be provided throughout the facility as follows:

Table 6.1 - Cable Containmentment

Electrical System	Types of Containmentment
HV Mains	Heavy Duty Ladder
LV Mains	Heavy Duty Ladder/Tray
LV Sub-Circuits	Heavy Duty Ladder/Tray
Life Safety	Heavy Duty Tray
Data	Cable Basket
Security	Cable Basket
BMS/Control	Cable Basket/Tray
Lighting & Small Power	Cable Trunking & Conduit
Ancillary Systems	Cable Basket/Tray

6.11 Security

The security design will be developed with the Trust’s security team and consist of CCTV, electronic door access control and where applicable, intruder detection and alarm systems.

The CCTV and door access control systems will be an extension of the existing site systems.

6.12 Data & Telephone Systems Distribution

The RJ45 data outlets will be distributed across the building to provide connectivity to the connected devices through CAT-6 cables distributed from network patch cabinets located within the new building. The ICT system will provide both hard wired connection and wireless via Wi-Fi points distributed throughout the building.

The ICT system will be an extension of the existing site ICT network and designed by the Trust’s inhouse ICT team.

6.13 Life safety and fire safety systems

Power supplies to Life safety and fire safety systems will be designed in accordance with:

- BS 9999:2017 – Fire safety in the design, management, and use of buildings – Code of practice, and
- BS 8519:2020 – Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications – Code of practice.
- BS 8491:2008 – Method for assessment of fire integrity of large diameter power cables for use as components for smoke and heat control systems and certain other active fire safety systems

Life Safety services will include:

- Fire shutters
- Fire alarm and detection systems
- Fire damper controls
- Smoke extract

The life-safety supplies will be provided and supplied by two diversly routed and segregated power supplies, both incoming supplies will be fire rated to BS 8519:2020.

‘Life safety’ circuits will be supplied via fire-resistant cables. The cables carrying power to life safety equipment must have diverse routes and be fire-protected in accordance with the requirements of BS 8519, BS 8491 and the

building control authority. The equipment will be served from adjacent automatic changeover devices installed within the safe fire compartment.

Fire alarm coverage throughout the building will be provided to category L1 and cabled using enhanced fire rated cabling.

6.14 Emergency and Assistance Call Systems

Emergency and assistance call systems will be provided as follows:

- WC / shower assistance call
- Nurse call

The systems will be designed to alert both locally and centrally as required by the operational use of the building.

7.0 MECHANICAL SERVICES DESIGN

7.1 Introduction

This section of the report outlines the mechanical building services engineering concepts for the Elective Recovery Building. This section will cover the ventilation, heating and cooling considerations and options that have been highlighted to date.

7.2 Mechanical Design Criteria

7.2.1 External Environmental Design Conditions

The design ambient temperature will be based on the ASHRAE 2021 n=10 temperature extremes as recorded for Farnborough weather station (WMO 037680) as a minimum requirement, tabulated by the [ASHRAE Meteo](#) website:

- Minimum dry-bulb temperature: -10.1°C
- Minimum wet-bulb temperature: -10.7°C
- Maximum dry-bulb temperature: 33.3°C
- Maximum wet-bulb temperature: 25.6°C

Although Bracknell weather station is within a closer proximity, 2021 data for this station is limited. Therefore, Farnborough has been selected due to owning a full weather data profile.

As per HTM guidance, “It is essential to design to future climate projection to ensure design temperatures are maintained even in the event of prolonged heatwave conditions”. ASHRAE n=10 conditions provide a closer representation of the extreme conditions experienced by equipment during such scenarios, and provides an appropriate uplift from design conditions set out in CIBSE guidance.

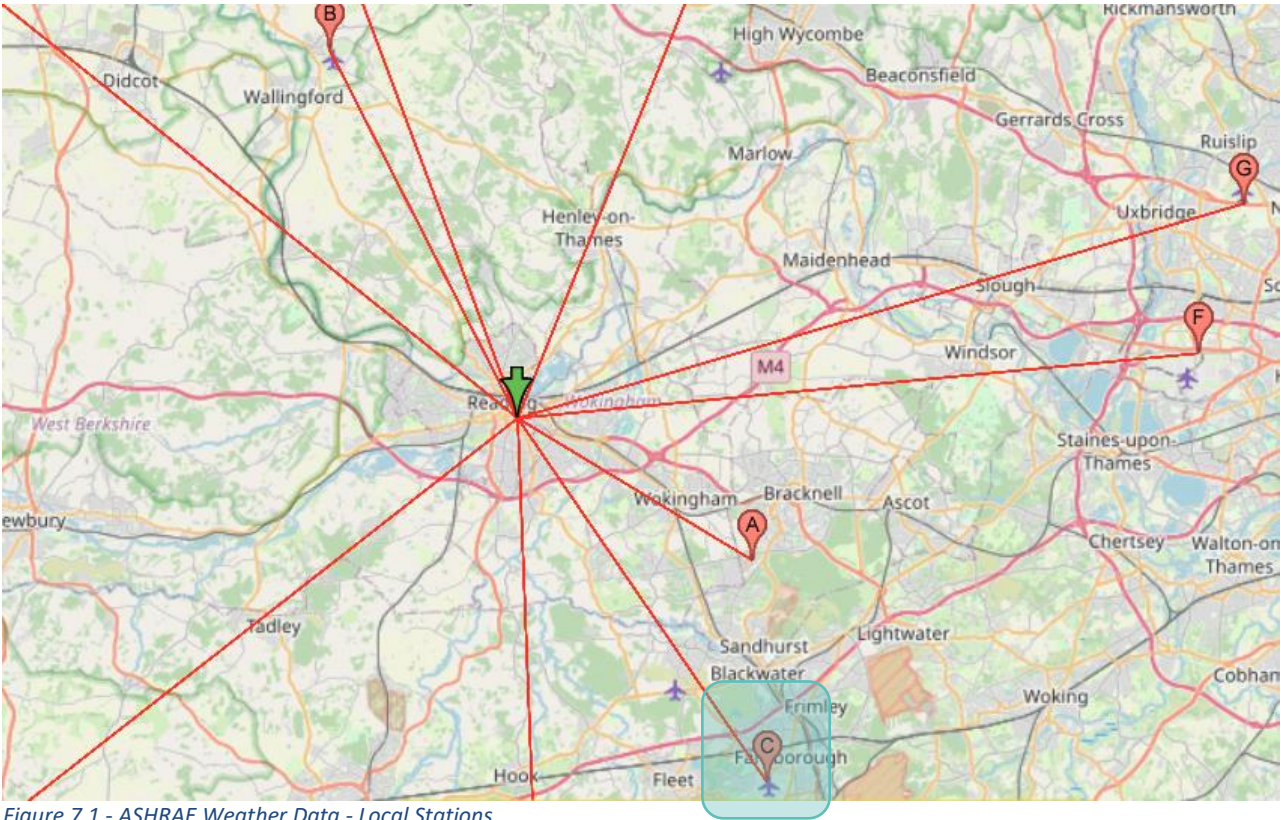


Figure 7.1 - ASHRAE Weather Data - Local Stations



FARNBOROUGH, UNITED KINGDOM (WMO: 037680)

Lat:51.2800N

Long:0.7725W

Elev:65

StdP: 100.55

Time zone:0.00 (EUW)

