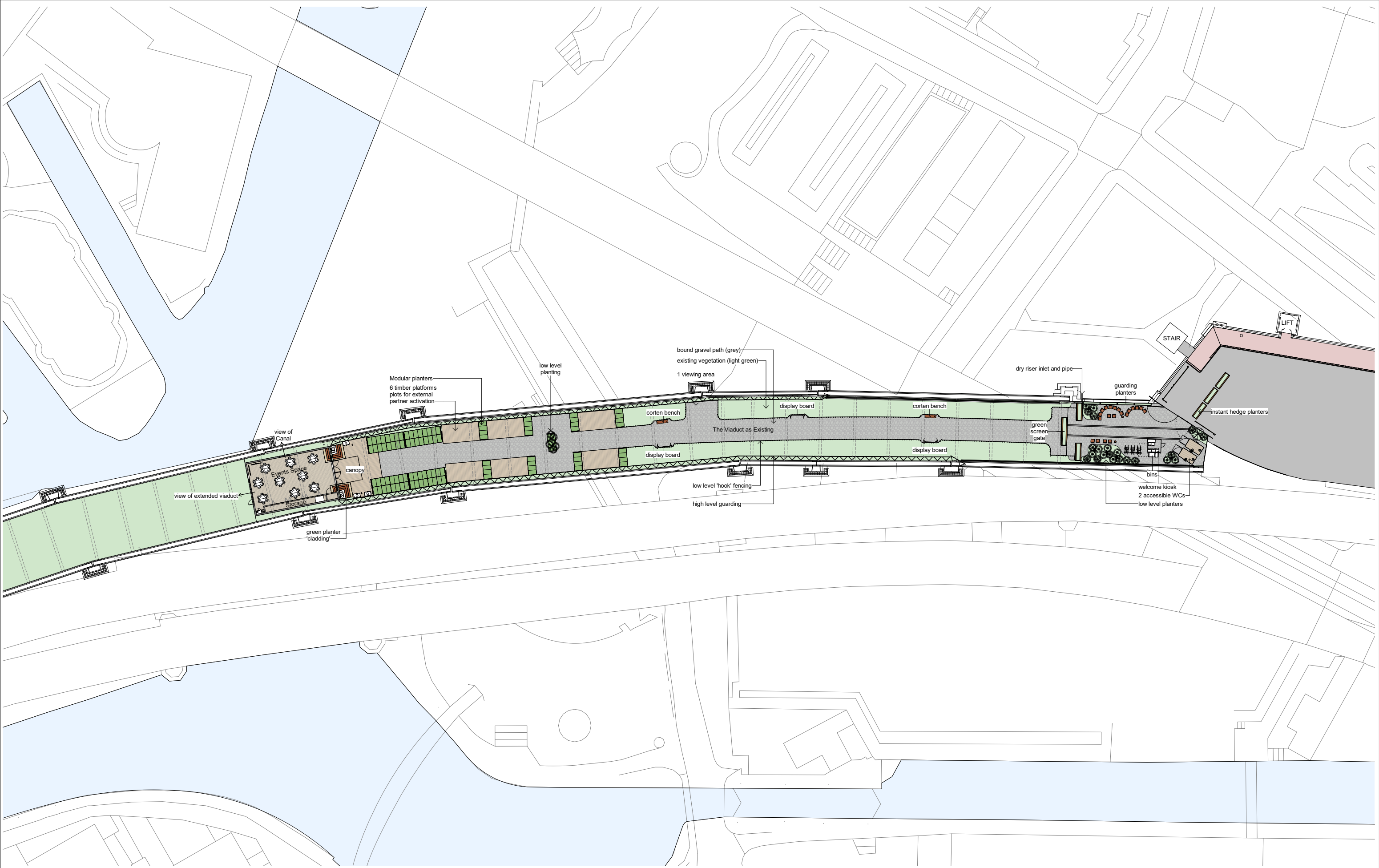




CDM Issues - Significant/Residual Hazards:

All designers involved in this drawing are to ensure that all foreseeable Significant Hazards relating to this drawing are indicated below.

Significant Hazards are not necessarily those that result in the greatest risks, but those that are:

- Unlikely to be obvious to a competent contractor or other designers;
- Unusual;
- Likely to be difficult to manage effectively.

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Hazard	Description	Measure/Location/Reference
Fall from height	☐	
Falling objects	☐	
Hazardous materials	☐	
Uncontrolled substances	☐	
Site transport	☐	
Crushing/entrapment	☐	
Hazardous operations	☐	
Confined spaces	☐	
Noise	☐	
Dust	☐	
Vibration (HAV)	☐	
Manual handling	☐	
Asbestos	☐	
Others	☐	

Notes:

1. Do not scale from this drawing.
2. Dimensions are in millimetres (mm) unless otherwise stated.
3. This drawing is to be read in conjunction with all relevant Architectural, Civil, Structural and Service Engineer's drawings, schedules and specifications.

Key:

Rev.	Date	Description	Dm	Chkd	Appd
A	15/10/21	Design development revisions	IA	MC	IA
B	22/10/21	Changes to WCs, guarding, dry riser pipe, water butts	IA	MC	IA
C	10/11/21	Post survey adjustments, design development	IA	MC	IA

Key Plan:

Scale @ A1:

1:300

Date:

22/09/21

Drawn:

IA

Checked:

MC

Approved:

MC

Job No.:

122019

Drawing No.:

(GA)001

Revision:

C

Issue Status:

STAGE 4

Project Title:

The National Trust
Castlefield Viaduct

Drawing Title:

Stage 4 Masterplan

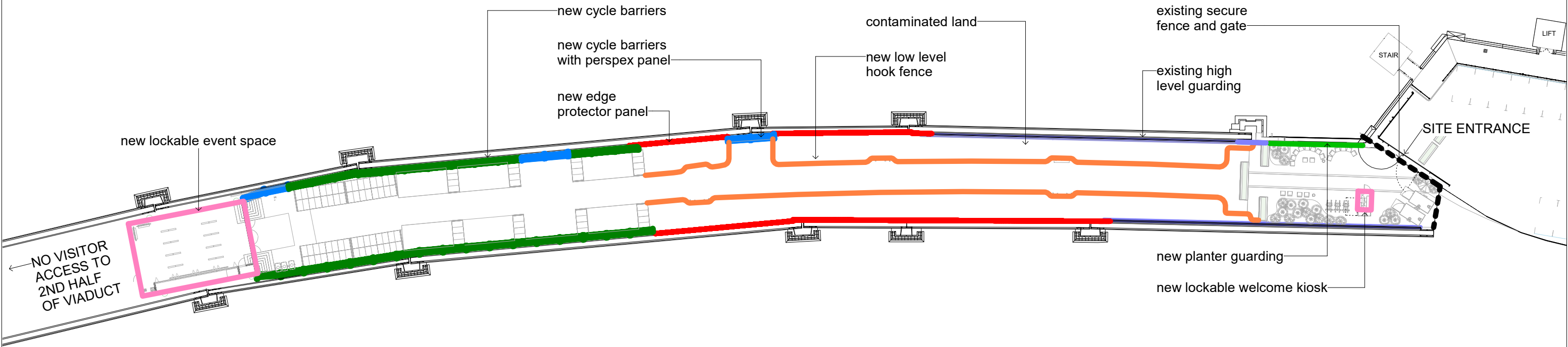
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e: info@twelvearchitects.com
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KEY

- 1. Existing Secure Fence and Gate
- 2. Existing High Level Guarding
- 3. Edge Protector Panel
- 4. Cycle Barrier
- 5. Cycle Barrier with Perspex Panel
- 6. New Planter Guarding
- 7. Low Level Hook Fence
- 8. Lockable Building Enclosures



CDM Issues - Significant/Residual Hazards:			Hazard		Description		Measure/Location/Reference		Notes:		Key:		Rev.		Date		Description		Dm.		Chkd		Appd		Key Plan:		Issue Status:		PLANNING			
All designers involved in this drawing are to ensure that all foreseeable Significant Hazards relating to this drawing are indicated below. Significant Hazards are not necessarily those that result in the greatest risks, but those that are: - Unlikely to be obvious to a competent contractor or other designers; - Unusual; - Likely to be difficult to manage effectively. As a design and building project, the Main Contractor is deemed to be a designer under the CDM Regulations as well as the Client, Architect, Engineer or subcontractors. This risk schedule is not a design risk assessment of a full and complete risk schedule and should not be deemed as such. Copies of the designers' risk assessment along with risk schedules are to be available from the Main Contractor's site office upon request.			Fall from height						1. Do not scale from this drawing.				A		16/11/21		Minor revisions following physical survey results		IA		MC		IA				Project Title:		The National Trust Castlefield Viaduct		 twelve architects & masterplanners 148 Tooley Street London SE1 2TU UK t: +44 (0) 207 846 2012 e: info@twelvearchitects.com w: www.twelvearchitects.com	
			Falling objects								2. Dimensions are in millimetres (mm) unless otherwise stated.				B		30/11/21		Detail added to clarify barrier types		IA		MC		IA		Drawing Title:		Security Measures Diagram			
			Hazardous materials						3. This drawing is to be read in conjunction with all relevant Architectural, Civil, Structural and Service Engineer's drawings, schedules and specifications.																							
			Uncontrolled substances																													
			Site transportation																													
			Crushing/entrapment																													
			Hazardous operations																													
			Confined spaces																													
			Noise																													
			Dust																													
			Vibration (NAV)																													
			Manual handling																													
			Asbestos																													
			Others																													

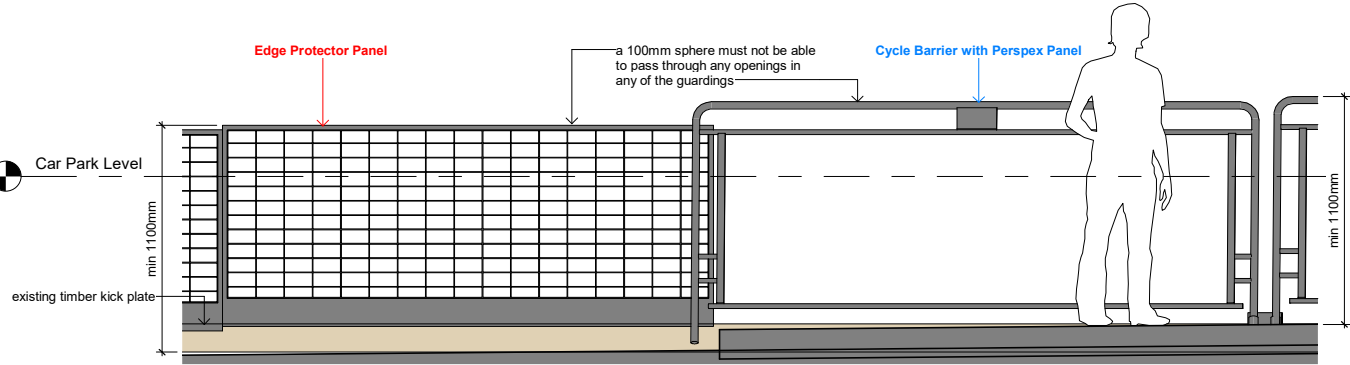
KEY

Edge Protector Panel (97m)
fixed to existing scaffolding
RAL 7016 Anthracite Grey

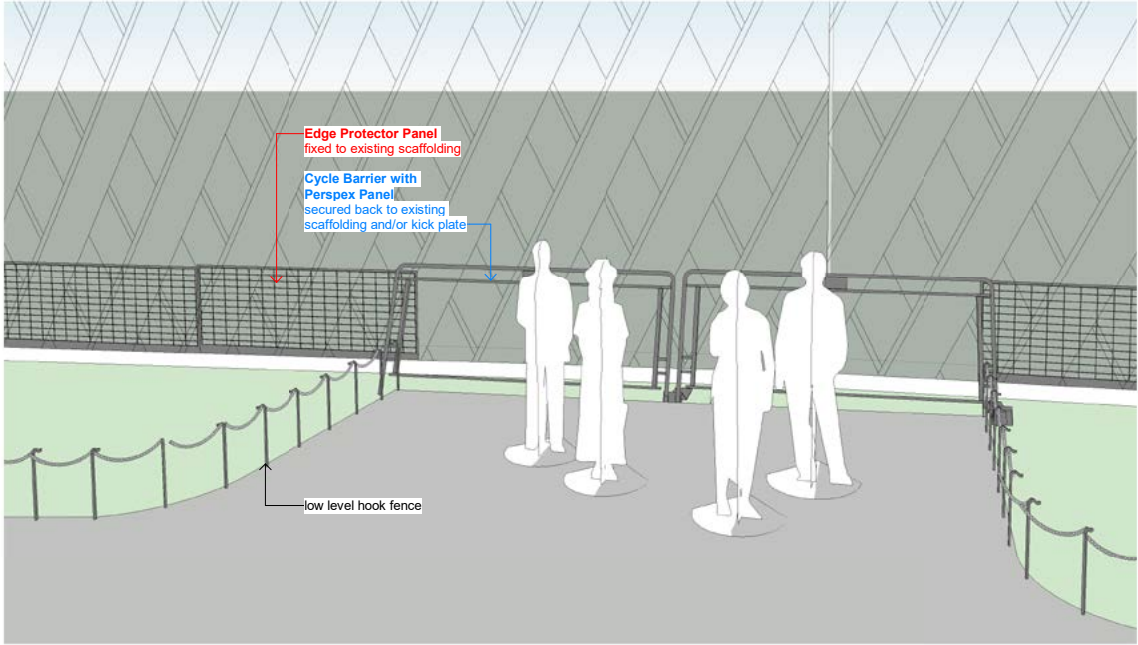
Cycle Barrier (93m)
secured back to existing scaffolding and/or kick plate
RAL 7016 Anthracite Grey

Cycle Barrier with Perspex Panel (19m)
secured back to existing scaffolding and/or kick plate
RAL 7016 Anthracite Grey

