SCIENCE MUSEUM GROUP

Building ONE
The Science Museum Group at Wroughton

December 2017

Sustainability Statement

Science Museum Group - Building ONE

Collection Storage Facility

Sustainability Statement

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Science Museum Group

feasibility

SCIENCE MUSEUM GROUP

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Section 1.0

Introduction

1.1 CONTEXT

This report has been prepared by GWP Architecture to support the application for the development of the proposed new Building ONE collection facility, with input from the following parties:

- Desco - Building Services Engineer
- Pegasus Group - Planning Consultant
- Atkins - Structural / Civil Engineer
- Feasibility Ltd - Project Manager / Quantity Surveyor
- GWP Project Services - Principle Designer
- Clarkson & Woods Ltd - Ecologist
- Croft Transport Solutions - Transport Consultant

1.2 SCOPE

This Sustainability Strategy document describes the sustainable approach being applied to the proposed Building ONE facility. The document sets out the planning policy and regulatory framework which govern the sustainability and energy performance of new buildings and analyses how the approach to the project aims to meet these requirements. Importantly, this unique development houses objects of international significance that have specific environmental demands. The overarching sustainability strategy for SMG, is to deliver a building which can sustain the long-term conservation and preservation of the SMG collection, in optimum conditions, and be sustainable to build and operate

1.3 PURPOSE

This document is submitted in support of a full planning application for a new collections management facility to house objects for the Science Museum Group (SMG), at their site in Wroughton (SMGW).

1.4 PROJECT DESCRIPTION

SMGW houses large object storage, library and archives for the SMG. The site is not open for public access, though research visits can be arranged to use the library and archive facilities, or to view the storage collection, by appointment.

The new building will be a fit-for-purpose facility that will house and manage the SMG collection and accommodate managed public visits, support object conservation work and provide staff facilities. The building will utilise the existing vehicular access to the site and its functions will also be supported by the existing SMG operational buildings on the wider site.

The proposed new building has a footprint of circa 27,000m^2 and provides up to 37,700 m^2 GIA of new floorspace comprising:

- Ground floor of up to 27,000 m^2 GIA comprising collection storage and support spaces including: conservation laboratory; conservation workshop; photography studio; collection study; staff welfare facilities; specialist store (freezers, special collection store) and transit areas for delivery/ loading/unloading of objects.
- Mezzanine level of up to 9,645 m^2 GIA comprising collection storage and a conditioned store.
- External plant spaces of up to 1,050m^2 GIA comprising: Electrical Substation/HV/LV Switch room; Chiller Compound/Cold water pump room; AHU chillers; conditioned are plant; boiler room and sprinkler tanks / pump room.
- Associated works include:
    - Visitor car park for 12no. cars (inc. 2no DDA spaces);
    - Internal circulation areas;
    - External service yard for transit collection / delivery;
    - Pedestrian access routes including access steps/ramp;
    - Male/Female/DDA WCs;
    - External refuse collection store;
    - Service vehicle access routes.

1.5 THE SITE AND SURROUNDINGS

SMGW is located approximately 6.5 kilometres south of the centre of Swindon and 1.4 kilometres south of the intervening village of Wroughton. The site falls within the North Wessex Downs Area of Outstanding Natural Beauty.

The single access point to the site is from the north-west via the A4361 (Avebury-Wroughton) road, which, in turn, is within close proximity and well connected to both Junction 15 and 16 of the M4 motorway.

The facility will be located in the northern section of SMGW. A feasibility study has determined that this location takes best advantage of level ground, proximity to services and existing road network.

The development plot is predominantly flat improved grassland, bordered by disused concrete runways. The tarmac and concrete runways stretch to the edges of the plot and are connected by smaller perimeter roadways. The recent development of 73 hectares of solar panels now covers the western and southern parts of the main site.

Section 2.0

Policy and Regulatory Framework

2.1 SUSTAINABILITY FRAMEWORK

The Planning and Compulsory Purchase Act 2004 introduces a number of significant reforms designed to simplify and make the planning system more responsive to local need. Crucially, the Act imposes a statutory duty on local planning authorities to contribute towards the achievement of sustainable development. The museum sector has an important role to play in this challenge. This chapter is structured into two parts. The first summarises why the development proposals are necessary in the context of sustainable development drivers. Having set out this context, the chapter then goes on to outline the relevant sustainability statement guidance and policy at national and local level.