Period:94-19

WBAN:99999

Annual Heating, Humidification, and Ventilation Design Conditions																		
Coldest Month	Heating DB		Humidification DP/MCDB and HR						Coldest month WS/MCDB				MCWS/PCWD to 99.6% DB		WSF			
			99.6%			99%			0.4%		1%							
	99.6%	99%	DP	HR	MCDB	DP	HR	MCDB	WS	MCDB	WS	MCDB	MCWS	PCWD				
1	-4.8	-3.2	-6.2	2.3	-2.0	-4.9	2.5	-0.9	12.4	10.4	11.3	10.3	0.9	230	0.572			
Annual Cooling, Dehumidification, and Enthalpy Design Conditions																		
Hottest Month	Hottest Month DB Range	Cooling DB/MCWB						Evaporation WB/MCDB						MCWS/PCWD to 0.4% DB				
		0.4%		1%		2%		0.4%		1%		2%						
		DB	MCWB	DB	MCWB	DB	MCWB	WB	MCDB	WB	MCDB	WB	MCDB	MCWS	PCWD			
7	9.8	27.4	18.9	25.3	18.1	23.5	17.2	20.3	25.0	19.1	23.6	18.1	22.0	3.9	200			
Dehumidification DP/MCDB and HR																		
0.4%			1%			2%			0.4%			1%			2%			Extreme Max WB
DP	HR	MCDB	DP	HR	MCDB	DP	HR	MCDB	Enth	MCDB	Enth	MCDB	Enth	MCDB				
18.7	13.6	22.1	17.5	12.6	20.8	16.6	11.9	19.8	58.5	24.8	54.5	23.6	51.3	22.1	28.0			
Extreme Annual Design Conditions																		
Extreme Annual WS			Extreme Annual Temperature				n-Year Return Period Values of Extreme Temperature											
			Mean		Standard deviation		n=5 years		n=10 years		n=20 years		n=50 years					
1%	2.5%	5%	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max				
10.2	8.9	8.0	DB	-8.0	30.4	1.7	2.2	-9.2	32.0	-10.1	33.3	-11.1	34.5	-12.3	36.1			
			WB	-8.2	22.7	2.0	2.2	-9.6	24.3	-10.7	25.6	-11.8	26.8	-13.3	28.4			

Figure 7.2 - ASHRAE N=10 Weather Data (Farnborough)

7.2.2 Internal Environmental Design Conditions

The internal design conditions will be mainly based on industry accepted benchmarks and standards as listed in the Mechanical Codes, Standards, and Document Reference section as summarised in the table below:

Table 7.1 – Mechanical Design Criteria

Type	Room Name	Temperature Control Range	Winter Set Point Temp	Summer Set Point Temp	Humidity	Vent	Pressure	NR Level
Healthcare	Minor Theatre / Lithotripter	18-25 °C	22 °C	22 °C	35% - 70%	25 ACH	+ 25 Pa	40
	Recovery	18-28 °C	22 °C	22 °C	< 70%	6 ACH	Negative	35
	Ultrasound	18-25 °C	21 °C	22 °C	< 70%	6 ACH	Balanced	35
	Treatment Room	18-25 °C	22 °C	22 °C	< 70%	10 ACH	Positive	35
	Consultation Room	18-28 °C	22 °C	22 °C	< 70%	6 ACH	Balanced / Negative	35
Amenities	Toilets	18-28 °C	21 °C	N/A	< 70%	6 ACH	Negative	45
	Changing Room	18-28 °C	22 °C	N/A	< 70%	6 ACH	Negative	45
	Dirty Utility	18-28 °C	18 °C	N/A	< 70%	6 ACH	Negative	40
	Clean Utility	18-28 °C	21 °C	N/A	< 70%	6 ACH	Positive	40
General	Reception	18-28 °C	21 °C	23 °C	< 70%	4 ACH	Balanced	58
	Offices	18-28 °C	21 °C	23 °C	< 70%	4 ACH	Balanced / Negative	35
	Circulation Corridors	18-28 °C	18 °C	N/A	< 70%	Min 0.5 l/s/m²	Balanced	40
	Waiting Rooms	18-28 °C	21 °C	23 °C	< 70%	4 ACH	Balanced / Negative	63
		Notes: (1) All room design criteria are as per ADB generated Room Data Sheets, provided by the architect. The temperature control range adheres to HTM 03-01 Part A (2) Stated temperature criteria are subject to control tolerances (2) Relative humidity will not generally be directly controlled (3) Outside Air will be based on a minimum of 12 l/s/person to Part F, or the ACH provided by the ADB rooms data sheets (whichever is more onerous) (4) Client to advise appropriate summer set point. HTM 03-01 provides temperature control ranges shown above and ADB Room Data Sheets provide the heating (winter set point), but do not inform of a summer set point. The summer set point can adopt the upper level of the HTM 03-01 control range, or adopt a more comfortable set point set out in CIBSE Guide A (stated in table above) (5) Values highlighted in bold indicate an allowable “float” (non controlled) temperature range						

Please refer to drawing P.019694-RED-XX-00-DR-Z-0003 for a full list high-level room design criterion, as per the latest architectural layout.

7.2.3 Heat Loss/ Gain

The heat gain and loss calculations will be conducted in accordance with the CIBSE, BREEAM and Local Standards. The following items will be included in the calculations.

Envelope (External) Loads:

- a) Transmission loads through the fenestration,
- b) Solar loads through the fenestration,
- c) Transmission loads through the external walls and roof,
- e) Loads through the infiltration and ventilation.

7.2.4 Steady State modelling

A benchmarking model has been produced in thermal modelling software (IESVE). This model contains notional zones; consultation areas, circulation, treatment rooms, WC/Changing rooms, and admin spaces. The purpose of this model is to use simple geometries to obtain an initial estimate of cooling and heating loads for the terminal building.