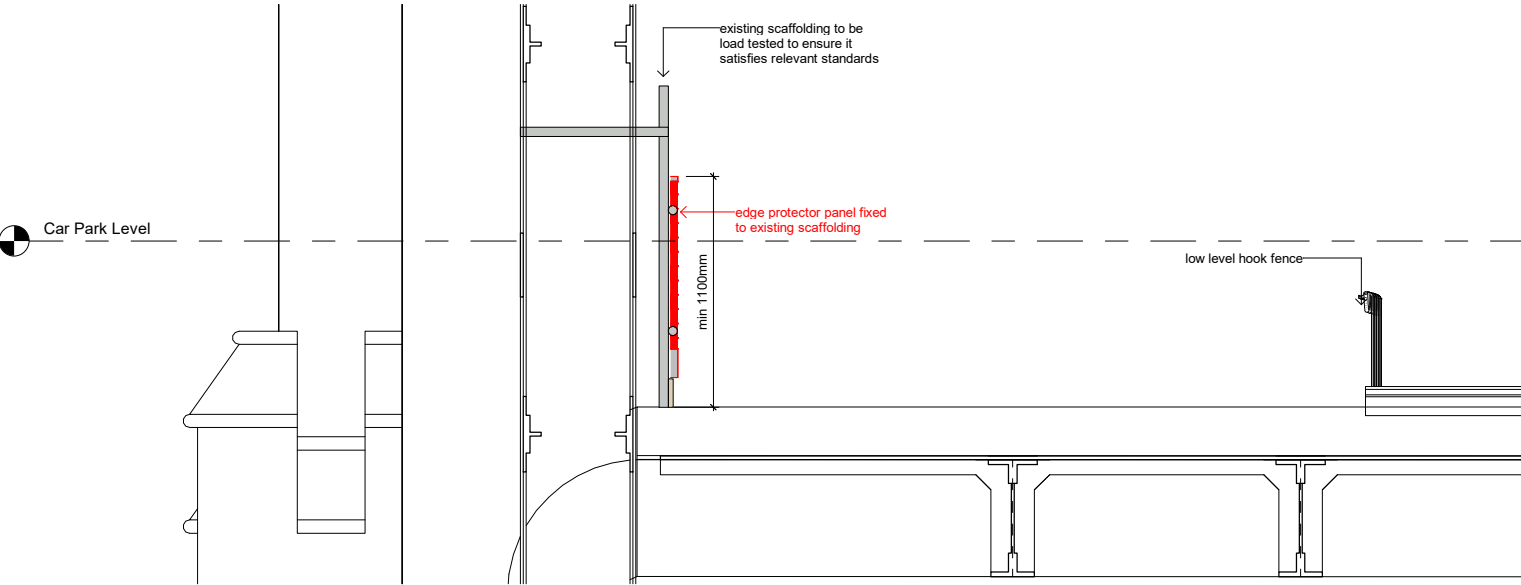
(34) Extent of high level guarding
1 : 250



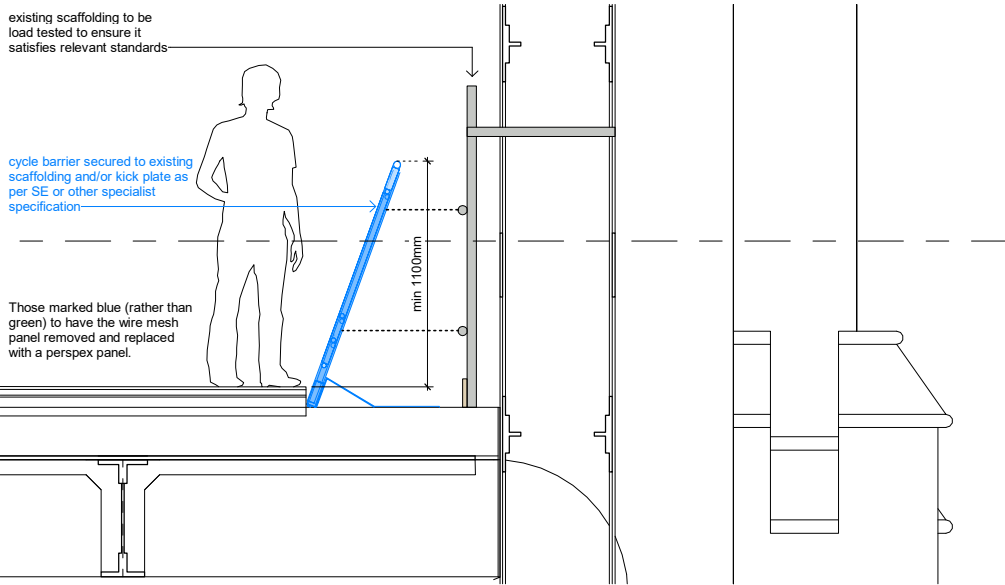
(34) Guarding Elevation
1 : 20



(34) 3D View
4



(34) Guarding Section
1 : 20



CDM Issues - Significant/Residual Hazards:

All designers involved in this drawing are to ensure that all foreseeable Significant Hazards relating to this drawing are indicated below.
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Hazard	Description	Measure/Location/Reference
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Hazardous materials	☐	
Uncontrolled substances	☐	
Site transport	☐	
Crushing/entrapment	☐	
Hazardous operations	☐	
Confined spaces	☐	
Noise	☐	
Dust	☐	
Vibration (HAV)	☐	
Manual handling	☐	
Asbestos	☐	
Others	☐	

Notes:

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Key:

Rev.	Date	Description	Dm.	Chkd	Appd
A	29/11/21	Viewing Platform Barriers changed to have Perspex Infill	IA	MC	IA
B	08/12/21	Camomile lawn viewing platform changed to perspex wall	IA	MC	IA

Key Plan:

Issue Status:

STAGE 4

Project Title:
**The National Trust
Castlefield Viaduct**
Drawing Title:
High Level Guarding Details

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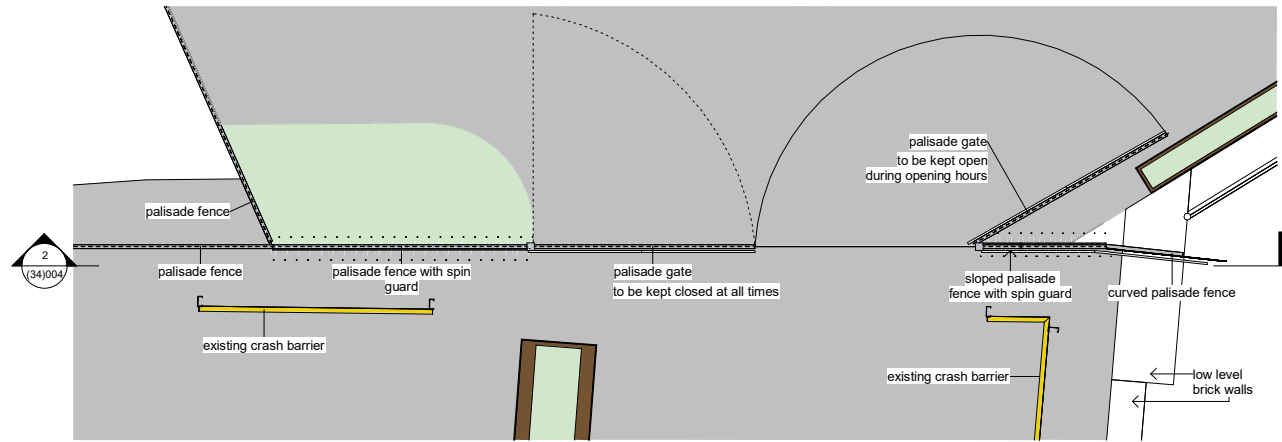
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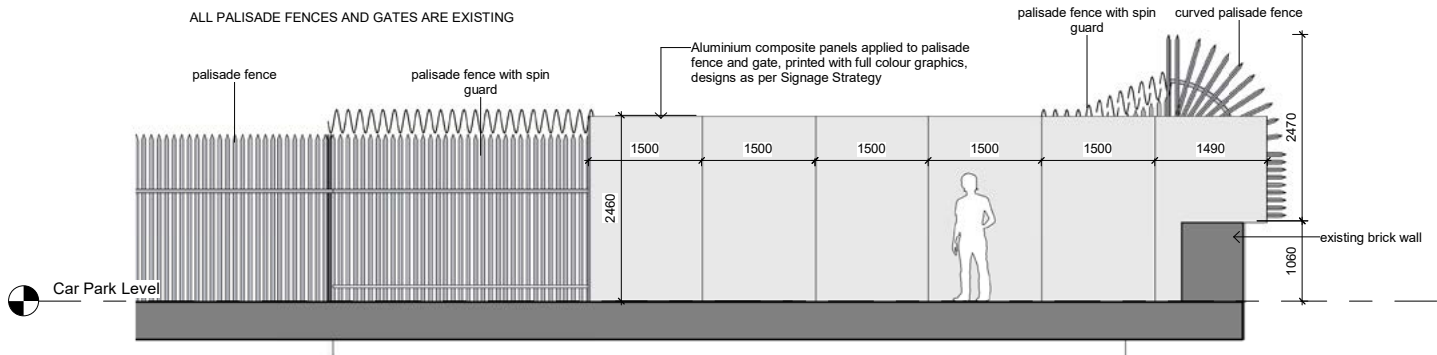
Scale @ A1:	Date:	Drawn:	Checked:	Approved:	Job No.:	Drawing No.:	Revision:
varies	29/11/21	IA	MC	IA	122019	(34)001	B



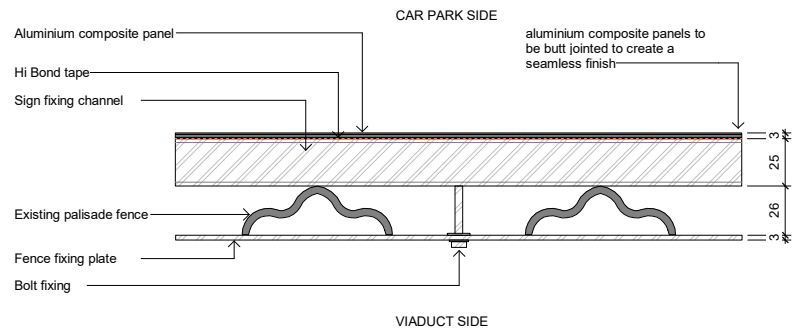
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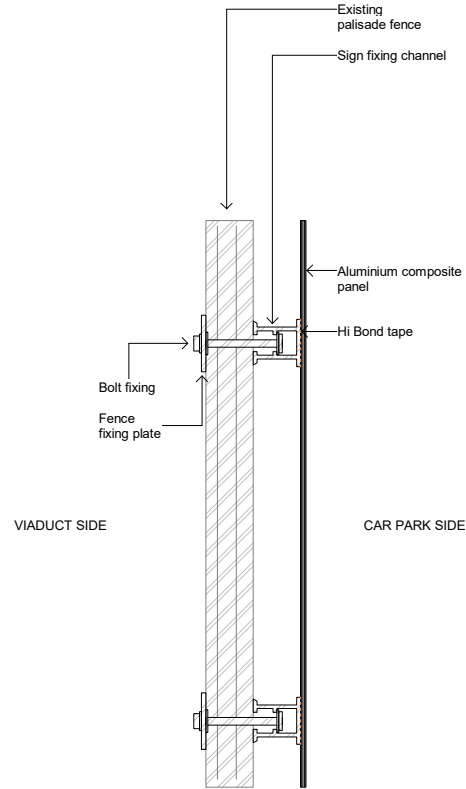
1 (34) Entrance Fence Plan
1 : 50



2 (34) Fence Dressing Elevation (Gate Closed)
1 : 50



3 (34) Fence Fixing - Plan Detail
1 : 2



4 (34) Fence Fixing - Section Detail
1 : 2

N.B.: Existing fence to be measured on site before manufacturing aluminium composite panels.

Fixing details to be checked and approved by specialist subcontractor.

CDM Issues - Significant/Residual Hazards:			Notes:			Key:			Key Plan:			Issue Status:			Project Title:			Drawing Title:			Scale @ A1:			Date:			Drawn:			Checked:			Approved:			Job No.:			Drawing No.:			Revision:		
All designers involved in this drawing are to ensure that all foreseeable Significant Hazards relating to this drawing are indicated below. Significant Hazards are not necessarily those that result in the greatest risks, but those that are:			1. Do not scale from this drawing. 2. Dimensions are in millimetres (mm) unless otherwise stated. 3. This drawing is to be read in conjunction with all relevant Architectural, Civil, Structural and Service Engineer's drawings, schedules and specifications.									STAGE 4			The National Trust Castlefield Viaduct			Entrance Fence Dressing Details			varies			13/12/21			IA			MC			IA			122019			(34)004			-		
• Unlikely to be obvious to a competent contractor or other designers; • Unusual; • Likely to be difficult to manage effectively.															twelve architects & masterplanners																													
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Manual handling			☐																																									
Asbestos			☐																																									
Others			☐																																									



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3 MVHR FIXTURES AND FITTINGS, LIGHTING, CCTV & POWER DRAINAGE DESIGN BY ARUP

1 Planning Conditions Responses

Condition 3

Item	Comments
MVHR	As detailed in MEP specification: CVI-ARUP-ZZ-XX-SP-V-000001 'Section 6.6 Ventilation system' & as detailed on drawing No. CVI-ARUP-ZZ-GF-DR-M-000501. The Contractor is required to produce installation drawings that comply with the Mechanical services drawings and MEP Particular Specification, and Mechanical & Electrical Materials and Workmanship Specification.
High Level Guarding	Table 2 in BS7818:1995, outlines the Horizontal Imposed Loads on pedestrian restraint systems in metal. For Class 2 occupancy, normal duty where crowd loading is not anticipated, a horizontal design load of 0.7kN/m is recommended. Horizontal displacement of the restraint system should not be greater than 50mm as set out in Table 4.
Fixtures and fittings,	As detailed in MEP specification: CVI-ARUP-ZZ-XX-SP-V-000001. CCTV, PAVA and Intruder alarm shall be designed by the contractor, see section 10, 11.2 & 11.3 or the MEP specification. The Contractor is required to design the systems identified and produce installation drawings that comply with the Electrical services drawings and MEP Particular Specification, and Mechanical & Electrical Materials and Workmanship Specification.
lighting,	As detailed in MEP specification: CVI-ARUP-ZZ-XX-SP-V-000001 'Section 12' and drawing No. CVI-ARUP-ZZ-GF-DR-E-002501 & CVI-ARUP-ZZ-GF-DR-E-002502. The Contractor is required to produce installation drawings that comply with the Electrical services drawings and MEP Particular Specification, and Mechanical & Electrical Materials and Workmanship Specification.
CCTV,	As detailed in MEP specification: CVI-ARUP-ZZ-XX-SP-V-000001 'Section 11.3. The Contractor is required to design the systems identified and produce installation drawings that comply with the Electrical services drawings and MEP Particular Specification, and Mechanical & Electrical Materials and Workmanship Specification.
power	As detailed in MEP specification: CVI-ARUP-ZZ-XX-SP-V-000001 'Section 11.3' and drawing No. CVI-ARUP-ZZ-GF-DR-E-000501 & CVI-ARUP-ZZ-GF-DR-E-000502. The Contractor is required to produce installation drawings that comply with the Electrical services drawings and MEP Particular Specification, and Mechanical & Electrical Materials and Workmanship Specification.
Drainage	The relevant Public Health services drawing is CVI-ARUP-ZZ-GF-DR-P-003501 - Above Ground Drainage Layout Viaduct Level The Contractor is required to produce installation drawings that comply with the Public Health services drawings and MEP Particular Specification, and Mechanical Materials and Workmanship Specification.