2.2 DEVELOPMENT DRIVERS

National Heritage Act 1983

The Science Museum was established under the National Heritage Act 1983 with its own Board of Trustees. It has the status of a non-departmental public body, operating within the public sector but at arm's length from its sponsor department, the Department for Digital, Culture, Media and Sport (DCMS).

This legislation sets out the principles by which the SMG takes responsibility for, an ensuring that there are effective arrangements for, collections information management and access to the SMG Collection.

Under the National Heritage Act 1983, the Board of Trustees of the Science Museum is responsible for (under section 10(1) of the Act):

> (1) So far as practicable and subject to the provisions of this Act, the Board shall—
> (a) care for, preserve and add to the objects in their collections,
> (b) secure that the objects are exhibited to the public,
> (c) secure that the objects are available to persons seeking to inspect them in connection with study or research, and
> (d) generally promote the public's enjoyment and understanding of science and technology and of the development of those subjects, both by means of the Board's collections and by such other means as they consider appropriate.

Section 10(2) of the Act sets out how SMG remit may extend to encompass education and research and acquire land and other property:

> (2) For those purposes the Board may, subject to the provisions of this Act—
> (a) provide education, instruction and advice and carry out research,
> (b) enter into contracts and other agreements (including agreements for the Board's occupation or management of the building known as the Science Museum or other premises), and
> (c) acquire and dispose of land and other property.

To summarise, The SMG has a statutory obligation under the National Heritage Act 1983 (as amended) to care, preserve and add to the objects in their collection.

As defined in the 1983 National Heritage Act, SMG's charitable objectives are to: -

- Care for, preserve and add to the objects in its collections;
- Secure that the objects are exhibited to the public;
- Secure that the objects are available to persons seeking to inspect them in connection with study or research; and
- Generally, promote the public's enjoyment and understanding of science and technology and of the development of those subjects, both by means of the Board's collections and by such other means as they consider appropriate.

The Mendoza Review: An Independent Review of Museums in England (November 2017)

Commissioned and published by the Department of Digital, Culture, Media and Sport; the Mendoza Review looked at the existing national infrastructure for museums in England and makes recommendations on how they should sustainably evolve for the enjoyment of ours and future generations.
The review identifies nine priorities for museums today, five of which are relevant to the development proposal these are (inter alia): -

"Growing and diversifying audiences reflects the important purpose of museums in engaging people and communities. Over half of the adult population now visits museums – up from around two in five a decade ago – a significant achievement. But those audiences are still less likely to be representative of the very young or very old, ethnic minorities, disabled, or lower socio-economic backgrounds. There is no complacency in the sector – museums are increasingly reaching out to their communities to provide exhibitions that welcome people. These include, for example, building more sophisticated partnerships to co-produce exhibitions; using new technology to collect and analyse visitor data; and gathering other evidence to understand how best to serve their visitors. In many ways, national museums have spearheaded these approaches, and provided support to museums outside London to improve access all over the country. This work needs to continue and develop as further best-practice techniques are established and economies of scale established.

Dynamic collections curation and management are the fundamental point of museums – to protect and take care of the collections they hold, and to make them accessible to the public, not just physically, but meaningfully as well. This is not without its challenges: buildings maintenance backlogs (including insufficient storage) are a common issue, as is less available curatorial time and expertise, and the ongoing need for a sensible approach to both growing and rationalising collections. There are good examples of where sharing skills and infrastructure can help to overcome these issues; this is a particular area where a strategic framework for how the national museums' work with the rest of the sector will benefit museums across the country
Contributing to placemaking and local priorities helps museums play a part in their communities and in local decision-making, as well as leveraging investment in culture to also deliver on priorities such as health and wellbeing. There is increasing evidence to show that cultural institutions contribute a great deal to the local economy, to the wellbeing and education of its residents, and to attracting tourists and businesses to the area. Museums are especially able to do this because of their position as a civic space and their collections, which connect people to place. To encourage this work it is important that museums have and use consistent, statistically robust methods to measure economic and social impact.