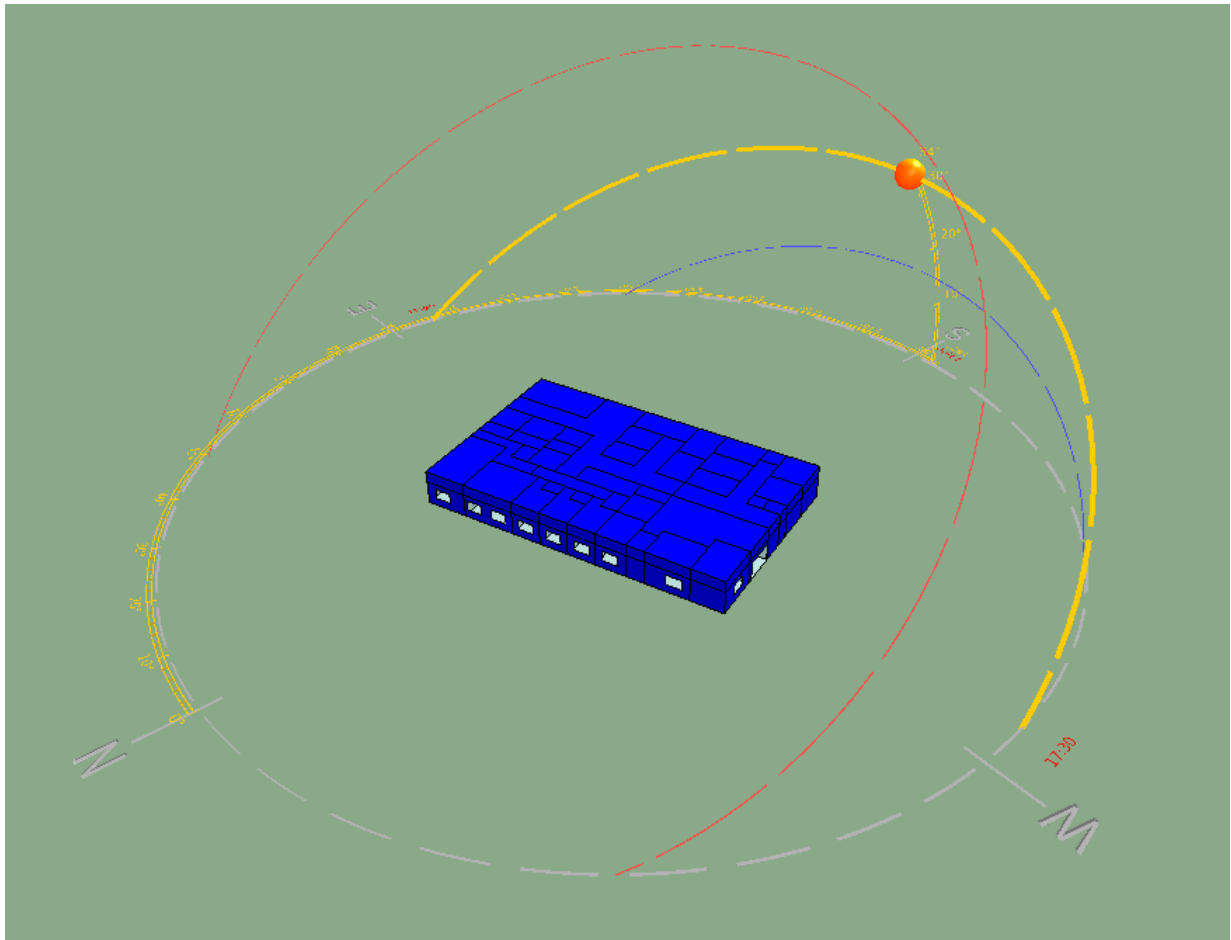


Figure 7.3 - IES model

7.2.5 Internal Loads:

Space Type	Occupancy Gains	Lighting Gains	Miscellaneous Gains	Infiltration
Utility Rooms / Clean Cupboard	N/A	8 W/m ²	N/A	0.25 ACH
WCs / Changing Rooms	N/A	8 W/m ²	N/A	0.25 ACH
Corridors	N/A	8 W/m ²	N/A	0.25 ACH
Consultation Rooms	90 W/p sensible 60 W/p latent	8 W/m ²	3 W/m ²	0.25 ACH
Treatment Rooms	90 W/p sensible 60 W/p latent	8 W/m ²	3 W/m ²	0.25 ACH
Offices	90 W/p sensible 60 W/p latent	8 W/m ²	15 W/m ²	0.25 ACH
Staff / Seminar Room	90 W/p sensible 60 W/p latent	8 W/m ²	5 W/m ²	0.25 ACH
Theatre	90 W/p sensible 60 W/p latent	8 W/m ²	60 W/m ²	0.25 ACH
Recovery	90 W/p sensible 60 W/p latent	8 W/m ²	3 W/m ²	0.25 ACH
Ultrasound	90 W/p sensible 60 W/p latent	8 W/m ²	10 W/m ²	0.25 ACH
Waiting Rooms	90 W/p sensible 60 W/p latent	8 W/m ²	5 W/m ²	0.25 ACH
Reception	90 W/p sensible 60 W/p latent	8 W/m ²	15 W/m ²	0.25 ACH

Table 7.2 - IES Internal Load Notional Values

7.2.6 Building Fabric

The construction values used in the model are shown in the following table, which has been extracted NCM Modelling Guide (2021):

Element	U-value (W/m²K)		Thermal capacity³ (kJ/m²K)
	Side-lit and unlit activities	Top-lit activities	
Roofs⁴ (irrespective of pitch)	0.15	0.18	88.3 (1.40 if metal-clad)
Exposed walls	0.18	0.26	21.8 (1.40 if metal-clad)
Exposed floors and ground floors (subject to paragraph 36)	0.15	0.22	77.7
Windows*	1.4	-	-
Roof-lights*	-	2.1	-
Vehicle access and similar large doors	1.3		2.1
Pedestrian doors and high usage entrance doors	1.9		54.6
Internal walls	1.8		8.8
Internal floors/ceilings	1.0		71.8 from above / 66.6 from below
*This is the overall U-value of the complete unit, including the frame and edge effects, and it relates to the performance of the unit in the vertical plane for windows (and roof windows), and in the horizontal plane (i.e., already adjusted for flat roofs) for roof-lights (BR443²) so, where applicable, the U-value must be adjusted (from the vertical plane) for the slope of the roof by +0.3 W/m²K if the roof is flat, and +0.2 W/m²K if the roof is pitched. All the roof-lights in the Notional building are assumed to be conical or domed, and hence, for the purposes of heat transfer calculations, their developed to projected ratio is set to 1.3, i.e., the area of the roof-light is 1.3 times the area of the opening in the roof.			

Figure 7.4 – NCM Modelling Guide notional U-Values for new builds

These values provide an initial modelling benchmark but should aim to be improved during future design stages in order to increase energy efficiency, and hence reduce the demand on the heating and cooling systems.

7.2.7 Internal Air Quality

Outside air inlets and outlets will be configured to minimise re-entrainment of exhaust contaminants. Outside air intake louvres will be sited to utilise the best available air quality and environmental conditions in accordance with CIBSE, BREEAM and best practice guidance.

Consideration will be given to include activated carbon filters on all/any HVAC outside air inlets, to reduce the presence of noxious fumes. Consideration should be given to siting outside air intakes away from the vehicle exhausts, which may obviate the need for activated carbon filtration. Guidance is to be provided from the air quality consultant at the next stage.

Should activated carbon filtration not be a project requirement, all AHU filter types and grades will comply with the HTM 03-01 requirements.

7.2.8 Resilience

Resilience will be provided to the following plant:

- a) General ventilation - (N)
- b) Critical ventilation- (N+1)
- c) LTHW & CHW pumps – (N+1)
- d) Heat Pumps/Chillers - (N+1)
- e) Buffer Vessel & Expansion (N)

Note: N = the number of plant items required to suit the connected load requirements. For example, the +1 heat pump allows for future planned or reactive maintenance activities to be provided without any loss to the load to the system.

7.3 Primary Cooling Plant

7.3.1 Overview

- Closest existing cooling network is served via Mitsubishi E-Series chillers located on the roof of South Block.
- Existing network primarily serves rooftop AHU's from an existing Low Loss Header.
- Current connected load assumed to align with the duty of the existing chillers – thus no spare capacity.
- 2No options are proposed to serve the new Elective Building.



Figure 7.5 - Example of existing chillers

7.3.2 Option 1 – South Block Plant Expansion

- Increase existing chiller compound capacity to meet the demands of the Elective building.
- Upgrade the primary network if required due to increased duty.
- Install new secondary pipework and pump set to serve to the Elective building. Pipework could either be:
 - Routed across the roof of South Block, drop to low level, and traverse the gap between the buildings.
 - Routed internally in a similar manor and provide future provisions for connectivity in South Block before exiting the building a traversing the gap.
 - Or either of the above, but the link between the 2No buildings would be via pipework suspended from the link bridge. This variation is shown in by the blue line on the image below.
- The new distribution could also be sized to allow for future connection within the wider South Block and reduce reliance on standalone DX systems.