MEP SPECIFICATION

SECTION 6.6 VENTILATION SYSTEM

- 6.5.3.2

The electric panel heater shall come complete with integral controls incorporating a weekly time schedule, including night-time setback for frost protection.
- 6.5.4

Distribution Strategy
- 6.5.5

Event Space
- 6.5.5.1

Refrigerant pipework shall emanate from the DX-split heat pump as indicated on the combined mechanical services layout drawing.
- 6.5.5.2

The DX-split system shall be connected by a 2-pipe refrigerant circuit to their respective FCU, providing heating and cooling to achieve the required comfort conditions of the area.
- 6.5.5.3

All refrigerant pipework shall run within dedicated containment.
- 6.5.5.4

Refer to the Materials and Workmanship Specification for further information on pipework joints, insulation, fittings, fixings, supports, expansion, and ancillaries.
- 6.5.6

Cooling System
- 6.5.7

DX Split System - Event Space
- 6.5.7.1

Refer to section 6.5.2
- 6.5.8

Condensate
- 6.5.8.1

Gravity condensate drains shall be provided, refer to above ground drainage (AGD) layout drawing(s).
- 6.6

Ventilation Systems
- 6.6.1

Performance Objectives
- 6.6.1.1

The Contractor shall design, supply, test, commission and set to work a complete ventilation installation inclusive of all necessary plant, distribution equipment, controls etc. to provide a fully functional safe and energy efficient system.
- 6.6.1.2

The contractor shall test and commission the ventilation systems in line with the requirements defined within CIBSE Commissioning Code A: Air Distribution Systems

- 6.6.2

General
- 6.6.2.1

The internal spaces shall be served with fresh air by a means of mechanical ventilation, supplemented with natural ventilation via manually openable windows/doors.
- 6.6.2.2

Ventilation air distribution ductwork shall be to HVCA DW144 standard with all necessary fittings, dampers, access points, and grilles/diffusers.
- 6.6.2.3

Galvanised side entry plenum boxes shall be attached to the back of weather rated louvres. Spigot connection shall match the adjoining ductwork diameter.
- 6.6.2.4

Where flexible ductwork is installed, the contractor shall ensure the maximum length does not exceed 500mm. All flexible ductwork shall be free from knots and be well supported to avoid sagging. Refer also to the mechanical and workmanship specification for details of flexible ductwork connections.
- 6.6.2.5

Weather rated louvres shall meet HEVAC B2 classification to minimise water ingress.
- 6.6.3

Mechanical Ventilation Heat Recovery (MVHR) System Description
- 6.6.4

00/MVHR/01 – Event Space
- 6.6.4.1

The outside air shall be drawn in through insulated ductwork emanating from a swan inlet terminal above the roof c/w insect mesh.
- 6.6.4.2

Extract air shall exhaust to atmosphere through insulated ductwork connected to a weather rated louvre, c/w insect mesh.
- 6.6.4.3

The MVHR shall pre-heat/pre-cool the incoming air via the thermal wheel heat exchanger.
- 6.6.4.4

The MVHR shall be provided with an integral control system with a touch screen interface.
- 6.6.4.5

The ventilation system shall operate at a constant volume flow rate and shall be activated/disabled on time control.
- 6.6.4.6

The contractor shall agree the time schedule with the client prior to commissioning.
- 6.6.5

Ductwork Access Doors
- 6.6.5.1

Access doors shall be provided to satisfy all access and cleaning requirements as scheduled in DW/144 and TR19.

- 6.6.5.2

Access doors shall be installed no greater than 600mm from the item/equipment.
- 6.6.5.3

It is the Contractor's responsibility to position the access doors to avoid other services and still maintain clear access to the door. Any access doors rendered not fully accessible when the installation is completed shall be supplemented with additional site fitted access doors positioned to overcome the access issues.
- 6.6.6

Noise Control
- 6.6.6.1

Attenuation shall be provided to the general ventilation system to achieve a room noise rating of NR35-40
- 6.6.6.2

All acoustic control equipment shall be provided to meet the requirements of the Materials and Workmanship Specification and as detailed within this specification.
- 6.6.7

Insulation
- 6.6.7.1

Refer to materials & workmanship specification.
- 6.6.8

Natural Ventilation
- 6.6.8.1

A passive approach to ventilation shall be adopted wherever feasible.
- 6.6.8.2

Natural ventilation is reliant on wind pressure and temperature difference. The Work Stage 4 design of these spaces has been carried out in accordance with the guidance in CIBSE Guide A, CIBSE Applications Manual 10 and all other relevant guidance and standards.
- 6.6.9

Event Space
- 6.6.10

The event space shall be provided with mixed mode ventilation. During general operating conditions (max occupancy of 22 people), the fresh air requirements shall be met via the means of mechanical ventilation, as outlined in section 6.6.4. During times where special events are hosted and when the occupancy exceeds 22 people, the additional fresh air requirements shall be met via

- the means of natural ventilation, via manually openable windows/doors.
- 6.6.11

For details of the free area requirement, please refer to the mechanical services drawing.
- 6.6.12

The free area stated has been sized to ensure the internal CO₂ conditions do not exceed 1200PPM for a prolonged period.
- 6.6.13

Welcome Kiosk
- 6.6.13.1

Fresh air requirements to the welcome kiosk shall be achieved via manually openable windows.
- 6.6.13.2

High level opening windows have been incorporated as shown on the combined mechanical services layout drawing.
- 6.6.13.3

The windows available free area has been sized to provide adequate ventilation to achieve a comfortable environment, in line with TM52: The limits of thermal comfort: Avoiding overheating in European buildings.
- 6.6.13.4

For details of the free area requirement, please refer to the mechanical services drawing.

MEP SPECIFICATION

SECTION 10

10 PUBLIC ADDRESS AND VOICE ALARM SYSTEM

10.1.1 Overview

- 10.1.1.1 A combined Public Address and Voice Alarm (PAVA) system is required to be provided throughout the public realm area of Castlefield Viaduct, in accordance with the fire strategy – refer to the Arup fire strategy documentation for further information.
- 10.1.1.2 The PAVA system is a contractor design portion – refer to the Technical Introduction for details. The Contractor shall undertake detailed design of the PAVA system and shall hold full design responsibility for the complete system, including final electroacoustic performance and the interface with the Fire Detection and Alarm system. The responsibility of the Contractor shall include the final electroacoustic design including the type, number, location, orientation and power of loudspeakers.
- 10.1.1.3 The Contractor shall include for the design, procurement, supply to site, off-loading, storage, coordination, erection, installation, connection, setting-to-work, testing, commissioning, demonstration and hand over to the Client of all necessary equipment, materials, accessories, controls, cabling and other items comprising complete, safe and functionally efficient installations.
- 10.1.1.4 The Contractor shall demonstrate the system and provide instruction to the client’s operating staff and to Building Control after the PAVA system has been installed, fully tested and commissioned.
- 10.1.1.5 The work in this Contract shall include the whole of the labour and all materials necessary to form a complete, fully operational installation and all tests, adjustments and commissioning as prescribed in this performance specification, other related documents as may otherwise be required to give an effective working installation to the satisfaction of the Employer’s Representative.

10.1.2 System outline

- 10.1.2.1 The PAVA system shall be interfaced with the viaduct fire detection and alarm system – refer to the schematic drawings for details.

- 10.1.2.2 Operation of the PAVA system shall be consistent with the fire safety strategy and evacuation plan – refer to the fire strategy documentation for further information.
- 10.1.2.3 The primary function of the system shall be to provide secure, fail-safe and high intelligibility emergency speech broadcast to all areas.
- 10.1.2.4 The foregoing summary is intended for general guidance only, to assist in the preparation of a detailed design, and no omission from this description shall relieve the Contractor from his obligations to carry out the whole of the works hereinafter described.

10.1.3 Performance requirements

- 10.1.3.1 The system shall provide a Speech Transmission Index (STI), as described in BS EN 60268-16:2011, of ≥ 0.50 STI average across all measurement points with a corresponding average minus one standard deviation of ≥ 0.45 .
- 10.1.3.2 The system shall achieve the above STI values with an overall signal to noise ratio $\geq 10\text{dBLA}$ (and $\geq 10\text{dB}$ in each of the 500Hz, 1kHz and 2kHz frequency octave bands).
- 10.1.3.3 The Contractor shall conduct an ambient typical operating level survey and design a PAVA system that shall deliver intelligible voice messages from the emergency microphones and emergency pre-recorded message units 5dBLAeq above the measured ambient operating level.
- 10.1.3.4 The Contractor shall select appropriate EN 54 compliant PAVA speakers to meet the requirements of the system.
- 10.1.3.5 Loudspeaker cables shall be selected and sized to ensure $\leq 1\text{dB}$ power loss, assuming an additional future power load of at least +10% on each circuit.
- 10.1.3.6 The average (rms) sound levels of attention drawing signals preceding emergency message speech shall be 0dBLA to +3dBLA of the average sound level of the speech.
- 10.1.3.7 Voice reproduction shall be of a good quality and natural sounding except for areas covered by re-entrant horn loudspeakers. Switching shall be inaudible and the system shall be free from audible distortion, hum and noise.
- 10.1.3.8 All primary user and automatic actions, i.e., use of microphone panels and fire panel commands, shall result in full and complete system response within 0.5s of the action.
- 10.1.3.9 The Contractor shall rectify any defect or shortcoming of the installed system which results in or contributes to a failure to meet

any of the above performance requirements, and which is attributable to the Contractor.

10.1.4 Functional requirements

10.1.4.1 The system shall provide the following functional facilities:

- Interface(s) to the Fire Detection and Alarm System based on final number of evacuation zones and staged alarm requirements.
- Automated initiation of pre-recorded emergency speech broadcast to selectable areas triggered by the Fire Detection System.
- Manual initiation of pre-recorded emergency speech broadcast to selectable areas.
- Live emergency speech broadcast to selectable areas.
- Fault monitoring, indication / reporting / logging including reporting back to the Fire Detection and Alarm System.
- Back-up power and resilient systems (avoiding single points of failure), with adequate redundancy.
- Public address message broadcast to selectable zones.

10.1.4.2 The system security and resilience features shall include:

- Fire rated cabling and equipment rooms.
- Diverse cable routing, equipment and appropriate containment.
- Interleaved loudspeaker circuits as required by BS 5839-8.
- Prioritisation of emergency broadcasts over non-emergency inputs.
- Loudspeaker and loudspeaker line monitoring.
- Critical signal path monitoring (fault monitoring of all critical components including microphones, emergency digital message stores, amplifiers and routing and control equipment) with local alarms and reporting to the Fire Detection and Alarm System.
- Redundant / spare amplifier capacity.
- Component identification and labelling, including red colour coding where appropriate.
- Clear operator instructions for emergency use.
- Standby/back-up power supply systems.

10.1.4.3 The system shall consist of the following elements:

- Emergency microphones and control panels for live emergency speech broadcast and selection of evacuate, alert and coded messages.
- Digital message units containing pre-recorded speech.
- Public address messaging microphone and control panel/touch screen for non-emergency speech broadcast, and audio relay

selection – refer to drawings included in the appendices for proposed locations.

- Distributed equipment racks located within comms rooms or PAVA equipment rooms.
- Industry standard digital signal processing (DSP) system and dedicated system distribution network.
- Loudspeakers.
- Amplification.

10.1.4.4 PAVA amplifier racks are proposed to be provided within a dedicated cabinet within the Welcome Kiosk.

10.1.4.5 The PAVA system is provided with a dedicated 20A single phase supply routed directly from the National Trust Feeder Pillar in fire-rated cabling in to a lockable isolator. The Contractor shall be responsible for the final connections to the PAVA cabinets and associated battery backup / UPS to comply with the requirements of BS 5839-8.

10.1.4.6 The Contractor shall verify that the rooms allocated and the building services provided are adequate to suit the PAVA installation selected.

10.1.4.7 PAVA amplifier racks shall include electrical containment, lockable doors (keyed alive) and fan trays as required.

10.1.5 Quality assurance

10.1.5.1 Installations shall comply with all relevant statutory instruments and regulations current at the date of tender (unless specifically stated otherwise in this Performance Specification or on any drawing) and in particular with the following:

- BS 5839-8
- BS EN 60268-16.

10.1.5.2 Wherever possible, all products, systems and equipment shall be certified as compliant with the following standards unless this would lead to deficient electroacoustic performance such as sound pressure level, speech intelligibility etc.:

- BS EN 54-16
- BS EN 54-24.

10.1.5.3 Any deviations/variations from BS EN 5839-8 and the relevant BS EN 54 standards shall be brought to the attention of the Employer’s Representative.