Delivering cultural education has benefits for schoolchildren as well as helping to make the adult museum audiences of the future. Museums can and do support pedagogy, enhancing the theory and practice of formal learning and the curriculum, as well as engaging children with development – particularly around their social history and place in the world.

Developing leaders with appropriate skills and diversifying the workforce are long-standing concerns of the museums sector; they must be tackled successfully if museums are to adapt to reduced public funding and encourage more diverse audiences. The skills needed for a museums career are changing, with greater emphasis now on flexibility and collaboration, business and digital, commercial, marketing and fundraising. Volunteers are still of crucial importance in keeping museums running, although routes to entry into the sector need to expand to offer greater opportunities to a wider range of people, particularly reflecting the make-up of the local communities they serve.

Digital capacity and innovation is an area where museums have been slower than other arts and cultural sectors to develop. Beginning with senior leadership, but encompassing upskilling people in numerous roles, there is a need for greater understanding of the wide potential of digital in museums. Examples include display and interpretation, collections, communications, data – and the need for a strategic approach to embedding tools and technologies into every aspect of museums' work."

The Culture White Paper March 2016

The white paper sets out how the Government will support the cultural sector over the coming years and how culture will play an active role in building a fairer and more prosperous nation. Page 38 of the white paper states (inter alia) *"Many museums are actively involved in digitising their collections, but still only a fraction of the extensive and unique collections of our national museums can be readily viewed by the general public.* ***The government is providing £150 million of capital funding over the next five years to the British Museum, the Science Museum and the Victoria and Albert Museum to preserve, protect and transform public access to the collections currently stored at Blythe House in London, by relocating them to appropriate, world-class facilities.*** *As part of this move, objects from the collections will be photographed and made available digitally".*

2.3 NATIONAL PLANNING POLICY FRAMEWORK

The National Planning Policy Framework was adopted by Central Government on 27th March 2012. Within the "Ministerial Foreword" it states that *"the purpose of planning is to help achieve sustainable development"*. Further, the Ministerial Foreword notes that *"sustainable means ensuring that better lives for ourselves don't mean worse lives for future generations"*.

The Minister goes on to state *"In order to fulfil its purpose of helping achieve sustainable development, planning must not simply be about scrutiny. Planning must be a creative exercise in finding ways to enhance and improve the places in which we live our lives. This should be a collective enterprise. Yet, in recent years, planning has tended to exclude, rather than to include, people and communities. In part, this has been a result of targets being imposed, and decisions taken, by bodies remote from them"*.

The document stipulates that *"sustainable development is about positive growth - making economic environmental and social progress for this and future generations"*. *Following on from this the Ministerial Foreword notes that "development that is sustainable should go ahead, without delay – a presumption in favour of sustainable development is the basis for every plan, and every decision"*.

Paragraph 7 confirms that there are three dimensions to sustainable development: Economic, Social and Environmental. These dimensions give rise to the need for the planning system to perform a number of roles (inter alia): -

- *An Economic Role – contributing to building a strong, responsive and competitive economy, by ensuring that sufficient land of the right type is available in the right places and at the right time to support growth and innovation; and by identifying and coordinating development requirements, including the provision of infrastructure;*
- *A Social Role – supporting strong, vibrant and healthy communities... with accessible local services that reflect the communities needs and support its health, social and cultural well-being; and*
- *An Environmental role – contributing to protecting and enhancing our natural, built and historic environment.*

Paragraph 8 advises that in order to achieve sustainable development, economic, social and environmental gains should be sought jointly and simultaneously through the planning system.

Paragraph 10 notes that plans and decisions need to take local circumstances into account, so that they respond to the different opportunities for achieving sustainable development in different areas.

Paragraph 17 of the NPPF sets out 12 sustainable core land-use planning principles which should underline both plan-making and decision-taking. The sustainable land-use principles pertinent to the development proposal and development site are: -

- *Take account of and support local strategies to improve health, social and cultural wellbeing for all, and deliver sufficient community and cultural facilities and services to meet local needs;*
- *Promote mixed use developments, and encourage multiple benefits from the use of land in urban and rural areas, recognising that some open land can perform many functions;*
- *encourage the effective use of land by reusing land that has been previously developed (brownfield land), provided that it is not of high environmental value;*
- *encourage the reuse of existing resources, including conversions of existing buildings; and*
- *proactively drive and support sustainable economic development and identify and then meet the development needs of an area, and respond positively to wider opportunities for growth.*

Paragraph 19 confirms the Government's commitment to supporting sustainable economic growth and that *"planning should operate to encourage and not act as an impediment to sustainable growth and therefore significant weight should be placed on the move to support economic growth through the planning system"*.