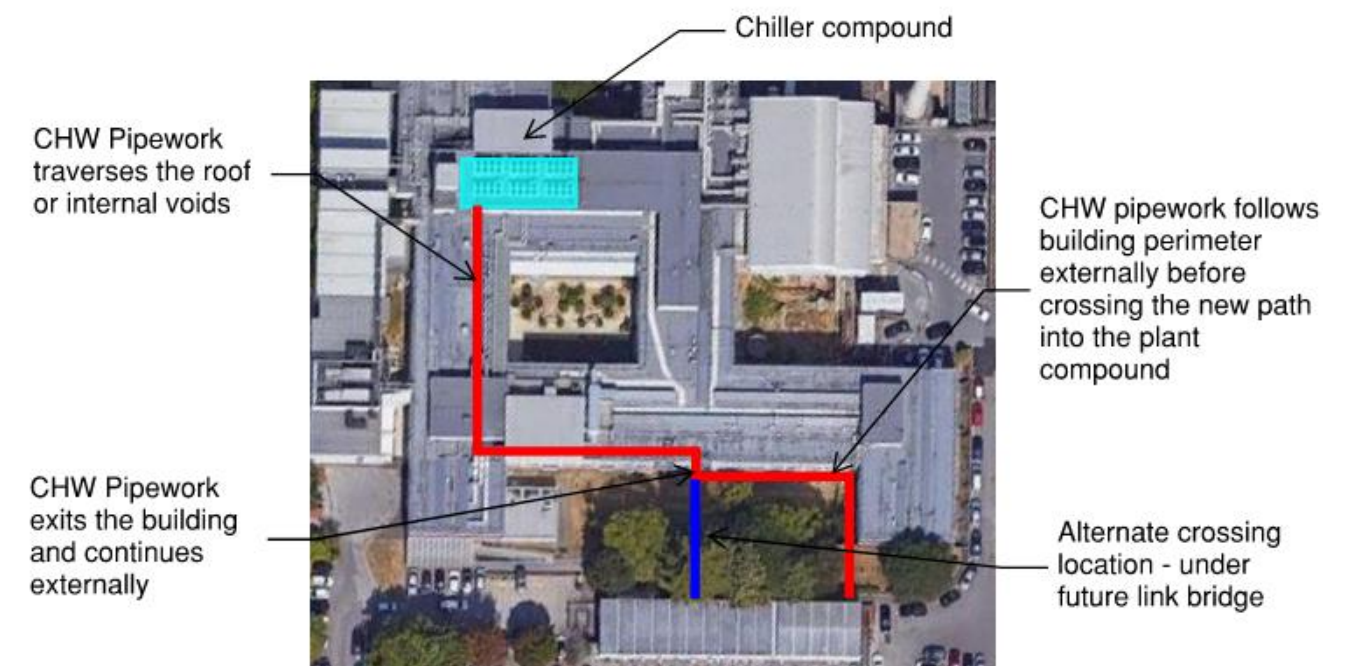


Figure 7.6 - Option 1 - Potential CHW pipework routes

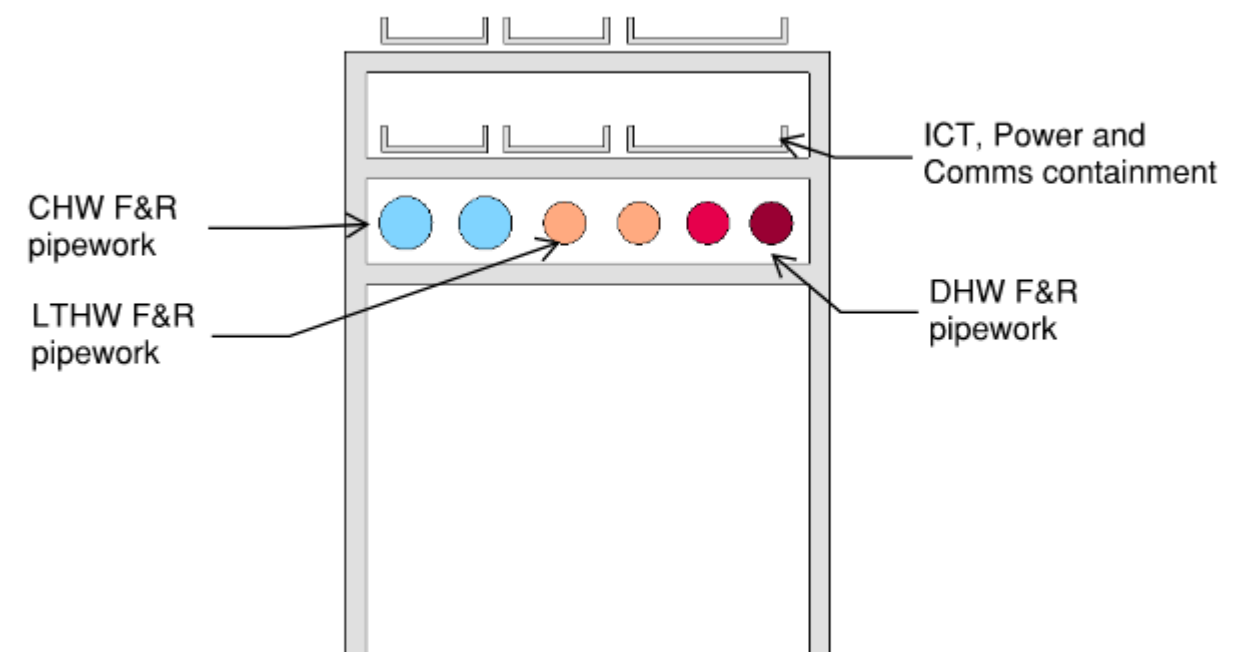


Figure 7.7 - Example external services routing configuration

7.3.3 Option 2 – Standalone Primary plant

- New standalone system local to the building.
- New 2 (or 4) pipe chillers sized to meet the cooling demands of the rooms and fresh air tempering.
- Chillers to be located within the external plant compound to the East of the building.
- Associated ancillary items (primary and secondary bumps, buffer vessels, low loss header etc.) would be situated in a packaged plantroom to support the off-site construction.
- From the packaged plantroom, the pipework serves the various AHU's and emitters within the building.
- Where there is a critical cooling requirement, separate DX system will be provided for redundancy.