10.1.6 Coordination

- 10.1.6.1 The Contractor shall ensure that the installation is fully coordinated with all other services and building elements.
- 10.1.6.2 The Contractor shall coordinate layout and installation of system components with other mechanical and electrical systems.
- 10.1.6.3 The locations of loudspeakers, microphones, microphone control panels and other equipment are to be subject to such revision by the Employer’s Representative as may be found necessary or desirable at the time the work is installed in order to meet field conditions or to coordinate with modular requirements of ceilings, or to simplify the work, or for other legitimate causes.
- 10.1.6.4 All equipment and systems shall be designed and installed such that there will be no effect of electromagnetic interference on the operation of the PAVA system.
- 10.1.6.5 The Contractor shall: establish grades and elevations and shall verify all dimensions and locations in the field prior to the start of any work and/or installation of equipment, containment and fixtures; adjust the location of containment, panels, equipment, pull boxes, fixtures, etc. to accommodate the work to prevent interferences, both anticipated and encountered and determine the exact route and location of each cable containment prior to fabrication.

10.1.7 Submittals

- 10.1.7.1 The Contractor shall submit the calculations and drawings and any other installation proposals to the Employer’s Representative for comment and for any revisions arising out of such comments.
- 10.1.7.2 The Contractor shall submit the following technical information to the Employer’s Representative for comment prior to the installation of any part of the PAVA system and for any revisions arising out of such comments.
 - At the time of tender, a list of all proposed equipment items, with technical data sheets or other documentary evidence to show that each item will meet the requirements of this Performance Specification.
 - Loudspeaker layout drawings, demonstrating coordination with fixtures and fittings as necessary.
 - Schematic diagram showing interconnection of components.
 - Public address console layouts.
 - Statement of compliance with BS 5839-8 detailing any variations.

- Details of any minor deviations from this Performance Specification.

10.1.7.3 The Contractor shall supply the following technical information prior to the manufacture or delivery of any equipment:

- Drawings of the racks and panels as appropriate, e.g. auxiliary input panels, emergency microphone panels etc.
- Performance Specifications for all cables to be installed, together with full wiring drawings showing the route, protection, separation and termination requirements for each cable. Power supply requirements shall also be shown.
- A power amplifier schedule.

10.1.7.4 Operations and Maintenance manuals shall contain the following:

- A description of system operation (e.g. system priority and the use of input panels), routine care, maintenance and testing and simple fault-finding procedures.
- Settings record for all controls, including pre-amplifier, signal processing and amplifier settings.
- A schedule of loudspeaker tapings and a copy of plan layout drawings of the building showing the final sound level measurements.
- A full set of drawings, manufacturers' handbooks for all proprietary items, and a list of the spares provided.

10.1.7.5 A system layout drawing, framed or otherwise permanently mounted, shall be provided for installation adjacent system control equipment in the PAVA rack locations. The drawing shall show the coverage zones, main distribution routes and the locations of all system inputs and loudspeakers.

10.1.8 Testing

- 10.1.8.1 The Contractor shall carry out performance tests on the Contract works to demonstrate that the works meet the requirements of the Contract documents, in accordance with this Performance Specification. A method statement shall be provided to the Employer’s Representative for approval at least 10 days before the performance tests are scheduled to commence. Upon successful completion of these tests, the Contractor shall carry out a full system demonstration for acceptance purposes.
- 10.1.8.2 The Contractor shall arrange for works inspection of the central equipment rack and remote panels. The Contractor shall advise the Employer’s Representative when the equipment has been fully works tested and is ready for pre-delivery inspection. Temporary circuits shall be connected, as necessary, to enable complete

testing of all audio paths, zoning, priority switching and fault warning circuits.

10.1.8.3 The Contractor shall allow a minimum of 1 day for the acceptance demonstration, plus 1 day for instruction of operational staff.

10.1.8.4 The Contractor shall have available during the testing period the following electro-acoustic test equipment:

- Sound level meter and calibrator, complying with IEC 61672-1:2013 Type 1 or 2;
- 1/3 octave band spectrum analyser (minimum range 40Hz - 16kHz at ISO centre frequencies, display resolution increment 2 dB);
- Pink noise source (minimum bandwidth 20Hz - 20kHz, ±0.5dB);

10.1.8.5 The works inspection and performance testing shall include, but not necessarily be limited to:

- Objective speech intelligibility tests: STI or STIPA measurements;
- Sound level measurements, to ensure that the system sound levels for each input, meet the Performance Specification requirements;
- Subjective assessment of the electro-acoustic performance of the system, including judgements and comments on the intelligibility of speech in all other areas as agreed with the Employer’s Representative;
- Full operational tests on the rack equipment and system inputs, including a complete check on input routing and priority;
- Test of interfaces to the fire detection system;
- Impedance of each loudspeaker line;
- Equalisation of the system in each acoustically distinguishable space;
- Electrical safety and earth checks (by a competent person, to be approved).

10.1.8.6 The results of the tests shall be presented to the Employer’s Representative not more than 10 working days after the tests have been completed. Three copies of each test report shall be provided. A copy of the report, including any amendments, shall be included within the system manual. The report shall include:

- Test details - dates, times, test personnel (with qualifications as appropriate);
- Measured values of system performance in appropriate format for the parameter measured, e.g. marked-up drawings and tables showing electroacoustic performance and completed matrices proving correct priority and routing operation.

10.1.8.7 The objective speech intelligibility measurement procedure shall be as follows:

- Measurements of speech intelligibility in shall be measured in accordance with the methodology for the STI method detailed in IEC 60268-16: 2011; using MLS, swept sine signal or STIPA signal.
- The number and location of measurement position shall be agreed in advance with the Employer’s Representative.
- “Noiseless” and “With noise” results to be provided on site if a STIPA signal is used.
- Calculations in the final report shall be based upon the post processing inclusion of ambient noise, absolute threshold masking and spectrum, using measured ambient noise levels and measured sound operating levels on site.

10.1.8.8 The sound level measurement procedure shall be as follows:

- The sound level meter shall be calibrated immediately before commencing the measurements. The sound level meter shall be set to dBLA, slow (‘S’) response.
- Measurements shall be taken at 1.5m above floor level (1.2m above floor level in seating areas).
- The required sound level shall be set within one area (average of at least 3 measurement locations within each space) using a pre-recorded test message. A pink noise signal shall then be fed into the system via the test input, and the test input gain (not the amplifier gain or loudspeaker tappings) shall be adjusted to obtain the same level.
- The pink noise input gain setting shall be noted and used to set up the sound levels at all other locations. One zone shall be selected at a time to minimise disturbance.
- Measurement locations within each space shall be chosen to indicate the maximum range of sound levels.
- The sound levels measured using a dBLA sound level meter without an Leq facility shall be visual averages. When an Leq facility is available the sound level shall be measured over a 15 second period when measuring a pink noise signal.
- Measurement locations and corresponding sound levels shall be marked up on the loudspeaker layout drawings. The drawings shall also indicate the final tapping value of each loudspeaker or each set of similar loudspeakers.
- If the measured sound levels do not meet the required levels then adjustments shall be made to the pre-amplifiers, amplifiers and/or loudspeaker tappings. The documented levels shall be the measured levels after adjustment. Any areas where the required levels cannot be achieved shall be highlighted on the drawings.
- The pink noise test shall ensure that the relative sound levels between different areas are correctly set. Once this is completed

each system input needs to be set correctly. This shall only involve measurements at 2 locations and adjustment of the pre-amplifier setting of each system input.

- Each of the recorded messages stored within the system shall be broadcast and measured in turn. The sound levels of any pre-announcement tone and of the spoken message shall be measured and noted separately. The sound level shall be the dBLA visual average or Leq over the length of the pre-announcement tone or the spoken message. Adjustments shall be made to the pre-amplifier setting until the measured sound level of the spoken message meets the required sound level.

10.1.8.9 Upon successful completion of the tests the Contractor shall carry out a full system demonstration for acceptance purposes.

10.1.8.10 If required by the Employer’s Representative (in the event of apparent non-compliance of the installed system with the Performance Specification), the Contractor shall provide precision test equipment for verification of voltage, impedance, power, frequency response, phase response, signal-to-noise ratio, total harmonic distortion and STI.

10.1.8.11 The PAVA system shall be considered defective if the outcome of the above tests and inspections do not comply with the requirements of this Performance Specification.

MEP SPECIFICATION

SECTION 11.2 & 11.3

11 ELECTRONIC SECURITY SYSTEM

11.1 Scope of Works

- 11.1.1.1 The Contractor shall be responsible for the detailed design, supply, installation, test and commissioning of the electronic security systems that include:
- CCTV
 - Intruder Detection Systems

11.2 Electronic Access Control System

11.2.1 Overview

- 11.2.1.1 The Contractor shall design, supply, install and commission a fully online CCTV & Intruder Alarm system covering the Paterson building and associated external areas within the project boundary.
- 11.2.1.2 The electronic CCTV & Intruder Alarm is a contractor design portion. The Contractor shall be responsible for appointing a specialist to complete the detailed design, coordination, supply, installation, commissioning and demonstration of the complete electronic access control system.
- 11.2.1.3 The electronic access control systems typically comprise the following components:
- CCTV cameras
 - CCTV panel
 - Intruder alarm sensor devices
 - Intruder alarm panel

11.3 CCTV System

11.3.1 Overview

- 11.3.1.1 The Contractor shall design, supply, install and commission an Internet Protocol (IP) closed circuit television (CCTV) system covering the Castlefield Viaduct project.
- 11.3.1.2 The CCTV system shall be provided for the protection of staff, visitors and their associated property, for the prevention of vandalism and antisocial behaviour and for the protection of National Trust property and equipment.
- 11.3.1.3 The CCTV system shall typically comprise of CCTV cameras, CCTV servers and CCTV monitoring and control stations.

- 11.3.1.4 The CCTV system is a contractor design portion. The Contractor shall be responsible for appointing a specialist to complete the detailed design, coordination, supply, installation, commissioning and demonstration of the complete CCTV system.

11.3.2 CCTV Performance Requirements

- 11.3.2.1 The CCTV system will be designed to provide an ‘identification’ level of coverage, as defined by BS EN 62676-4, to the following areas:
- All entrances and exits to the site
 - At areas where cash handling is made
 - The public event space
- 11.3.2.2 CCTV coverage providing an ‘identification’ level of detail shall provide a resolution of at least 4mm per pixel on the target persons with a frame rate of at least 12.5 frames per second.
- 11.3.2.3 All other areas covered by CCTV shall provide a ‘recognition’ level of coverage, as defined by BS EN 62676-4.
- 11.3.2.4 CCTV coverage providing an ‘recognition’ level of detail shall provide a resolution of at least 8mm per pixel on the target persons with a frame rate of at least 12.5 frames per second.

11.3.3 CCTV Cameras

- 11.3.3.1 The CCTV system shall be an IP system and shall utilise the structured wiring network within the site. CCTV cameras shall be connected to local structured wiring outlets.
- 11.3.3.2 All internal CCTV cameras shall be PoE.
- 11.3.3.3 External CCTV cameras may require fibre connectivity due to the cable lengths – the Contractor shall be responsible for determining the specific requirements and providing media converters as required.
- 11.3.3.4 Power supplies shall be provided where required to external cameras to supply demisters, heaters, wipers etc.
- 11.3.3.5 The performance specification of CCTV cameras including resolution and lens types shall be selected to suit the spaces served and coverage required.
- 11.3.3.6 Internal CCTV cameras shall be located for ease of maintenance, and wherever possible shall be in single height spaces or on the walls / columns of double-height spaces. Due regard shall be taken to down-stand beams and signage, which could cause an obstruction.
- 11.3.3.7 Typical performance specification of internal fixed CCTV cameras are as follows:

- IP rating: 20
 - Operating temperature: 5C to 40C
 - IP addressable filtering, password protected and HTTPS encryption
 - Controllable frame rates and bandwidths
 - 25 Frames per second
 - Colour
 - Supports M-PEG4 and H-264 video compression
 - Built-in image analytics
 - ONVIF Compliant.
- 11.3.3.8** Typical performance specification of external fixed CCTV cameras are as follows:
- IP rating: 66
 - Operating temperature: -20C to +40C
 - IP addressable filtering, password protected and HTTPS encryption
 - Controllable frame rates and bandwidths
 - 25 Frames per second
 - Colour
 - Supports M-PEG4 and H-264 video compression
 - Built-in image analytics
 - ONVIF Compliant.
- 11.3.4 CCTV Monitoring and Control Workstations**
- 11.3.4.1** CCTV monitoring will primarily be undertaken at the welcome kiosk, which monitors CCTV images across the site.
- 11.3.4.2** Each CCTV monitoring workstation shall comprise:
- Desktop PC
 - Keyboard and mouse
 - 1No. 24 inch high-contrast, high definition, LED backlit desktop monitor
- 11.3.4.3** The CCTV monitoring workstation at the Welcome Kiosk shall be capable of monitoring CCTV camera in all areas.
- 11.3.4.4** The CCTV system shall be provided with multiple use access levels, controllable on a camera by camera basis, with different levels of permissions for real-time monitoring, recorded image monitoring etc.
- 11.3.5 CCTV Digital Video Recording and Storage**
- 11.3.5.1** The Contractor shall supply, install and commission CCTV recording facilities in the form of CCTV digital video recorders installed within the Welcome Kiosk.
- 11.3.5.2** The digital video recorders shall be sized to ensure image storage from all CCTV cameras at the chosen resolution and level of compression for a minimum of 31 days.

- 11.3.6 Signage and Compliance with the Data Protection Act**
- 11.3.6.1** All necessary signage shall be provided in accordance with the data protection act.
- 11.4 Intruder Detection Systems**
- 11.4.1 Overview**
- 11.4.1.1** The intruder detection system shall cover all internal areas and shall comprise of intruder detection devices including door contacts and motion sensors.
- 11.4.1.2** The intruder detection system shall be hard-wired.
- 11.4.1.3** Local activation of the intruder detection system shall be capable of remote signaling to the National Trust desired platform / location. The Contractor to discuss requirements with the National Trust.
- 11.4.1.4** The intruder detection system shall be provided with battery backup of 24-hour autonomy.
- 11.4.1.5** Intruder detection systems shall be served from a local double-pole key switch on a dedicated circuit.
- 11.4.1.6** The Contractor shall liaise with the National Trust and if required the National Trusts appointed insurance company to determine the appropriate zoning of the intruder detection system to meet the operational and security requirements of the building. Separate zones shall be provided with separate access codes as required. It shall be possible to arm / disarm any zone from any intruder detection keypad. Dedicated zones with time delays shall be provided for entry and exit zones.
- 11.4.1.7** The Contractor shall develop a commissioning method statement prior to commissioning. All devices shall be tested under all operational conditions. Alarm signalling facilities shall be fully tested and confirmed by the monitoring station. Completion certificates shall be provided to the Client for submission to their appointed insurance company.