Paragraph 28 duly promotes the sustainable growth and expansion of all types of business and enterprise in rural areas, both through conversion of existing buildings and well-designed new buildings. It states that planning policies should support economic growth to create jobs and prosperity by taking a positive approach to sustainable development.

On the issue of community involvement Paragraph 66 identifies how local planning authorities should look more favourable upon proposals that take account of views of the community.

2.4 DEVELOPMENT PLAN

The Swindon Borough Local Plan 2026 (adopted March 2015)

The Swindon Borough Local Plan 2026 was adopted in March 2015 and sets out the local policy framework to deliver sustainable growth to 2026 and beyond. The Local Plan includes a Policies Map which shows the administrative area to which the policies contained in the plan relate. The Policies Map pertinent to the development site is set out below and shows how the site is located outside Wroughton's settlement boundary and within the SMG's land use allocation.

Policy RA2 Wroughton [and the Science Museum]

As the site is located within the SMGW's landholding, it is prudent to consider its namesake policy. Policy RA2 states (inter alia): -

> *Development at Wroughton shall be in accordance with Policies SD1 and SD2 and should support the following local priorities at Wroughton: -*
>
> - *Maximise opportunities associated with the Science Museum to benefit Wroughton and the Borough through: (i) Realising tourism benefits associated with the Science Museum; and (ii) Allowing expansion of museum related activities and enabling development providing the benefits of the development are delivered sustainably and do not conflict with other policies in the Local Plan.*

The thrust of the Policy, with regards to development opportunities at the Science Museum, is to deliver a proposal which benefits Wroughton and the Borough. The policy goes on to identify how enabling development would be promoted providing the benefits of the development are delivered sustainably and do not conflict with the other policies of the Plan.
In this instance, the development proposal includes the creation of a new purpose-built facility to enable the SMG to facilitate the preservation, conservation and engagement of its stored collections in line with its duty of care under the National Heritage Act 1983.

The Policy makes reference to Policies SD1 and SD2 and these are discussed in turn below.

Policy SD1 Sustainable Development Principles

Policy SD1 relates to the delivery of sustainable development and sustainable communities. The policy sets out sustainable development principles which should be followed by proposals and states: -

> *To enable the delivery of sustainable development and support sustainable communities in the Borough all development proposals will: (i) be of high quality design; (ii) promote healthy, safe and inclusive communities; (iii) respect, conserve, and / or enhance the natural, built and historic environments; (iv)assess and address the impact of climate change through mitigation and / or adaption measures; (v) provide or contribute to the assessed local and borough wide infrastructure and service requirements; (vi) contribute to the retention of jobs and growth of the local economy and complement Town Centre regeneration; (vii) be accessible by walking, cycling and/or public transport; and, (viii) use land and resources (such as water, energy, minerals and waste) in an efficient and effective way.*

The amplification to the policy, at paragraph 3.7 of the Local Plan, states *"Policy SD1 sets out the development principles which underpin this Local Plan and the development proposals which will come forward in the Borough. They represent a sustainable and balanced approach to the provision of new development and respond to [amongst other things] the need for new development to contribute to sustainable and balanced growth and change for the better in the borough"*. The development proposal would meet these requirements.

Policy SD2 Sustainable Development Strategy

Policy SD2 sets out the sustainable development strategy of the Development Plan. It states that development proposal in locations outside the settlement boundaries will be permitted where, amongst other things, it is in accordance with other policies of the Plan permitting specific development in the countryside.

Policy SD3 Managing Development

Policy SD3 sets out how the Council will take a positive approach when considering development which reflects the presumption in favour of sustainable development. Through this policy the Council will always seek to work proactively and jointly with applicants to find solutions which means the proposal can be approved wherever possible, and to secure proposals that improves economic, social and environmental conditions, and promotes health and well-being for those people living and working in Swindon Borough.