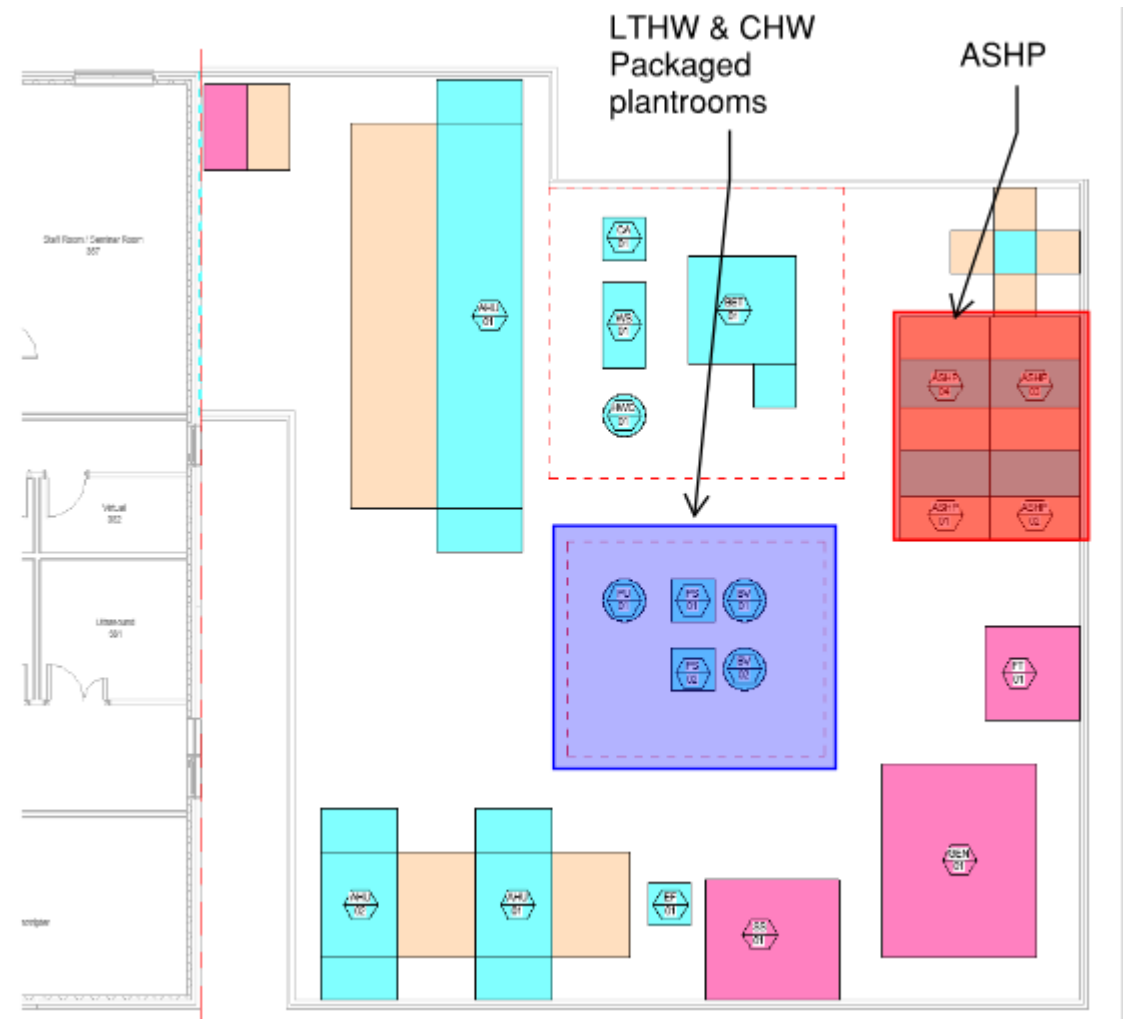


Figure 7.8 – Indicative Heating & Cooling Plant Locations

7.3.4 Options appraisal

	Option 1	Option 2
Pro's	• Utilises existing plant and infrastructure. • Could be used as a capital project to upgrade the hospitals central infrastructure. • Reduces external plant requirements	• Simplifies distribution of pipework due to the proximity of plant. • Improved efficiency as there is a reduced risk of part load operation. • Lower capital expenditure of pipework installation. • Supports the NHS ambitions to reduce carbon foot print
Con's	• Extensive amount of pipework and enabling works required. • Greater embodied carbon associated to pipework. • Greater parasitic load from pumps • Large CapEx associated with CHW network. • Increased pipework losses and trace heating (depending on routing solution)	• Increases the electrical demand of the building. • More area is required for plant adjacent to the building.
Risks	• Potential for insufficient capacity in the primary distribution and buffer vessels. • Risk of traversing areas with known asbestos in.	• Potential for there to be insufficient capacity in the local LV supply for these units. N.b. this would be mitigated if a general electrical infrastructure upgrade is required regardless of cooling strategy.

Table 7.2 - Cooling Options Appraisal

7.3.5 Chilled Water Distribution System

If the trust decides to go down the route of a new dedicated cooling system, it would consist of:

- Air cooled chillers/ASHP
- Primary duty/standby pumps
- Secondary pumps
- Buffer vessel and/or Low Loss header
- AHU circuit
- Building circuit.

For an initial topology refer to P.019694-RED-XX-00-DR-M-1201 and the exert below.

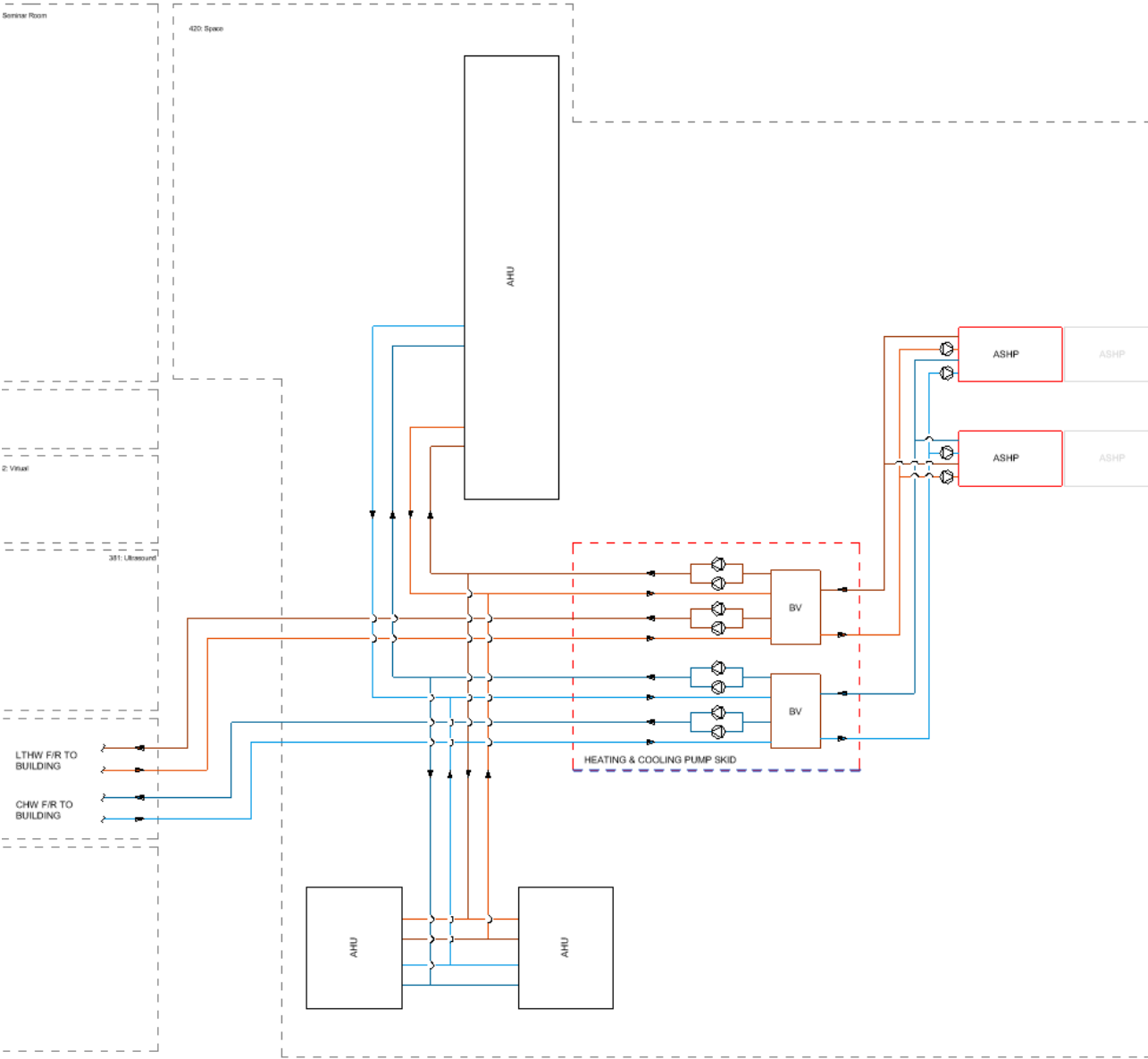


Figure 7.9 - Example CHW & LTHW Topology

7.4 Primary Heating Plant

7.4.1 Overview

- District LTHW network served by 3No gas fired boilers and 1No CHP located in a boiler room to the East of South Block.
- Secondary pipework distributes throughout the site via a network of under crofts to secondary plantrooms.
- These plantrooms contain several Plate Heat Exchangers that provide hydraulic separation for the domestic hot water services and heating circuits. There are then multiple tertiary networks that connect to the emitters.
- It is understood that there is spare capacity in the network to meet the demands of the new Elective building. However, additional information is required to determine whether there is capacity in the existing PHX to increase the connected load.
- The closest Plate Heat Exchangers are in the South Block plantroom with a total capacity of 4,00kW. Reference numbers PHE-SB-01/02/03/04.
- Similarly, to the cooling, there is 2No high level options for providing heating to the new Elective building. One is to connect to the existing district LTHW network or provide a standalone system adjacent to the building.