MEP SPECIFICATION

SECTION 12

12 LIGHTING & EMERGENCY LIGHTING

12.1 Overview

12.1.1.1 This section describes the materials and workmanship requirements for the lighting and emergency lighting of the Castlefield Viaduct project. It outlines the areas of scope, followed by detailed performance, technical and quality requirements.

12.2 Lighting Design & Documents

12.2.1 The Lighting Design Scope

12.2.1.1 This specification defines the requirements for lighting within the areas of the project designed by the Lighting Designer. These include:

- All public realm - feature and functional
- Event space
- Store rooms

12.2.2 The Lighting Documents

12.2.2.1 The Lighting Documents have been prepared to define the requirements and extent of the Lighting Works for the purposes of obtaining competitive tenders.

12.2.2.2 The following lighting drawings shall be referred to:

- CVI-ARU-ZZ-GF-DR-E-002501
- CVI-ARU-ZZ-GF-DR-E-002502

12.2.2.3 Where given, dimensions are for guidance only and represent the space allowance made. Alternative dimensions may be offered only if the space planning is adjusted accordingly, and any other specified requirements are met.

12.2.3 Lighting By Others

12.2.3.1 Lighting in areas outside of this package shall be developed by others. The areas not within this document are as follows:

- Welcome kiosk
- Restrooms
- Entrance staircase
- Lift and lift lobby

12.2.3.2 This document specifies the lighting control system functionality required. The detail design of the lighting control system and associated cabling and equipment is not within the scope of this

specification. Refer to section 12.12 for the lighting control system details.

12.2.3.3 This document and associated drawings provide identification and layout of emergency lighting luminaires.

12.3 General

12.3.1 Introduction

12.3.1.1 This section of the document describes the specific detailed requirements of the proposed lighting installation works.

12.3.2 Scope of Lighting Works

12.3.2.1 The work as detailed in this Specification shall comprise the whole of the labour and all materials necessary to provide the complete Lighting Installation. The scope of work comprises, but is not limited to the following:

- Luminaires
- Emergency lighting luminaires
- Exit signage
- Control system

12.3.2.2 The works shall comprise, but not be limited to, the installation/construction detailing & documentation, co-ordination, supply, delivery, installation, testing, commissioning and placing into service the lighting installation in accordance with this specification and the accompanying drawings/schedules. This shall include the provision of appropriate certification and documentation of as-built information, luminaires, operation and maintenance manuals, noise and vibration control, warranties and shop drawings; including the provision of appropriate samples, mock-ups, prototypes, spare parts/luminaires and training.

12.4 Lighting Design Intent

12.4.1.1 Refer to Appendix B for the lighting design intent.

12.5 Emergency Lighting

12.5.1.1 The emergency lighting system shall comprise the following elements. Refer to the lighting drawings for more information:

- Portable lanterns (Type A1 and A2)
- IP65-rated enclosures housing emergency torches with charging points included in enclosures (Type V)
- Stand-alone emergency luminaires in event space (Type T)
- Self-illuminated exit signage (Type S)

12.5.1.2 In the event of an emergency, the portable lanterns shall be distributed to visitors and staff, the emergency torches shall be collected from the nearest location and operated by staff, the emergency luminaires in the event space and exit signage shall automatically energise .

12.5.1.3 The emergency lighting scheme has been designed as such that the National Trust shall employ a management procedure to ensure that portable lanterns are adequately charged at all times to manage the risks associated with the loss of power and provide emergency illumination in case of emergency.

12.6 Responsibility Matrix

12.6.1.1 The following responsibility matrix identifies elements of design work and documentation that the Contractor will be responsible for completing as part of the works. This schedule is not deemed to be comprehensive as there may be other elements of design work specifically mentioned or implied within the particular requirements and associated equipment data sheets.

Task/Area of Work	Employer Representative	Contractor	Luminaire Manufacturer	Controls Specialist
Lighting design to Stage 4 Level of information	Lead			
Specification of luminaires and equipment	Lead			
Design Intent	Lead			
Design, selection and fabrication of luminaires, fixing and accessories		Support	Lead	
Installation of luminaires, fixings and accessories		Lead		
Approval of fixing proposals & method statements	Lead			
Demonstration of correct operation of fittings with power and data.		Lead		
Lighting control systems	Support	Support	Support	Lead
Verification of compatibility of all lighting controls equipment, installation of electrical service requirements for lighting controls equipment, installation of lighting controls equipment	Support	Support	Support	Lead
On site commissioning of the lighting control system	Support	Support		Lead

Task/Area of Work	Employer Representative	Contractor	Luminaire Manufacturer	Controls Specialist
On site commissioning and aiming of lighting equipment	Support	Lead		Support

12.7 Specialist Vendors, Suppliers and Installers

12.7.1.1 The Contractor shall include for all specialist equipment and systems to be designed, detailed and commissioned by suitably qualified and experienced specialist vendors and suppliers for systems such as, but not limited to, emergency lighting, lighting control systems, custom brackets and fixings.

12.7.1.2 The Contractor shall ensure that all works carried out by the Specialist Vendors, Suppliers and Installers are physically coordinated with each other prior to commencing the installation and that all Builders Work requirements are allowed for and coordinated.

12.8 Portable Lanterns

12.8.1.1 Type A1 and A2 luminaires shall be procured directly by the Client.

12.8.1.2 Type A1 and A2 luminaires shall be charged via bank of USB charging points within the store room of the event space. It is an operational requirement of the Client to ensure that the lanterns are sufficiently charged and distributed to visitors.

12.8.1.3 Lanterns shall be stored within the store room or another suitable indoor enclosure at the end of each day.

12.9 Codes and Standards

12.9.1.1 All equipment supplied shall comply with all relevant codes standards, regulations and acts as current at the time of the returned tender.

12.9.1.2 All luminaires shall be subject to EMC emission and immunity testing and provided with EMC compliance certification.

12.9.1.3 The whole of the work and materials to be supplied shall fully comply with the relevant Standards and Regulations of the Local Authorities having jurisdiction.

12.9.1.4 In the event of a contradiction between this Specification and any applicable Standards and Regulations, the most stringent requirements shall be deemed to apply, and the Architect shall be notified immediately for confirmation.

12.10 Submittals

12.10.1.1 The Contractor shall obtain written approval from the Architect prior to procurement of any lighting equipment for the project.

12.10.2 Technical submittals

12.10.2.1 The Contractor shall submit shop drawings, samples and prototypes as specifically instructed below. Shop drawings shall include but not be limited to:

- Manufacturer’s dimensioned scale drawings showing in complete detail the fabrication of all lighting luminaires including overall and detail dimensions, finishes, metal thickness, glass thickness, type, fabrication methods, support method, ballasts, transformers, sockets, type of shielding, reflectors, trims, hinges, gaskets, provisions for re-lamping and all other information to show compliance with the contract documents.
- Certified laboratory test data and reports including photometric data measured in accordance with BS EN 13032-1.
- Technical datasheets for all luminaire components:
- Luminaire.
- Light sources.
- Luminaire LED drivers
- Installation instructions.
- Maintenance and operating instructions, including tools required, details of cleaning methods and types / specification of appropriate materials, replacement parts identification list, and final as-built shop drawing.
- All drawings shall clearly indicate the contract drawing number used as a reference in the development of the shop drawings, the name of the project, Architect and Lighting Consultant.

12.10.2.2 The following reports, listings and information shall be completed by the manufacturer and submitted for review and approval by the Lighting Consultant prior to order:

- BS EN 13032-1:2004+A1:2012: Light and lighting. Measurement and presentation of photometric data of lamps and luminaires - Measurement and file format
- BS EN 13032-4:2015+A1:2019 Light and lighting. Measurement and presentation of photometric data of lamps and luminaires. LED lamps, modules and luminaires. Lifetime Projections. Provide test report and certificate including lifetime projections.
- LM-79-08 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products. Provide test report and certificate.
- LM-80-08 Approved Method: Measuring Lumen Maintenance of LED Light Sources. Provide test report and certificate.
- Lumen depreciation curve of the LED luminaire.

- Photometric Intensity Distribution using absolute photometry.
- Datasheets for LED light source, detailing manufacturer and product reference.
- Datasheets for LED driver, detailing manufacturer, product reference, power factor, efficiency and dimming type (PWM or CCR or hybrid). Where PWM is used the frequency of operation shall be clearly noted.
- Light source spectral power distribution data at 10nm increments from 380nm to 780nm.
- Colour rendering index data R1 to R15.
- TM-30-15 colour data, including but not limited to Rf, Rg, colour vector graphic and colour saturation graphic.
- Colour variation test data, identifying colour temperature and chromaticity coordinates at start of life (initial) and at 6,000 hours.
- Total luminaire wattage, including driver.
- Ambient temperature at which the LED luminaire performance is rated.
- LED luminaire warranty documentation.

12.10.3 Product Substitutions and Modifications

12.10.3.1 Any product substitutions for those explicitly specified as a part of this package shall be submitted to the Lighting Consultant for approval at least 4 weeks prior to the placing of the order. Any product not submitted and approved for use will not be accepted.

12.11 Lighting Materials and Workmanship

12.11.1 General Requirements

12.11.1.1 Refer to Section 3 of this document for general material and workmanship requirements. This section details requirements specific to the lighting installation.

12.11.1.2 The Contractor shall provide all accessories and design features described herein, or necessary in order to provide a complete installation, regardless of whether such features are included in the catalogue reference, including, mounting hardware, louvres, lenses filters, transformers, drivers, control gear etc.

12.11.1.3 Luminaires shall be manufactured in strict conformance with the contract drawings and specifications. Specifications and scale drawings are intended to convey the salient features, function and character of the luminaires only, and do not undertake to illustrate or set forth every item or detail necessary for the work. Minor details not usually indicated on the drawings, or specified, but that are necessary for the proper installation, manufacture and completion of the

luminaires, shall be included, the same as if they were herein specified or indicated on the drawings.

12.11.1.4 Where components of a luminaire are replaceable, including but not limited to control gear, LED modules, LED replacement lamps, and drivers, it should be clearly noted within the Operation and Maintenance manuals that exact replacements should be used. Should alternative components be used, it should be clearly noted that additional EMC and CE certifications may be required.

12.11.1.5 The Employer shall not be held responsible for the omission or absence of any detail, construction feature, etc which may be required in the manufacture and installation of the luminaires. The responsibility of accurately fabricating and installing the luminaires to the fulfilment of this specification rests with the Contractor.

12.11.1.6 It is the responsibility of the Contractor to bring to the attention of the Lighting Consultant any discrepancies or installation issues before proceeding with work.

12.11.1.7 All luminaires shall be CE certified and shall carry a CE Marking.

12.11.1.8 All equipment supplied shall be capable of installation in accordance with the manufacturers’ instructions (which shall be sought by the Contractor prior to commencement of the installation works).

12.11.1.9 The installation of non-approved luminaires will not be approved and is not acceptable.

- 12.11.1.10** For the Type C1/C2 luminaires:
- Type C1/C2 luminaires shall be mounted on a bespoke metal baseplate that will be fixed to a concrete pad buried within ground to resist luminaire overturning.
 - Type C1/C2 luminaire stem shall be securely fixed to the baseplate that will be buried under ground. The Contractor shall liaise with the luminaire manufacturer to provide drawing of fixing detail of the stem with baseplate for approval of Lighting Consultant.
 - An electrical junction box (1 cable in and 3 cables out) to electrical specification shall be positioned within the baseplate. Junction box shall be provided to reduce the cabling to each luminaire cluster. The junction box shall be kept within free draining pea gravel to landscape architect’s specification. 150mm hole shall be provided on the top surface of baseplate for access to junction box.
 - 25mm diameter flexible duct for cabling shall run through the concrete foundation towards the junction box within baseplate.

12.11.2 LED luminaires (general)

12.11.2.1 The following requirements apply to all LED luminaires:

- All LED luminaires shall undergo a minimum 24-hour burn-in test during manufacturing.
- Unless specified otherwise, minimum luminaire lifetime shall be 50,000 hours at L80/B10. Note this is the complete luminaire, not the LED source.
- Unless specified otherwise, the maximum failure fraction of LED luminaires at the end of luminaire lifetime shall be 10%, F10.
- All LED luminaires shall have lumen maintenance code 9 according to IEC/PAS 62717, where maintained luminous flux at 6,000 hours shall be in excess of 90% of initial luminaire lumens.
- All hardwired connections to LED luminaires shall be reverse polarity protected.
- All LED luminaires shall provide a cover or other suitable protection of LED chips to allow for cleaning. LED luminaires with exposed LED chips shall not be acceptable.
- All LED luminaires and/or associated driver(s) shall have a means of thermal protection in the form of an automatic dimming or stepping/holding down the output where temperature exceeds operational limits. Thermal cut-out devices which turn the fixture completely off are not acceptable for luminaires within spaces occupied by the public.
- Audible noise from luminaire and/or drivers when at full lumen output or at any dimming level shall not be acceptable.

12.11.3 LED luminaires (white light)

- 12.11.3.1** The following requirements apply:
- Light output power at 400nm and below shall be 0 (zero).
 - Unless specified otherwise, LED luminaires shall have a power factor > 0.9.
 - Refer to luminaire specification sheets for colour temperature and colour consistency requirements for LED luminaire types.
 - The specified colour temperature variation applies to the initial colour temperature variation and at any time prior to the end of the warranty period. If not specified, this shall be 3-step MacAdam ellipse.