Policy CM4 Maintaining and Enhancing Community Facilities

Policy CM4 is also pertinent as the collections management facility will provide an exemplar visitor experience. It is envisaged that Building ONE would generate a maximum of 15,000 visitors per year. These would approximately be made up of public tours, school visits on a pre-booked basis. The Policy states (inter alia): -

> *a. Proposals for new or extended community facilities will be supported, particularly where: the site is located within or adjacent to existing settlements; it is accessible for all members of the community and promotes social inclusion, and if possible they can be co-located with other community uses.*

The reasoned justification to the Policy, at paragraph 4.303, states *"Proposals for new facilities or the extension of existing community facilities will be supported where they promote the principle of creating and/or maintaining sustainable communities, for example through the co-location of services on a single site. The development of new sites should be located within or adjacent to existing settlements, and be well located to the intended catchment population to maximise the opportunity to travel to these facilities by sustainable transport means, particularly walking and cycling"*

Paragraph 4.308 goes on to list examples of community facilities and these include: "museums and art galleries". As stated elsewhere in this statement, the SMG site at Wroughton is located adjacent to existing settlement and therefore receives the full support of Policy CM4.

Policy CM3 Integrating Facilities and Delivering Services

Through Policy CM3 the Council will seek to encourage the delivery of flexible multi-use buildings.

Policy TR2 Transport and Development

Through Policy TR2 the Council will seek that development proposal are located where there is good public access in order to reduce the need to travel by car. The amplification to the Policy, at paragraph 4.197 of the Local Plan, states (inter alia) "in all cases development should provide a level of access that is appropriate to its location, and the type and nature of the vehicles that will use it".

Section 3.0

Energy and CO_2 / Low Carbon Technology

3.1 EXECUTIVE SUMMARY

This document has been produced to provide an overview of the Energy Strategy in relation to Low and Zero Carbon (LZC) technologies for the proposed new Building ONE at Wroughton for the Science Museum Group.

The approach to energy use follows the energy hierarchy which, follows three steps in order to improve the energy efficiency of the building.

Step 1: Lean Building – Firstly optimize the building form, orientation and building fabric to make the building as energy efficient as possible.

Step 2: Mean Building – Secondly optimise the performance of the building services, using good design and highly efficient services

These steps are included to establish the base building energy performance and CO2 emissions.

Step 3: Green Building – Lastly make use of the most appropriate Low and Zero Carbon (LZC) technologies.

The new Archive Building complies with current Building Regulations Part L2A, based upon the information we have at this time.

Following the LZC analyses, it is suggested from the results that biomass boilers would be suitable to provide low carbon heat energy to the new building.

In undertaking the calculations of energy contribution and C02 emissions saved from potential LZC installations the following apply:

1. The net yield of the LZC installations has been used (i.e. any energy used by the LZC installation such as pumps etc. has been subtracted).

3.2 INTRODUCTION

Detailed analysis of the building has been produced using IES software capable of Dynamic Simulation Modelling calculations. The Client's aspirations are for the creation of a high quality and environmentally sustainable building in terms of energy efficiency and sustainable construction methodology and operation.

This report reviews generation of energy through LZC technologies options for the building, providing a description of technology reviewed, estimated impact on the buildings CO2 emissions, capital costs, running costs advantages and disadvantages of each technology both generally and in the context of the site.

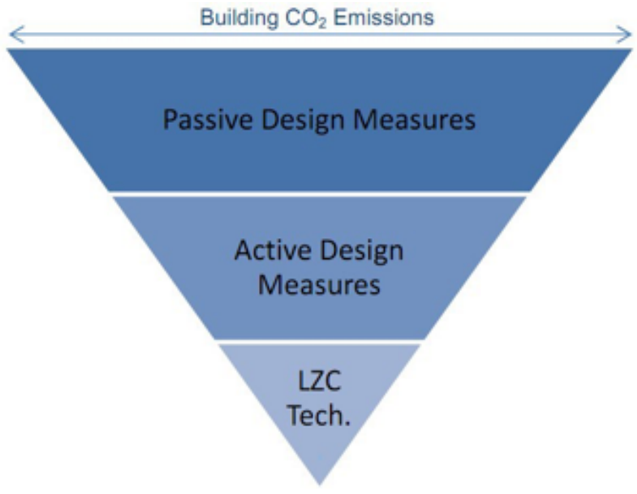
3.3 OVERVIEW OF ENERGY STRATEGY

The following report demonstrates the feasibility of utilising LZC and renewable systems that may be suitable for the development. Due to the early stages of the building design and concept this report should be used for information only and may not represent the final building installation.