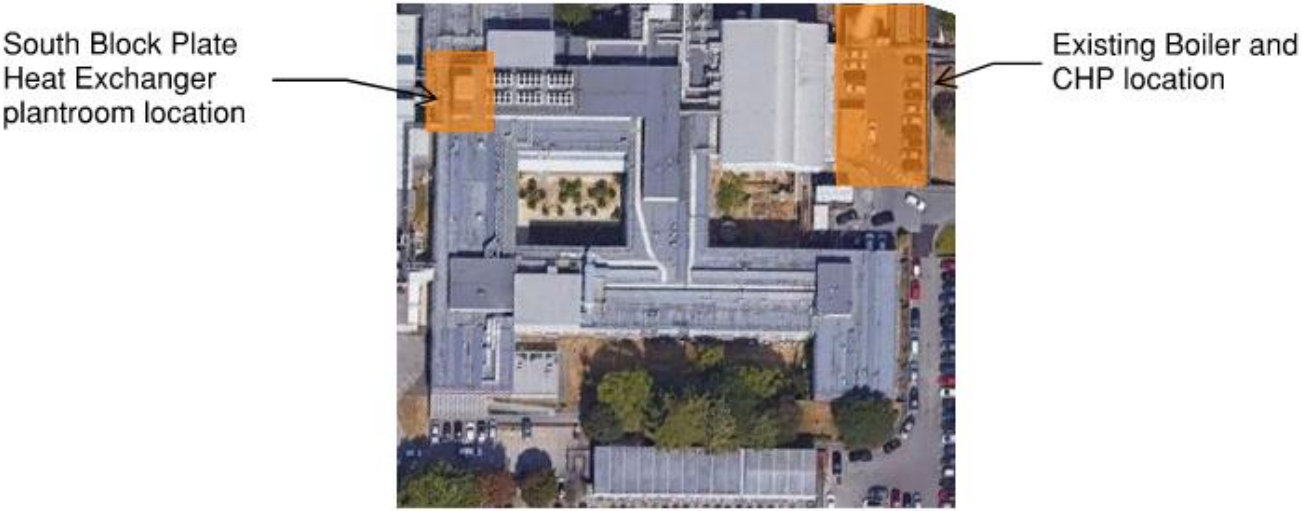


Figure 7.10 - Existing heating infrastructure locations

7.4.2 Option 1 – Connect to the existing network.

- Connecting to the existing LTHW network could be achieved in several ways, depending on the existing system topology:
 - Extending one of the tertiary networks from the PHX that has the largest spare capacity.
 - Installing a new dedicated PHX in the South Block PHX Plantroom and routing pipework to the Elective building.
 - Taking a new Secondary connection from the boiler room to a new PHX Adjacent to the Elective building.
- All options would allow the trust to take advantage of an existing asset, however, does not help to reduce their Carbon footprint by reducing gas consumption.
- The routes for connecting to the existing network would be similar to those described in the ‘cooling’ section as the pipework would emanate from a similar location. The orange line on the image below however shows how the boiler house could be directly connected to the elective building directly by below ground pipework.

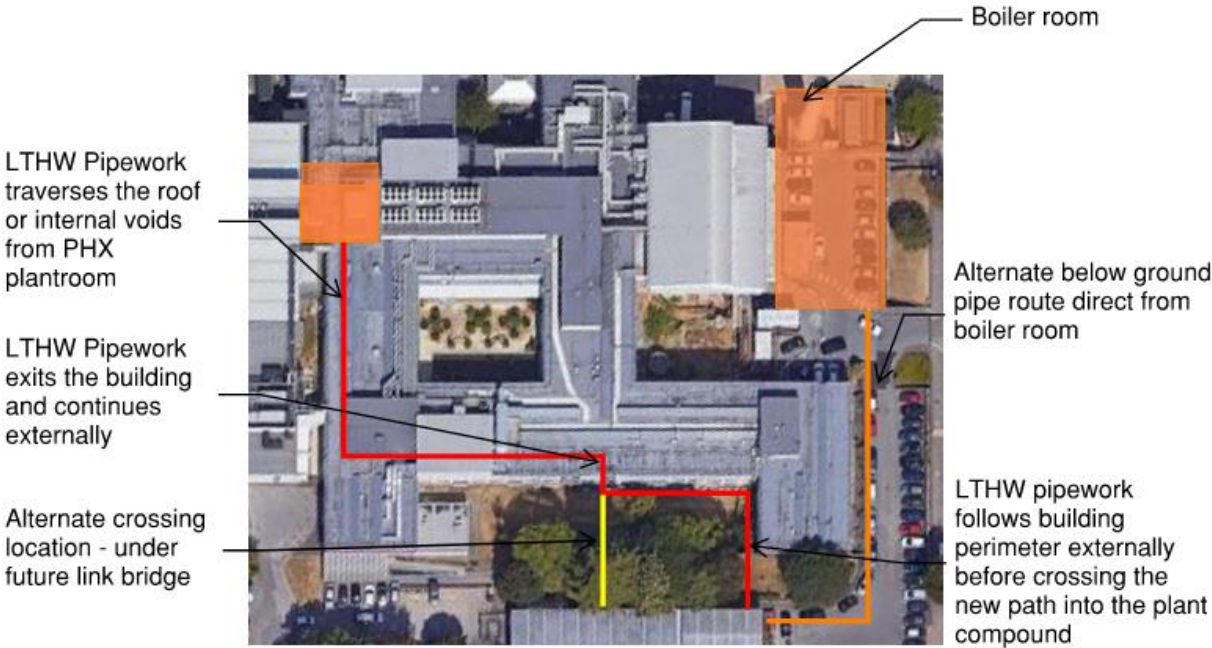


Figure 7.11 – Potential LTHW pipework routes

7.4.3 Option 2 – Standalone 4-pipe ASHP

- New standalone 4 pipe heat pump (assuming a decentralised cooling solution) sized to meet the heating demands of the rooms and fresh air provisions.
- ASHP’s would be located within the proposed plant compound to the East of the building. The units proposed in option 2 of the cooling solution would also be part of the heating solution.
- The associated ancillary items (primary and secondary bumps, buffer vessels, low loss header etc.) would form part of a combined heating and cooling packaged plantroom to support the off-site construction.
- From the packaged plantroom, the pipework serves the various AHU’s and emitters within the building.
- The ASHP’s will include on-board controls to maintain constant leaving water temperature.
- A variety of ASHP options will be researched and developed during RIBA Stage 3.
- The associated flow and return temperatures would be lower and more conducive with current guidance on energy conservation and support with the trusts aim to decarbonise the site.

7.4.4 Options appraisal

	Option 1	Option 2
Pro’s	- Utilises existing infrastructure. - Improves the existing part load efficiencies by adding more connected load. - Can be used to provide the domestic hot water generation.	- Simplifies distribution of pipework due to the proximity of plant. - Supports the Trusts drive to reduce carbon emissions by utilising green fuels. - Lower capital expenditure of pipework installation. - Greater efficiencies are provided by Heat Pumps compared to boilers. - Ability to drop flow temperatures and reduce losses.
Con’s	- Extensive amount of pipework and enabling works required. - Greater embodied carbon associated to pipework. - Greater parasitic load from pumps. - Maintains the Trusts reliance on non-low carbon technology. - Increased pipework losses and trace heating (depending on routing solution)	- Same as cooling – however, the same units would be used for both heating and cooling so these con’s are not duplicated. - Increases the size of emitters and pipework due to reduced flow and return temperatures. - Separate Heat pump required for hot water generation.
Risks	Could require works to the primary network depending on how the new connection is made.	Same as cooling.

Table 7.3 – Heating Options Appraisal

7.5 Ventilation

7.5.1 General

Due to the proximity of the existing car park and the risk associated to inhalation of car fumes and noise, it is proposed that all spaces in the Elective building are mechanically ventilated. Fresh air will be pulled in from the furthest feasible location to the car park whilst maintaining maximum separation between intake and exhaust locations.

Under summer and winter design conditions, the minimum tempered fresh air requirement is provided by AHUs in accordance with approved document F, the HTM's and BREEAM requirements. These AHUs will be equipped with either thermal wheel heat recovery or plate heat exchangers. The outside air will be heated/cooled by the CHW or LTHW heating coils in the AHU. Where required, an additional LTHW frost coil will be installed to protect the heat exchanger. All AHU's are to be specified in compliance with HTM 03-1 Section 4.

The outside air from the AHU is ducted into the space either directly into a terminal unit or to the back of the FCU where it mixes with recirculated room air where/if applicable.

For more details of the ventilation strategy, refer to the ventilation schematic P.019694-RED-XX-00-DR-M-1101.