12.11.4 LED Drivers

- 12.11.4.1** LED drivers shall comply with the following:
- LED driver lifetime shall match or exceed the LED luminaire lifetime.
 - LED drivers shall be RoHS compliant.
 - LED drivers shall have a minimum efficiency of 85%.
 - LED drivers shall have a total individual luminaire Harmonic Distortion (THD) of < 20%.

- The Contractor shall ensure complete system compatibility where different manufacturers of drivers and LED sources are used.
- Unless specified otherwise, where dimming is specified the LED luminaire shall dim smoothly to 10% or less of full lumen output.
- The Contractor shall ensure the LED driver is fully compatible with the lighting control system and dimming protocol.
- Dimmable LED drivers shall dim via Pulse Width Modulation (PWM) or using a hybrid combination of PWM and Constant Current Reduction (CCR).

12.11.5 Flicker

- 12.11.5.1 Visible blinking, flickering or strobing shall not be acceptable at full lumen output, nor at any dimming level should dimming be specified.
- 12.11.5.2 The requirements of IEEE 1789–2015 shall apply to all LED drivers, where unless specified otherwise drivers shall aim to limit other biological effects of flicker.
- 12.11.5.3 For basic PWM (where percent flicker is 100%) minimum frequency shall be 1,250 Hz.
- 12.11.5.4 Relationship between percent flicker and minimum frequency shall be as defined within IEEE 1789-2015.

12.11.6 Product Variations

- 12.11.6.1 If any variants of standard luminaires are required, these shall be developed by the manufacturer of the standard luminaire, unless otherwise specifically stated and approved, and shall be manufactured to the same standards as the equivalent standard luminaire.
- 12.11.6.2 Two copies of all working drawings of proposed variants, dimensioned in mm, shall be supplied to the Lighting Consultant for approval prior to fabrication.
- 12.11.6.3 Notwithstanding the above, the manufacturer shall remain responsible for ensuring compliance with relevant standards, the accuracy of the information shown on his drawings at all times and for ensuring that the equipment shown fulfils the requirements of this specification.

12.11.7 Warranty

- 12.11.7.1 The Contractor shall warrant the luminaire, its finishes and all of its component parts, including drivers, to be free of defects for a period of 3 years from the date of acceptance. The warranty shall be provided by the luminaire manufacturer as the sole source of service.
- 12.11.7.2 Replacement of faulty materials and the cost of labour required to remove and replace faulty luminaires shall be the responsibility of the

Contractor. This shall include all necessary access, builders work and making good.

- 12.11.7.3 An LED Luminaire is deemed to be faulty should any of the following conditions apply. These conditions are based on the warranty period required. For warranty periods in excess of 5 years the requirements below shall be prorated accordingly.
 - An LED luminaire, including all associated components and drivers, has catastrophically failed resulting full loss of light output at any time prior to the end of the warranty period.
 - More than 0.2% per 1000 burning hours of individual LED devices within an LED luminaire have catastrophically failed at any time prior to the end of the warranty period.
 - An LED luminaire has experienced lumen depreciation in excess of 0.6% per 1,000 burning hours at any time prior to the end of the warranty period.
 - Colour variation, from results recorded initially and submitted, at any time before the end of the warranty period in excess of n-step MacAdam ellipse, where n is defined within the luminaire specification sheets for each luminaire.
 - An LED luminaire experiences visible flicker or blinking at any time prior to the end of the warranty period.
 - An LED luminaire produces audible noise at any time prior to the end of the warranty period. This applies at full output and at any dimming level should dimming be specified.

12.11.8 Installation

- 12.11.8.1 The Contractor shall coordinate exact quantities and critical dimensions with site conditions. All linear and continuous linear luminaire dimensions are to be verified by the Contractor, on site when necessary, and submitted to the Architect for approval prior to order.
- 12.11.8.2 The Contractor shall facilitate a mock-up of each installed luminaire installed including mounting/foundation details.
- 12.11.8.3 The Contractor shall facilitate one mock-up of the control protocol of three Type C1/C2 luminaires demonstrating the fade in/fade out transitions of light.
- 12.11.8.4 The Contractor shall verify and coordinate the provision of appropriate framing, support structures, mounting brackets and other required structural connections by the General Contractor or other trades to ensure a timely, neat installation of all luminaires.
- 12.11.8.5 The Contractor shall coordinate and provide any associated mounting hardware, conduit connections, or associated appurtenances for the effective installation of the luminaires. Provide each luminaire with

complete installation instructions. All luminaires shall be installed in strict conformance with manufacturer’s recommendations and instructions.

- 12.11.8.6** All transformers, drivers, control gear and emergency battery packs for ceiling recessed luminaires are to be accessed through the ceiling cut-out unless stated otherwise in the specification or on drawings.
- 12.11.8.7** The Contractor is to ensure the co-ordination and compatibility of all luminaire control gear/transformer types with the lighting control system.
- 12.11.8.8** Exact locations of all luminaires including mounting heights and plan dimensions are shown on the architectural drawings. Any ambiguities or conflicts in this dimensional information shall be identified to the Architect prior to ordering and installation.
- 12.11.8.9** All fixing detail/cut-out and recess dimensions are to be confirmed with manufacturers by the Contractor.
- 12.11.8.10** Luminaires shall not be suspended from duct-work or pipework.
- 12.11.8.11** Luminaires shall not be operated for work light at any time during construction, nor shall they be illuminated for any other reason apart from necessary testing and commissioning of the installation. Failure to comply with this requirement will make it necessary for the Contractor to re-lamp at no additional cost to the Employer just prior to turnover of area to the Employer.

12.11.9 Commissioning, Focus and Adjustment

- 12.11.9.1** All adjustable luminaires shall be aimed, focused, and locked by the Contractor under the supervision of the Lighting Consultant.
- 12.11.9.2** All focusing and adjusting shall be carried out after the entire installation is complete. All ladders, scaffolds etc. required, shall be furnished by the Contractor, at the direction of the Lighting Consultant. The Contractor will ensure that adequate personnel are provided for such aiming, focusing and scene setting as are required to commission the installation. As aiming and adjusting is completed, locking set screws, nuts and bolts, shall be securely tightened. Where possible, units shall be focused during the normal working day. Where daylight prevents this, focusing shall be carried out during the night at a time mutually agreeable to Contractor, Lighting Consultant, and Employer. Adjustments shall be made in accordance with the Lighting Consultant’s stated intent, under their supervision.
- 12.11.9.3** The final focussing and scene setting of the installation must be undertaken with the Lighting Consultant and a lighting control technician in attendance. The programming of a lighting control

system from a written lighting scene schedule shall not constitute completion.

12.11.10 Testing, Commissioning and Handover

- 12.11.10.1** The Contractor shall be responsible for providing all handover documentation in accordance with industry best practice and the specific requirements of the Employer’s handover procedures.
- 12.11.10.2** On completion of the installation The Contractor shall undertake testing and commissioning of the complete system including the following:
 - Testing and commissioning of any general electrical installation works in accordance with BS7671.
 - Testing and commissioning of the emergency lighting installation works in accordance with BS5266.
 - Testing and commissioning of the complete lighting installation and demonstration of system operation to the Employer.
 - On completion of the works The Contractor shall compile and produce a complete Operating and Maintenance Manual to include the following information:
 - Electrical Installation Completion Certificate (and/or Minor Works Certificate where applicable) in accordance with BS 7671.
 - Emergency Lighting Completion Certificate (and/or Minor Works Certificate where applicable) in accordance with BS 5266.
 - As-Installed record drawings (layouts and schematics) showing equipment locations, cable routes and equipment identification references etc.
 - Operating and Maintenance Instructions.
 - Provide 12 months parts and labour warranty for the complete installation, including at least one service visit at the end of the 12 months defects period.
 - All drawings shall be provided electronically in both PDF and AutoCAD/Revit formats.
 - All text and schedules shall be provided in both editable format (e.g. MS Word, Excel, etc.) and in PDF format.
 - Equipment data sheets shall be provided in PDF format.
 - In addition, The Contractor shall provide the Employer with one paper copy of all O&M information as detailed above.

12.11.11 Clean-up

- 12.11.11.1** At the time of final acceptance by the Architect, all luminaires shall have been thoroughly cleaned with materials and methods recommended by the manufacturers. All broken parts shall have been replaced and all lamps shall be operative.

12.12 Lighting Control Systems Narrative

- 12.12.1.1 The following section describes the performance requirements for the two lighting control systems.
- 12.12.1.2 The Contractor shall provide a fully functioning and fully commissioned lighting control system to meet the system and operational requirements defined within this document.
- 12.12.1.3 Two lighting control systems shall be provided and are described in this section. This is demonstrated in the following table.
- Hard-wired lighting control system for all lighting elements apart from those controlled by BLE (Bluetooth Low Energy), see table below.
 - Wireless lighting control system- BLE lighting control for the event space lighting and for the control of type C1 and C2 luminaires.

Area	Control Type	Lighting Scenes	Local Switch	Local Dimming	Presence Detection	Astronomical Time Clock	Timings
Event Space	BLE	Static light	Y	Y	Y		Occupancy controlled timings
Store Rooms / Plant Rooms	Wired-Manual On/Off	Static light	Y				n/a
Public Realm (except C1/C2 luminaires)	Wired-Contactor On/Off	Static light				Y	Dusk – 8pm/event end
C1 and C2 luminaires	BLE	Dynamic sequence				Y*	Dusk – 8pm/event end

Lighting control strategy

* The BLE devices shall be programmed to vary between 50% and 100% output on a 20second continuous cycle following switch on of the drivers via the astronomical time clock. The drivers will not be in sequence with each other and shall be randomly energised.

12.12.2 Wired Control

- 12.12.2.1 Plant rooms/store rooms shall be controlled via a hard-wired wall-mounted manual switch.
- 12.12.2.2 A DIN rail mounted astronomical time clock shall be located in the feeder pillar next to the Welcome Kiosk and shall switch on the public

realm lighting via time-delay contactors. Refer to the control schematic.

12.12.3 Bluetooth Low Energy Lighting Control System

- 12.12.3.1 A Xicato Bluetooth Low Energy (BLE) lighting control system shall be provided integral to the G luminaires in the event space and the type C1 and C2 luminaires in the public realm.
- 12.12.3.2 The BLE system shall enable commissioning and configuration via a DPI (digital portable interface, i.e. tablet or smartphone) without the need for a head-end PC.
- 12.12.3.3 BLE shall be integrated within the lighting elements and controlled in the event space by:
- G type luminaire in the event space shall be provided with Integrated BLE allowing control via the BLE Mesh technology
 - A BLE compatible wall mounted switch shall be provided in the event space. The switch shall use energy harvesting kinetic technology, thus requiring no external power source (i.e., EnOcean switch). This will enable on/off/dimming override of the luminaires in the event space.
 - The presence detector in the event space shall be Xicato Integrated BLE and be provided in a ceiling mounted housing (complete with battery) in the locations shown on the drawing. The battery powered sensor shall have a minimum 5-year life between battery changes.
 - By default, the occupancy sensor in the event space shall be configured to time-out the BLE enabled lighting after 30minutes. The exact time shall be agreed with the client at the commissioning stage.
 - Event space G type luminaires are controlled as one group via the presence detector, but individual luminaires can be programmed to provide a different output as necessary via the BLE system.
- 12.12.3.4 BLE shall be integrated within the C1 and C2 type public realm lighting elements and controlled by:
- C1 and C2 type luminaires in the public realm shall be provided with paired BLE mains voltage Xicato ‘XAD’ LED driver. The BLE beacon is integral to the luminaire LED driver and shall enable dimming of the LED type C1 and C2 luminaires.
 - The C1 and C2 luminaires shall be controlled in groups of up to four luminaires from one XAD driver. The control groups are defined on the lighting drawings.
 - The control system shall allow for individual control of each control group.
 - The XAD driver shall be located within an IP-rated plastic enclosure suitably sized to allow for heat dissipation. The

contractor shall liaise with Xicato to confirm a suitable size for each enclosure.

- The XAD driver shall be located <10m from the luminaires that it is controlling to allow for signal propagation. The Contractor shall be responsible for ensuring that the drivers are positioned to allow for the required signal strength.

12.12.3.5 The lighting control system shall provide the following level of controls and functionality:

- Event space local control: room switching via local fixed switch.
- Automatic control: the C1 and C2 type luminaires will be factory-set with a timed-fade on a regular cycle to create a dynamic, slow movement to the lighting along this stretch of the viaduct. The final sequence shall be approved by Employer Representative.
- Expert Control: for commissioning engineer, direct connection to the BLE control system via a laptop control panel app. Once configured the system shall operate autonomously, being energised either by the time clock (external) or presence detector (internal)
- Refer to the Lighting Layout drawings for the location of switches and sensors.

12.12.3.6 The Contractor shall employ the services of Xicato lighting controls specialist to finalise the configuration of the system and components. In summary, this shall include:

- Stable Xicato reliable mesh
- Controls planning
- On-site provisioning
- Configuration and Verification

12.12.3.7 Xicato lighting controls specialist shall be employed to carry out the following works as part of the commissioning process:

- Define network provisioning, including secure network names, passwords, and membership
- Define the node provisioning: naming and numbering of lights, sensors, switches, and other nodes
- Define groups including group names, numbers, and membership
- Configure scenes and scene names numbers, membership, and member behaviour (i.e. transitions between scenes etc.)
- Configure sensor responses and behaviours
- Configure time schedules and behaviours

12.12.3.8 Commissioning of the lighting control system shall take place once the Contractor has demonstrated that all BLE devices are connected, provisioned and operational. This shall include employing the services of a BLE Mesh lighting controls specialist to complete the following works:

- Network provisioning, including secure network names, passwords, and membership
- Node provisioning: naming and numbering of lights, sensors, switches, and other nodes
- Configuring the nodes with groups, scenes and schedules, associating switches and sensors, designating mesh relay nodes, and programming the control logic.
- Putting into service any drivers necessary for third party central interfaces.
- Complete a verification of the functionality and security of the system including, but not limited to,
- Device IDs and names, grouping, luminaire group command responses, correct scene recalls
- Verify that all devices respond correctly to occupancy and switches.
- Check security (including response to commands issued through any gateways).