The current compliance modelling undertaken for this project under Part L2a 2013 (including 2016 amendments) has not adopted the renewable systems mentioned in this report.

The proposed energy strategy for the building will adopt a fabric first approach. The design intent is to minimize energy consumption by the appropriate design of the building fabric elements along with the air tightness detailing. This will ensure that the energy loads for heating and cooling for the building are kept to a minimum.

As a target minimum the building elemental U values will be significantly better than over those dictated within Approved Document Part L2a.



The orientation of the building is generally fixed and agreed with major facades having almost a south-west and north-easterly orientation.

The general collection storage will be provided with heating or cooling by means of air handling plant to control the humidity levels to within the required relative humidity parameters of 35-60%RH with cumulative fluctuations of no more than 20% RH in 24hours.

A summary of the key features of the building to meet this requirement are:

- Enhanced fabric insulation and air tightness (Passive Design Measure)
- Efficient lighting and lighting controls (Active Design Measure)

At this stage, the concept design complies with Part L2a 2013 (with 2016 amendments) of the building regulations without the addition of LZC technologies. However as we develop the design and fully consider all engineering services to serve all areas (this being done further into the detailed design process) there may be a modest impact on the BRUKL that would require additional measures are needed to meet Part L2A compliance.

3.4 CARBON SAVINGS

For this project we have assessed the carbon savings for the building without a renewable energy technology in favour of a fabric first approach together with an LZC of air source heat pumps, low energy & intelligent lighting systems.

Currently under the 2013 Part L2a building regulations this solution demonstrates a 7.6% reduction (BER / TER) in Carbon through the use of initial passive measures, good building envelope 'U' Values and a good standard of air tightness.

Part L2a 2013 - Criterion 1		
Target Emissions Rate (TER)	**38.2**	**kg.CO2/m2/yr.**
Building Emissions Rate (BER)	**35.3**	**kg.CO2/m2/yr.**
Improvement margin	**2.9**	**kg.CO2/m2/yr.**
Improvement %	**7.6%**	

3.5 SELECTION OF BUILDING FABRIC

The choice of building fabric has a large impact on the requirement and size of the heating systems and will form an important part of the energy saving strategy that is to be implemented. The proposed fabric 'U' values for the development are shown below.

Element / System		Limits 2013 Regs	As Designed Specification
Area Weighted U Value (W/m^2K)	External Wall	0.35	0.14
	Exposed Floor	0.25	0.15
	Exposed Roof	0.25	0.14
Air Tightness ($m^3/(h.m^2)$ @ 50 Pa		10	2.0

A building air tightness figure of 2.0 m3/hr.m2 at 50 Pa is also envisaged and will need to be confirmed at a more detailed stage of the design. It may be possible to achieve 1.03 m3/hr.m2 at 50 Pa but for the purposes of the calculations we have set the air tightness of the envelope at 2.0 m3/hr.m2 at 50 Pa.

The building envelope has been based upon a standard industrial type building, built to the most efficient thermal and air tightness standards available in this type of standard construction.

3.6 ENERGY EFFICIENT SERVICES AND EQUIPMENT

The correct selection and energy efficiency of services systems, plant and distribution is of great importance to the energy efficiency strategy of the building. As well as some standard measures to optimise the efficiency of the services it was decided that measures over and above the norm would be necessary to achieve the client's requirements.

Optimise Specific Fan Powers: All ventilation systems will be designed to operate at low specific fan powers. This project will aim to achieve specific fan powers of 2.0 W/l/s for the central ventilation systems and 0.5W/l/s for the toilet extract systems. As there is a large element of mechanical ventilation, significant energy savings can be made by the reduction of the specific fan powers.