At this stage there are 4No separate ventilation systems proposed:

- General Ventilation
- Dirty Extract
- Theatre Ventilation
- Clinical Ventilation

7.5.2 General Ventilation

Areas served:

- Consulting rooms
- WC's and changing facilities.
- Circulation
- General admin areas
- Clean Stores

As the AHU will be serving some rooms perceived as potentially odorous, the unit will include a plate heat exchanger as form of heat recovery to prevent the mixing of the 2 air streams and remove the risk of re-entrainment of these odours. However, they do require more space.

7.5.3 Dirty Extract

To mitigate the risk of cross contamination entirely, we have provisioned for a dedicated dirty extract system, this currently served the 'Dirty Utility', but may connect to additional rooms once the usages are clarified. The make-up air will be provided via the general ventilation AHU.

7.5.4 Theatre Ventilation

Section 4.13 of HTM 03-01 states:

'Certain clinical and non-clinical areas within a healthcare establishment are considered critical to its ability to provide healthcare. Typically, ventilation systems serving the following are considered critical: MRI, CAT and other types of emerging imaging technologies that require particularly stable environmental conditions to remain within calibration'

Our understanding of the Lithotripter theatre means that we believe that this space would be considered as a critical space. Therefore, duty/standby AHU's have been allowed for to serve this area. This requirement is to be further reviewed at the next stage as the precise procedure and equipment in this room are yet to be clarified.

7.5.5 Clinical Treatment

The treatment rooms will all be served via a dedicated AHU to enable the spaces to be conditioned via an all-air system. Depending on the future operating hours of the facility, night set-back could be deployed to reduce energy consumption.

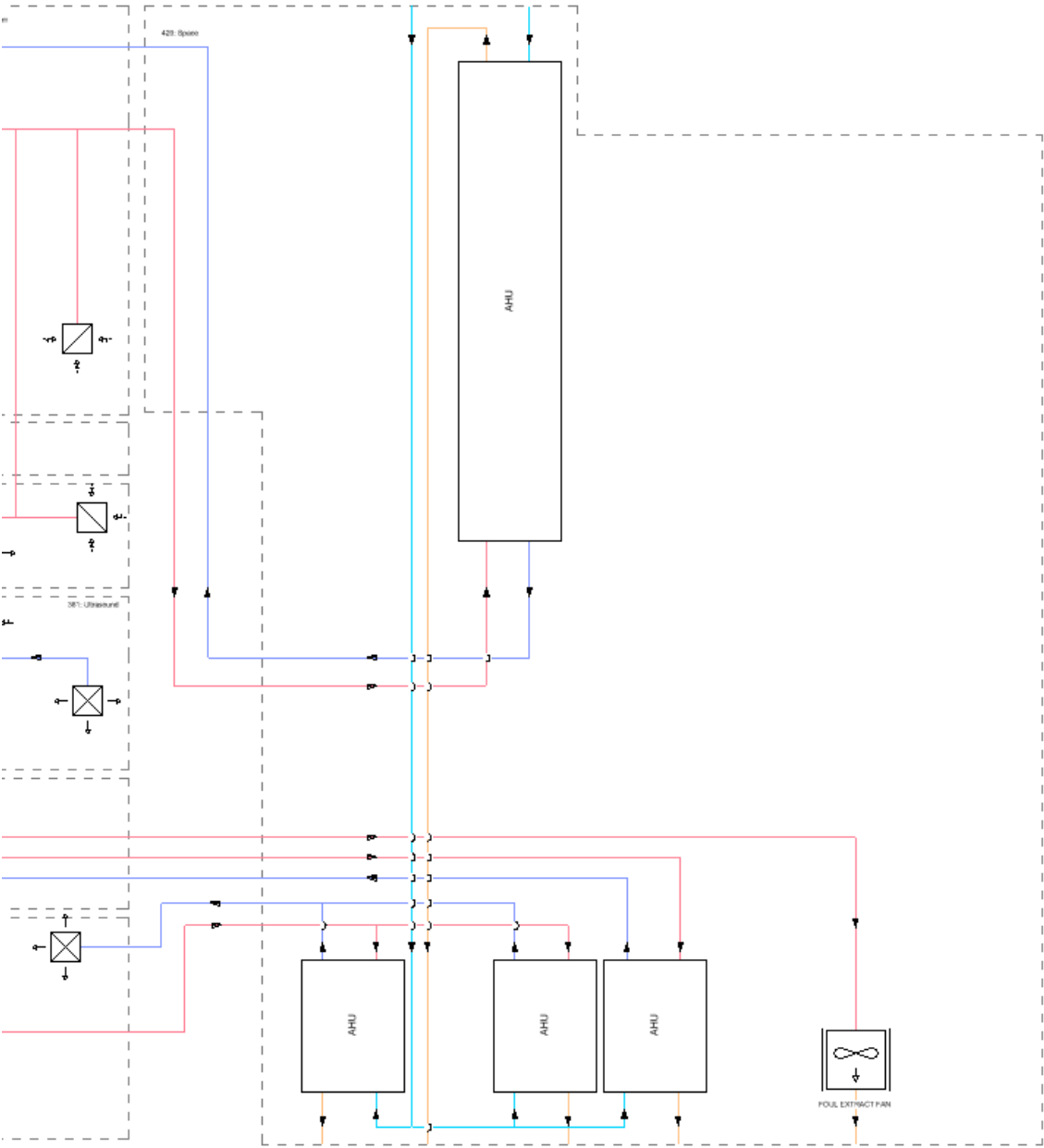


Figure 7.12 - Excerpt of ventilation schematic

7.6 Pipework Ancillaries

7.6.1 Pumps

- The CHW & LTHW water system will utilise a variable primary pumping strategy to vary flow rates in line with building load.
- Where possible the pumps are to form part of a modular pump skid combining run & standby pump.
- Depending on the agreed strategy, these will be either be in a packaged plantroom adjacent to the building or existing South Block plant room along with pressurisation units and other ancillary items required.
- The pump skid solution provides a neat, easily maintainable package.

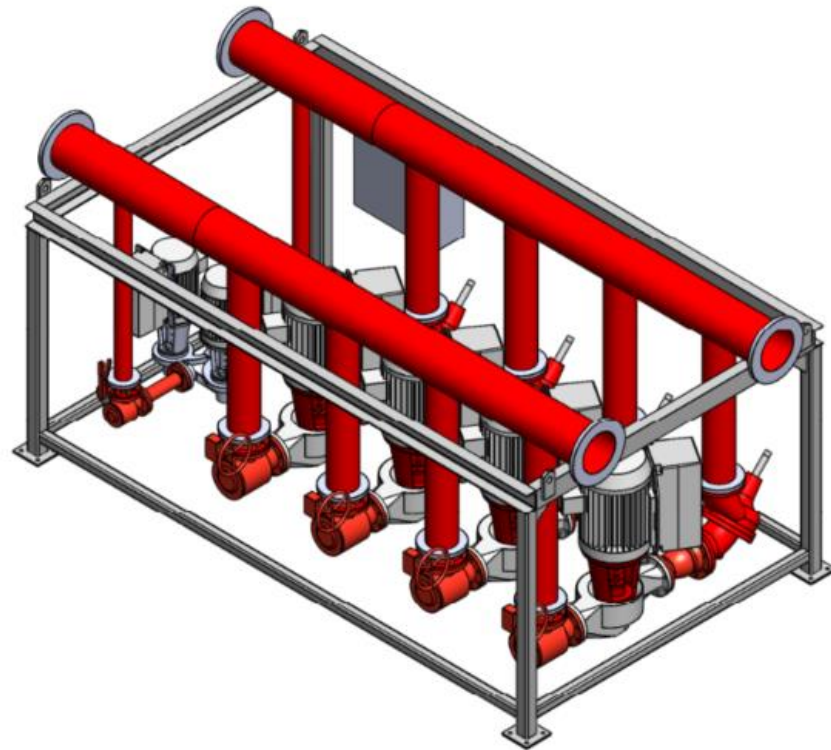


Figure 7.13 - Example pump skid

7.6.2 Water Treatment & Ancillaries

In addition to the pumping skids, the mechanical packaged plantroom will also house the associated plant such as pressurisation units, de-gassers, glycol top-up, chemical dosing and side stream filters. This will be done on an N per system basis.