12.12.3.9 Commissioning of the lighting scenes shall be undertaken with the Lighting Consultant, Client and Specialist Control Supplier in attendance. The programming of a lighting control system from a written lighting scene schedule shall not constitute completion.

12.12.3.10 The system shall be tested and commissioned, as far as possible during the normal working day. However, inevitably some commissioning will be required to be undertaken outside of normal working hours. The Contractor shall allow for night-time commissioning of the lighting installation. Final commissioning shall be carried out during the night at a time mutually agreeable to Contractor, Lighting Consultant, and Client.

12.12.3.11 Commissioning shall consist of the implementation of the programmed software, scenes, sequences, time recalls and web interface.

12.12.3.12 The Contractor shall arrange for the Client to view and agree the programmed scenes, sequences and timed recalls of the C1 and C2 luminaires of the Lighting Control System.

12.12.3.13 On completion of commissioning, the Contractor shall arrange with the Specialist Lighting Controls Supplier and the Client to provide any training required on the access, maintenance and use of the user interface.

12.12.3.14 The Specialist Controls Supplier shall provide an operation and maintenance manual for the lighting controls system detailing the day to day operation and maintenance required.

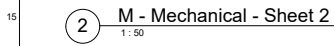
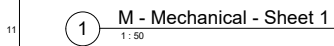
12.12.3.15 The Contractor shall provide the Lighting Designer and Client with an electronic copy of all files associated with the final commissioning,

including show files, test data and final setup parameters following acceptance of the commissioned system.

12.13 Luminaire Specification Datasheets

- 12.13.1.1 Luminaires data sheets are included in Appendix A of this specification.
- 12.13.1.2 Catalogue numbers are not included with luminaire specification sheets. The Contractor shall confirm the correct codes and catalogue numbers with the specified manufacturers prior to issuing technical submittals.

COMBINED MECHANICAL SERVICES LAYOUT
DRAWING CVI-ARUP-ZZ-GF-DR-M-000501



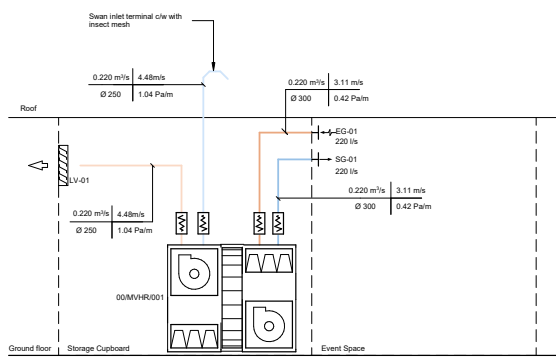
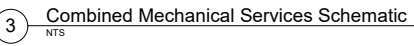
4 EDS R Fan Coils DX Schedule Fan Coil Units

5b EDS_Louvres_Louvres

5 EDS_Air Handling Unit_AHU EDS - 1

7 EDS_Electric Heaters_Electric Heater

5a EDS Supply Grilles and Diffusers Supply Grilles & Diffusers



Scale at AQ	As indicated	By/ Chkd / Appd JC/NH/TW
Role	Mechanical	
Status	S2 - Issued for Information	
Arup Job No	282210	Rev P01
ID	CVI-ARUP-ZZ-GF-DR-M-000501	

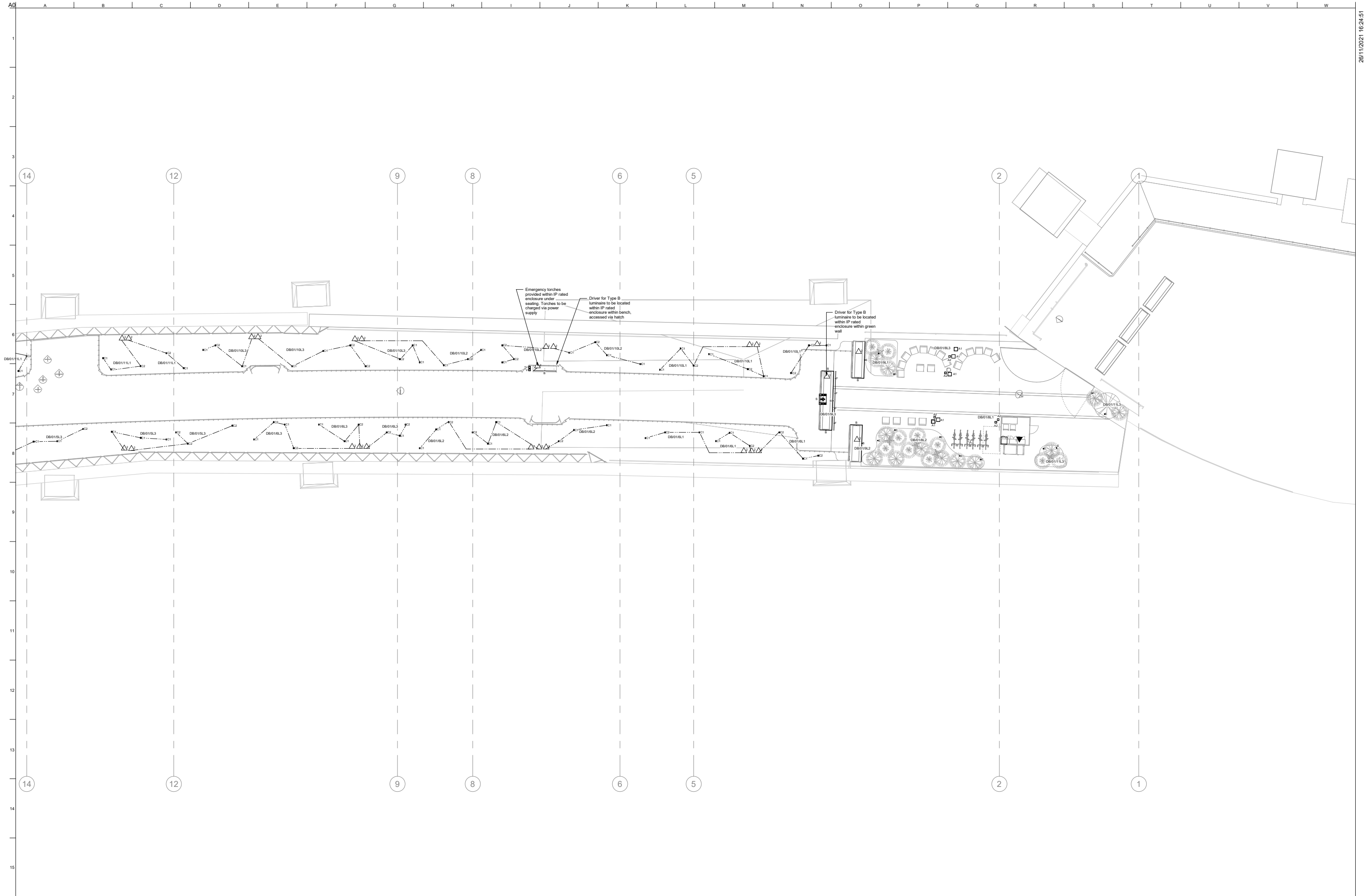
LIGHTING LAYOUT

DRAWINGS

CVI-ARUP-ZZ-GF-DR-E-002501 AND

CVI-ARUP-ZZ-GF-DR-E-002502

Scale at A0	1 : 100	By / Check / Appd SR/LB/DL
Role	Electrical	
Status	S2 - Issued for Information	
Arup Job No	262210	Rev P01
ID	CVI-ARUP-ZZ-GF-DR-E-002501	



General Notes

- This drawing shall be read in conjunction with all other relevant Arup drawings, details specifications and reports.
- All dimensions are illustrated in mm, unless otherwise stated.
- Do not scale from this drawing.
- Layout based on architectural Revit model received on 10/11/2021.
- This Drawing is not an Installation Drawing.
- All drivers located within plastic IP65 enclosure. Driver locations and quantities are indicative and exact location to be determined on site.
- Refer to luminaire data sheets for detailed specification of luminaires, mounting requirements and attachments/accessories.
- Planter spot lights, Type D, are indicatively placed in this drawing, final location to be determined on site.
- Type B shall be mounted to underside of bench, detail of this can be found in the luminaire schedule.
- Type C1 and C2 are sculptural reed lights to highlight the presence of soft planting within landscape areas.
- Lighting to toilets and kiosks to be supplied by others.

Legend

	Type A1 Lantern Luminaire		Type D Spike mounted spot light		Type K Wall mounted bulk head		Type V Torch
	Type A2 Lantern Luminaire		Type E Bollard luminaire		Type S Illuminated exit sign		Driver
	Type B Linear LED tape		Type F Surface mounted Linear LED		Type T Surface mounted emergency light		Presence Detector
	Type C1 and C2 Reed lighting		Type G Track and Spot lights		Type U Festoon lighting		Manual Switch

ARUP

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Tel: +44(0)161 228 2331 Fax: +44(0)161 228 6879
www.arup.com

Client
The National Trust

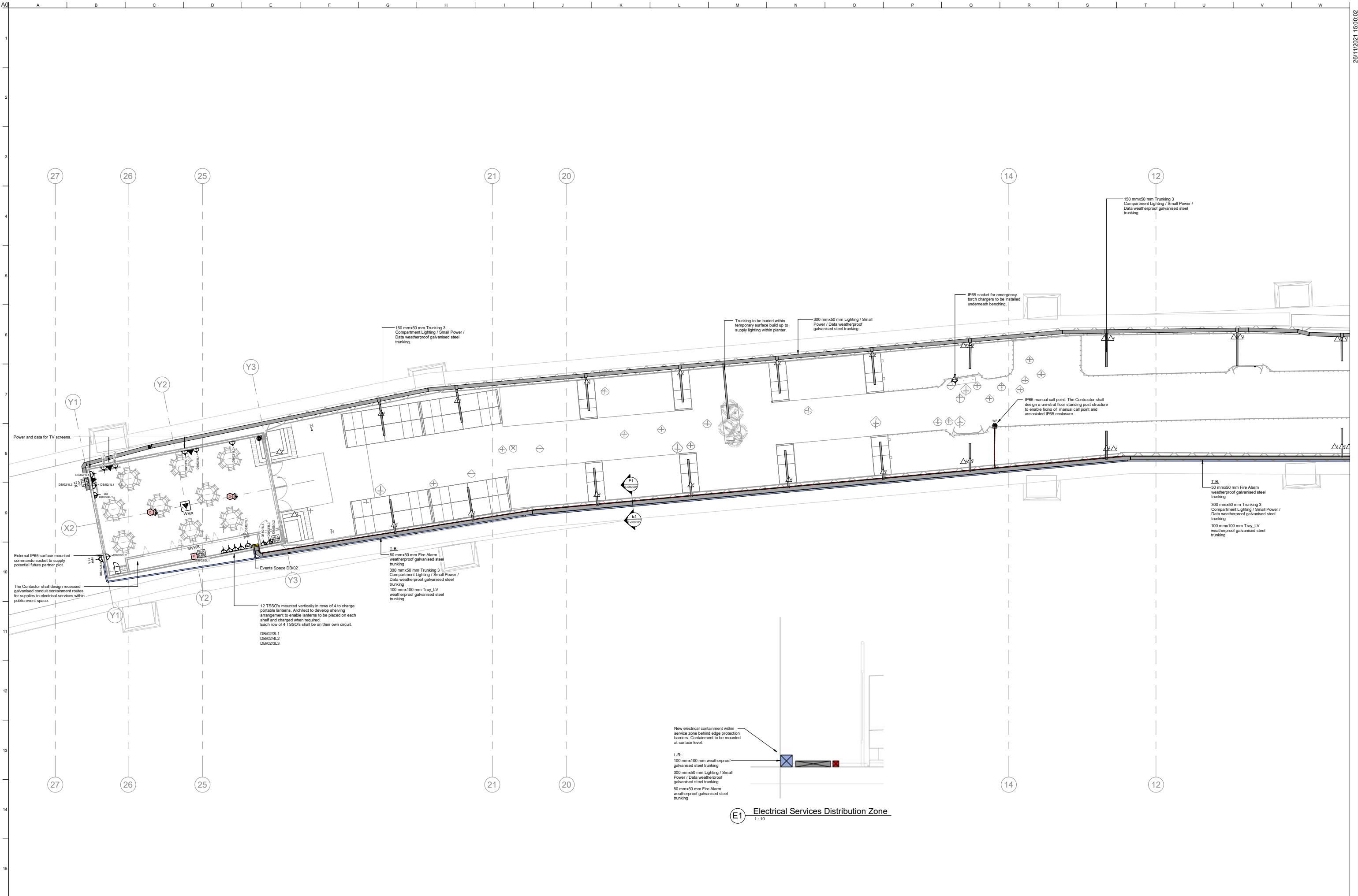
Project Title
Castlefield Viaduct

Drawing Title
Lighting Layout
Sheet 2

Scale of A0	1 : 100	By / Check / Appd	SKL/BJC
Role	Electrical		
Status	S2 - Issued for Information		
Arup Job No	282210	Rev	P01
CVI-ARUP-ZZ-GF-DR-E-002502			

COMBINED ELECTRICAL SERVICES LAYOUT
DRAWINGS

CVI-ARUP-ZZ-GF-DR-E-000501 AND
CVI-ARUP-ZZ-GF-DR-E-000502



General Notes

1. This drawing shall be read in conjunction with all other relevant Arup drawings, details specifications and reports.

2. All dimensions are illustrated in mm, unless otherwise stated.

3. Do not scale from this drawing.

4. Layout based on architectural Revit model received on 10/11/2021.

5. PAVA system components are not shown on this drawing. The Contractor shall be responsible for developing the design for the PAVA system - refer to specification CVI-ARUP-ZZ-XX-SP-V-000001 for details. PAVA system cabling shall be routed within the fire alarm trunking.

6. CCTV system components are not shown on this drawing. The Contractor shall be responsible for developing the design for the CCTV system - refer to specification CVI-ARUP-ZZ-XX-SP-V-000001 for details. CCTV system cabling shall be routed within the data compartment trunking.