Ventilation Heat Recovery: Ventilation heat recovery will be provided to the supply and extract ventilation system by means of a mixing box to the main store air handling unit/s. The mixing box will provide the ability to recirculate 88% of internal air back to the air handling unit/s. No heat recovery has been incorporated as the space will be held at a temperature of approximately 12°C during the winter months only to provide fabric protection. The internal environmental control of the building is predicated on the condition demands set by the collection, with Relative Humidity control within 35-60% being paramount and specific temperature control not being a requirement. Staff working areas such as conservation workshops, welfare areas etc. will be provided with mechanical supply and extract ventilation. The air handling plant for these areas will incorporate heat recovery via thermal wheel or plate heat exchanger technology and all fans will meet the required specific fan power requirements to comply with current Building Regulations.

Solar Hot Water: Solar hot water heating is a technology that, is proven to be reliable, cost effective and provide low to medium CO2 savings. Panels are positioned on roofs and use the suns energy to provide domestic hot water. Panels provide an optimum performance when mounted facing due south and inclined at an angle of 30-40°. During periods where the solar intensity is not high enough to provide the required amount of domestic hot water, the boiler low temperature hot water heating system will provide the shortfall in heat needed to raise the temperature of stored domestic hot water. Solar water heating systems which use larger volume cylinders to store the hot water operate more efficiently, as this allows for more solar hot water to be generated during periods of low domestic hot water use. The domestic hot water use of this building is unknown at this stage and will need to be developed further, once room data information for each space within the building is received from the Client team. An analysis of a solar hot water system will then be undertaken to review its inclusion or not in this scheme based upon the energy and CO2 savings which may be achieved.

Variable Speed Pumps: Variable volume LTHW heating systems serving the ventilation plant will be provided in order to maximise the energy savings afforded by the use of variable speed pumps. Automatic balancing valves will be provided in order to alleviate as far as possible any problems associated with variable volume water systems. As the building will operate under part load conditions for the vast majority of the year, further reductions in energy use can be provided by the use of variable speed pumps.

Efficient Lighting: Efficient LED & fluorescent lighting will be installed to reduce electrical energy consumption while maintaining the required lighting levels. High output light sources will be used where appropriate. In addition to efficient light sources, luminaires with high light output ratios using high efficiency optic and reflector technology will be used to optimise the useable output from the lamps. The SMG has specific requirements for lighting due to the impact on the collections from excess lux, heat and UV levels.

Lighting Controls: Lighting controls, in the form of presence and absence detection will be included in the design to minimise lighting energy use.

Power Factor Correction: The building will be equipped to support an installation of power factor correction equipment if the operating power factor is less than 0.95.

Metering Strategies: Metering of the building energy systems will be provided as recommended by CIBSE TM39.

Chilled Water Plant: High efficiency chillers using inverter speed controlled screw compressors with the opportunity to utilise free cooling when the external air temperature and required chilled water condition allows this.

The next stage is to look at making the building green, which requires an appraisal of the possible LZC technologies which may be applicable for the building

3.7 BRUKL OUTPUT

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Science Musuem - Gas — As designed

Date: Tue Dec 05 14:36:47 2017

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.8

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.8

BRUKL compliance check version: v5.3.a.0

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Peter O'Sullivan

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	36.9
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	36.9
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	33.2
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{k-Limit}$	U_{k-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.19	0.19	RM000004:Surf[0]
Floor	0.25	0.22	0.22	RM000004:Surf[2]
Roof	0.25	0.14	0.14	01000000:Surf[2]
Windows***, roof windows, and rooflights	2.2	-	-	No windows or rooflights in building
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{k-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{k-Calc} = Calculated area-weighted average U-values [W/(m²K)] U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	2

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- VRF

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	4.5	0	0	-
Standard value	2.5*	0.7	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

2- LTHW Heating (Gas)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	0.2	0	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.88. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

3- Storage

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	3	0	1.6	0.75
Standard value	0.91*	2.55	N/A	1.6^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

"No HWS in project, or hot water is provided by HVAC system"

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
00_Welfare	-	-	0.5	-	-	-	-	-	-	-	N/A
00_Toilets	-	-	0.5	-	-	-	-	-	-	-	N/A