7.7 Room Conditioning

7.7.1 Theatre and clinical spaces

- The HTM's specify that clinical spaces should, where possible be conditioned via all air system to maintain suitable air changes and minimise maintenance in the space.
- The theatre will be served via a dedicated system that will operate with a variable supply temperature to meet the room requirements. Variable volume hasn't been proposed due to the required air change requirement.
- The general treatment rooms will have a dedicated AHU that will also operate under the same philosophy with a night set-back to reduce energy consumption.
- The need for VAV re-heat will be assessed using dynamic simulations at the next stage when more detail on the room usages will be available.

7.7.2 Non-clinical spaces

There several options for the non-clinical spaces depending on the anticipated level of climate control the end users require. The solution is to be agreed by the trust at next stage.

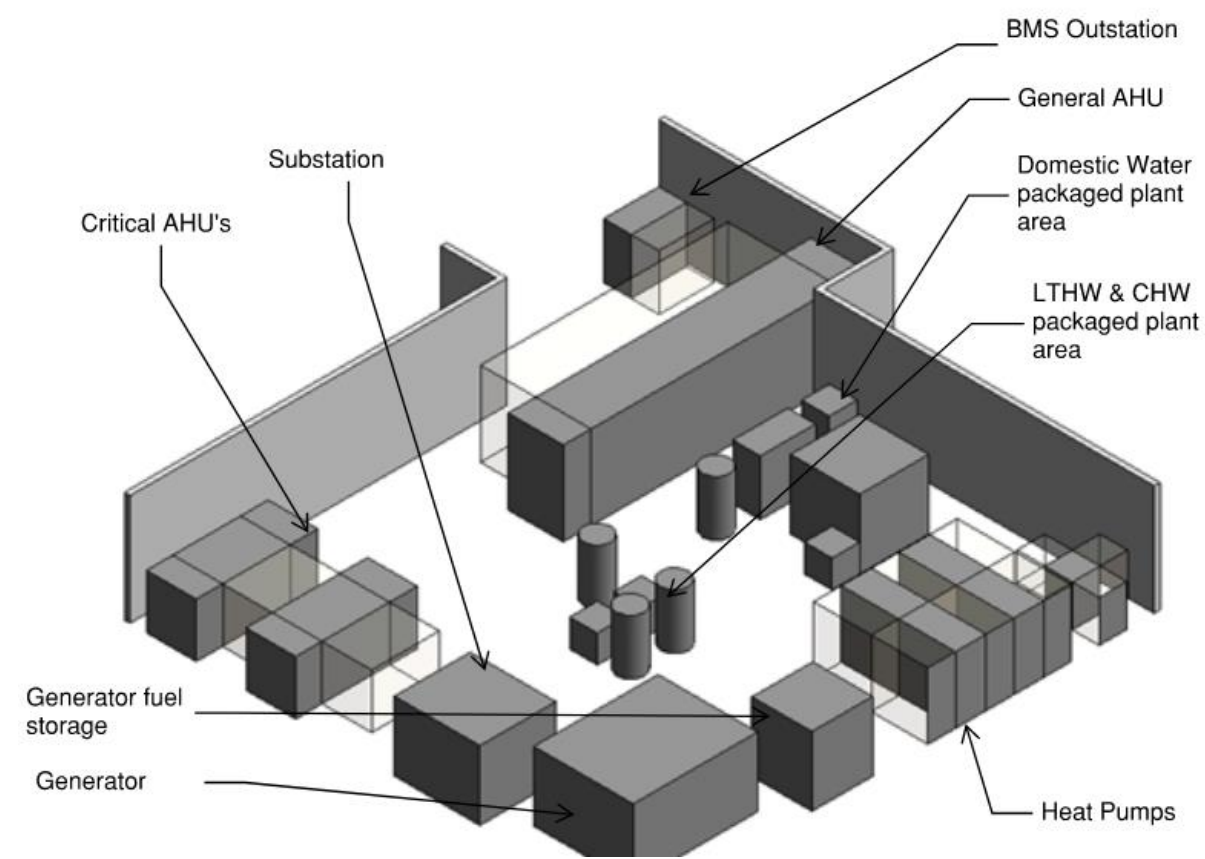
- Firstly, the option to naturally ventilate some spaces on the Northern façade is to be reviewed at the next stage with the air quality assessor. The risk of noise and exhaust fumes has resulted in a mechanical solution as this stage.
- Option 1 - all spaces provided with LTHW radiators to meet minimum room temperatures. No cooling provided on top of the auxiliary ventilation provided to meet the minimum fresh air requirements. This could result in excessive internal temperatures.
- Option 2 - provide a small VRF system to serve the particular rooms that require greater control or have the potential for large variations in occupancy.
- Option 3 - CHW & LTHW distributed throughout the building to serve 4-pipe FCU's in rooms that have a cooling requirement as shown in P.019694-RED-XX-00-DR-M-1201 & P.019694-RED-XX-00-DR-M-2201.

7.8 Plant Location

All primary mechanical plant is to be located at grade level to the east of the building as opposed to the roof as per client request. This is understood to be to future proof for a first-floor extension that does not require relocation of plant.

Where possible, packaged plantroom solutions will be deployed to house relevant plant such as pump set, water storage tanks, buffer vessels and similar ancillary components. This is preferred to an external plant to reduce losses, minimise trace heating and limit IP ratings.

AHU will have suitable weatherproofing or be located under a lightweight roof structure to provide protection from the elements to maintenance staff.



7.9 BMS

All new plant is to be connected into the existing site wide BMS system so there can be a central head end to interrogate system performance.

7.10 Fire

All HVAC building services engineering systems will **be designed in accordance with the future** Fire Strategy report.

8.0 PUBLIC HEALTH DESIGN

8.1 Introduction

The Public Health services for Elective Building comprise the following:

- Potable water system
- Domestic water system
- Non-potable water system
- Water storage and booster pumps
- Water treatment plant

8.2 Domestic Water

8.2.1 Water Tank

Water storage will be provided to give security of service in the event of mains failure. To facilitate maintenance, storage will be via two interconnected water tanks. Water storage will be based on 12-hour demand scenario as per section 7.17 of HTM 07-04.

8.2.2 Boosted Water

From the water tank, domestic water will be boosted and distributed throughout to serve fixtures and fittings via a duty/stand/by pump set. Water softening will also be provided if required.

8.2.3 Hot Water

It is proposed that hot water will be generated either:

- Locally at the point of use, with minimal storage. Showers would be instantaneous electric.
- Via high temperature heat pumps as part of a packaged system with calorifier
- Via the new LTHW connection from the district heat network

The most viable option will be based on the output of the general heating provisions.

8.3 Sanitaryware

To meet BREEAM targets, the maximum water used by sanitary fixtures and fittings will be:

- WCs - effective flush volume of 5 litres or less
- Basin tap - less than 9 litres/min or less and be one of the following:
 - Timed automatic shut-off taps e.g. push taps
 - Electronic sensor taps
 - Low flow screw-down/lever taps
 - Spray taps
- Showers- 10 litres per minute
- Urinals – 6 litre/bowl/hour and are either;
 - Fitted with individual presence detectors that operate the flushing control after each use; or
 - Ultra-low flush or waterless urinals

Lower values from those above, may be required to meet higher BREEAM targets of excellent and outstanding, kitchen taps, cleaners’ sinks and external taps are not restricted.

8.4 Foul Drainage

- Above and below ground foul drainage to suit building requirements.
- Gravity installation throughout where possible.
- Manholes within the building should be avoided. Where this is not possible, they should be located in a non-sensitive well-ventilated area.

Roof drainage should be via gravity only with pipework external of the building. Syphonic drainage may be used but, only where gravity drainage is not practicable.