- Legend**
- Double Switched Socket Outlet
- Industrial Socket Outlet
'N' denotes Rating (A)
'X' denotes No. of Phases
- Data Outlet
'N' denotes number of outlets
- Fused Connection Unit Switched
- Disconnector / Isolator
'N' denotes Rating (A)
'X' denotes No. of Phases
- Distribution Board
- WP Weatherproof IP65 rated
- Detector with Sounder and Beacon
- Red Break Glass Unit / Manual Call Point
- Fire Alarm Panel

P01	26/11/21	WS4 Issue
Issue	Date	

ARUP

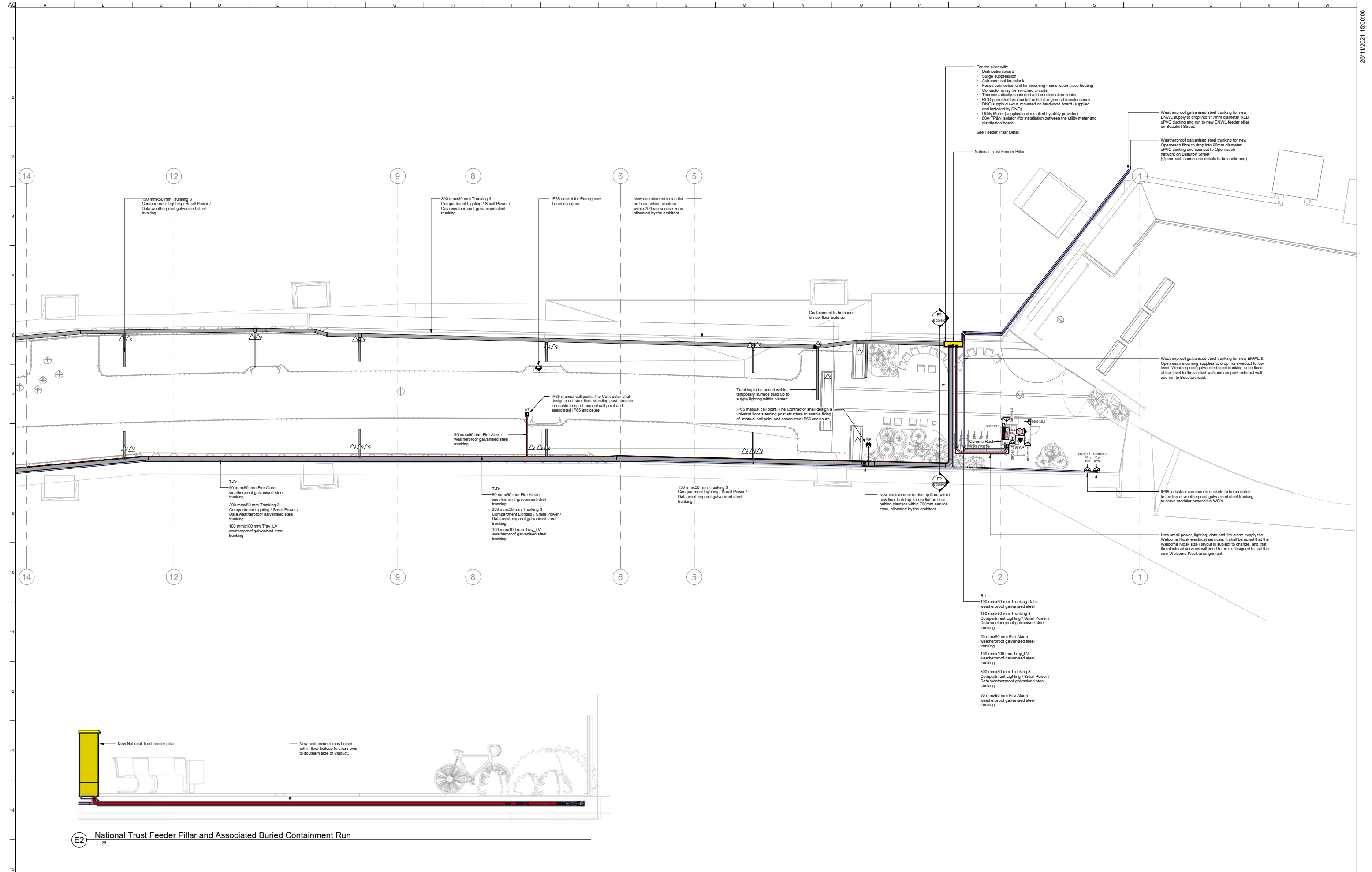
6th Floor, 3 Poultry Place
Manchester M1 3PT
Tel: +44 (0)161 228 2331 Fax: +44 (0)161 228 8879
www.arup.com

Client
The National Trust

Project Title
Castlefield Viaduct

Drawing Title
Combined Electrical
Services Layout
Sheet 1 of 2

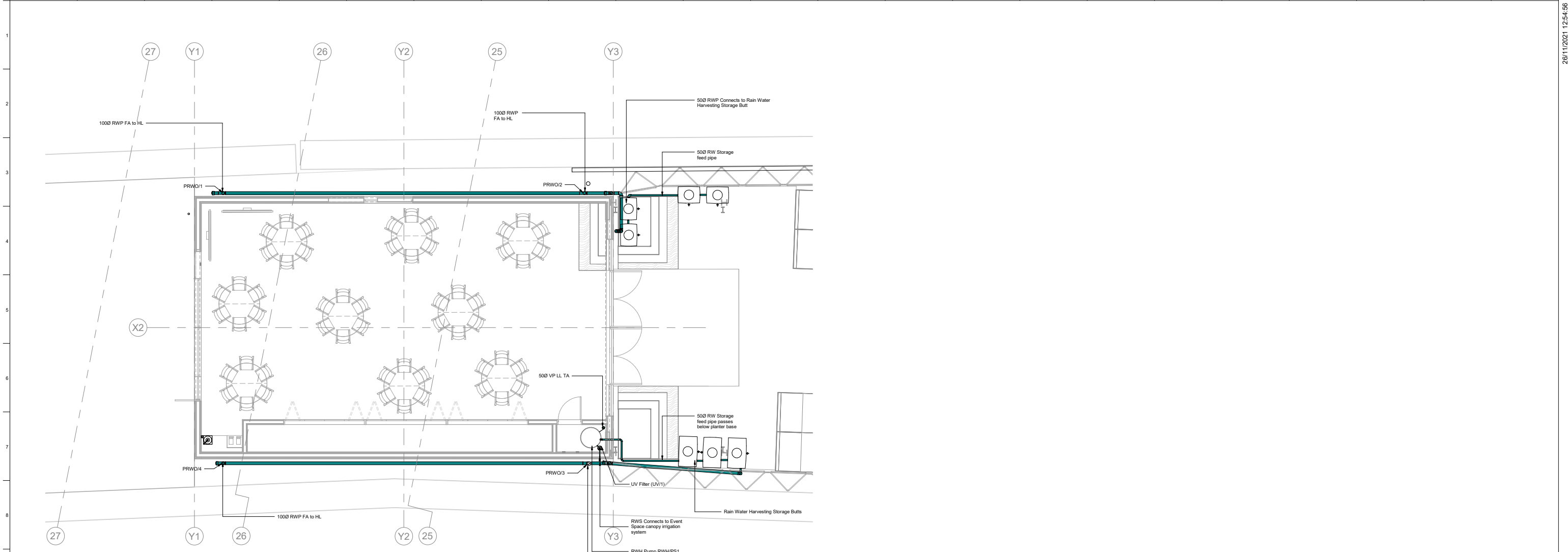
Scale as Indicated	By / Check / App'd WPCB/TW
Date Electrical	
Status S2 - Issued for Information	Rev
Arup Job No 282210	P01
ID CVI-ARUP-ZZ-GF-DR-E-000501	



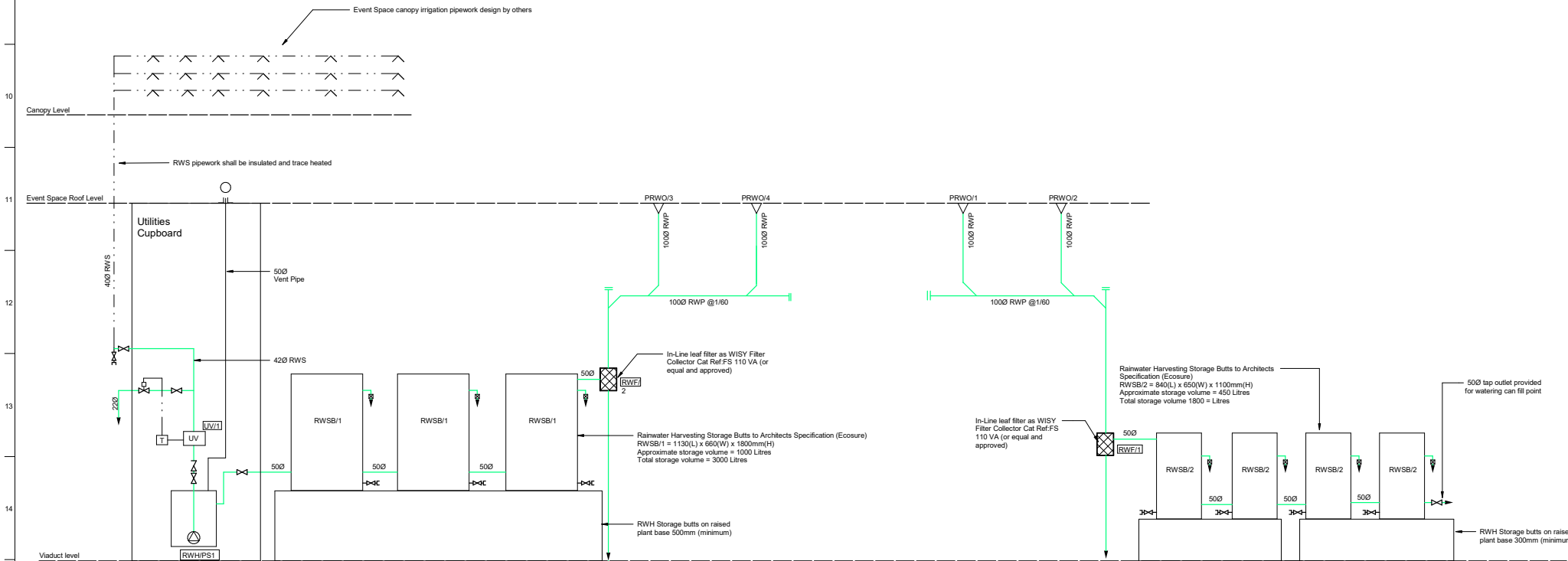
E2 National Trust Feeder Pillar and Associated Buried Containment Run
1 : 25

28/11/2021 15:00:06

ABOVE GROUND DRAINAGE LAYOUT - VIADUCT LEVEL
DRAWING CVI-ARUP-ZZ-GF-DR-P-003501



1 Above Ground Drainage Combined - Viaduct Level
1:50



2 Public Health Services Above Ground Rainwater Harvesting Schematic
NTS

UV Filter Technical Specification (UV/1) as Clear Water A WCS Group.

Model:
V Series (or equal and approved)

Chamber:
Material: 316L Stainless steel
Diameter: 129mm
Total length 708mm
Required Working Space: 1275mm
Weight: 6.8kg
Inlet/Outlet Connections: 1 1/2" BSP-T
Max. Pressure: 10 Bar @25 °C
Pressure Drop: <0.1 bar
Mounting Orientation: Horizontal/Vertical

UV Lamp:
Number of lamps: 1
Lamp Type: 50W Regular
Lamp life 8000 Hours
Preferred inlet water temp. 5 °C - 30 °C

Control Unit:
Material: Aluminium and ABS
Height: 300mm
Width: 160mm
Depth: 110mm
Weight: 2.1kg
Control Features: Lamp status, lamp hour counter, system running time, volt free alarm contacts.
Voltage 230 VAC, 50/60 Hz
Total power Consumption: 60 Watt
Protection Rating: IP55
Preferred ambient temp: 5 °C - 35 °C

Power Consumption per m³:
Dosage: Watt-hour/m³
300J/m³: 2.8Wh/m³
400J/m³: 16.7Wh/m³

RWH Pump (RWH/PS1) as New Haden Pumps Ltd

Model:
SEW/AC GRP 750/ATC20W (or equal and approved)

Tank Size: 300 litres
Tank Material: GRP
No of Pumps: One
Pump Type: ATC20W
Capacity per Pump: 1 l/s
Head Generated: 20 metres
Max. Solids Capacity: 10mm
Impeller Design: Cutter/Vorte
Motor Rating kW: 1.5
Motor speed rpm: 2900
Supply Voltage: 230-01-50
Full Load Current: 9.5 amps
Method of Starting: DOL
Level Controls: Stainless steel electrode rods for low and high level
Control Sequence: Duty
Length of Cable: 10 metres
Pump Outlet Branch: 40mm
Pipes and Valves: 40mm pipework with valves external
Final Discharge: 40mm
Tank Size: 750mm diameter x 750mm high

General Notes
1. This drawing shall be read in conjunction with all other relevant Arup drawings, details specifications and reports.
2. All dimensions are illustrated in mm, unless otherwise stated
3. Do not scale from this drawing

Legend
Pipework - Rainwater - RWP
Pipework - Main Cold Water Supply - MCWS
Pipework - Rainwater Supply - RWS
HL High Level
FA From Above
LL Low Level
VP Vent Pipe
RWSB Rainwater Storage Butts
RWP Rainwater Pump
RWH/PS1 Rainwater Harvesting Pump Supply
UV UV Filter
PRWO Rainwater Outlet

Drain Cock
Isolating Valve
Non Return Check Valve
2 Port Valve Motorised
Overflow
CAT 5 Standpipe

Rain Water Filter
Water Pump
Water Meter
Air vent Automatic
Pressure Reducing Valve
Break Line
Vent Cowl

Issue Date
P01 26/11/21 WS4 Issue

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www.arup.com

Client
The National Trust

Project Title
Castlefield Viaduct

Drawing Title
Public Health Services Above Ground Drainage Layout Viaduct Level

Scale of A0 As indicated
By / Check / App'd
MP/GW/GH
Date: Public Health
Status: S2 - Issued for Information
Rev
282210 P01
CVI-ARUP-ZZ-GF-DR-P-003051

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