3.7 BRUKL OUTPUT

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00_Collections Study	110	-	-	874
00_Welfare	-	75	-	220
00_Toilets	-	75	-	138
01_Conditioned Space	110	-	-	3516
00_Photography Studio	110	-	-	673
00_Conservation Workshop	110	-	-	2310
00_Stair	-	75	-	471
00_Conservation Laboratory	110	-	-	817
00_Corridor	-	75	-	444
00_Store - Low Bay	110	-	-	25091
01_Stair	-	75	-	396
01_Mezzanine Store - Low Bay	110	-	-	24721
00_Loading Bay	110	-	-	1449
00_Inward Transit	110	-	-	988
00_Outward Transit	110	-	-	851
00_Store - High Bay	110	-	-	68930
00_Freezer	110	-	-	609
00_Speical Collections Store	110	-	-	896

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00_Collections Study	N/A	N/A
00_Welfare	N/A	N/A
01_Conditioned Space	N/A	N/A
00_Photography Studio	N/A	N/A
00_Conservation Workshop	N/A	N/A
00_Conservation Laboratory	N/A	N/A
00_Store - Low Bay	N/A	N/A
01_Mezzanine Store - Low Bay	N/A	N/A
00_Loading Bay	N/A	N/A
00_Inward Transit	N/A	N/A
00_Outward Transit	N/A	N/A
00_Store - High Bay	N/A	N/A
00_Freezer	N/A	N/A
00_Speical Collections Store	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

3.7 BRUKL OUTPUT

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	33093	33093
External area [m²]	60420.5	60420.5
Weather	SWI	SWI
Infiltration [m³/hm²@ 50Pa]	2	3
Average conductance [W/K]	10957.5	18606.5
Average U-value [W/m²K]	0.18	0.31
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
100	**B8 Storage or Distribution**
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	0.94	3.72
Cooling	1.6	5.79
Auxiliary	30.24	22.07
Lighting	30.79	40.93
Hot water	5.56	5.45
Equipment*	43.65	43.65
TOTAL**	69.14	77.96

* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	23.79	93.19
Primary energy* [kWh/m²]	196.55	219.17
Total emissions [kg/m²]	33.2	36.9

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	109.6	0	32	0	6.6	0.95	0	0.95	0
	Notional	10.4	80.5	3.4	5.9	24.4	0.88	3.79	----	----
[ST] Constant volume system (variable fresh air rate), [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	1.7	17.8	0.5	1.6	33.4	0.95	3	0.95	3
	Notional	45.7	71	5	5.2	0	2.56	3.79	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	38.6	21.6	2.7	1.3	0	4	4.5	4	4.5
	Notional	93.1	0	30	0	6	0.86	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U_{i-Typ}	U_{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.19	RM000004:Surf[0]
Floor	0.2	0.22	RM000004:Surf[2]
Roof	0.15	0.14	01000000:Surf[2]
Windows, roof windows, and rooflights	1.5	-	No windows or rooflights in building
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

U_{i-Typ} = Typical individual element U-values [W/(m²K)] U_{i-Min} = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	2

Section 4.0

Sustainability Approach

4.1 ECOLOGY

An Extended Phase 1 Habitat survey has been undertaken at the site and has been augmented with a desk study of existing ecological information, the details of which are set out in the Ecological Impact Assessment. The site is situated approximately 100m away from Clouts' Wood SSSI and is in proximity to several Local Wildlife Sites. No impacts on the designated sites are anticipated, although the risk of temporary impacts arising during construction will be minimised through adoption of precautionary protective measures as part of a Construction Environmental Management Plan (CEMP).

The habitats within the development zone comprise patchily distributed semi-improved and improved grassland which were considered to be of low intrinsic value overall. An updated botanical survey of the grassland within the development zone will be undertaken in the flowering season to confirm the results of the Phase 1 survey undertaken in winter. The grassland may support ground nesting bird habitat, and a breeding bird survey will be undertaken at the appropriate time of year to identify species present and determine the need for any mitigation. Notwithstanding the findings of further bird and botany surveys, it is expected that the ecological enhancement of parcels of grassland to be retained close to the development will adequately mitigate impacts and contribute to an overall gain for biodiversity. No badger setts are present, although they are known to be present locally, and precautionary protection measures will be adopted during construction to avoid harming this species.

SMG has a long standing commitment to biodiversity enhancement at their site and details of the practices and activities in this area are reported in their annual accounts. These are published on their website.

4.2 TRANSPORT

SMG are committed to promoting sustainable travel to site by visitors and reducing the impact of associated traffic. SMG has been leading the sector in the early adoption of sustainable vehicle use with current operations making use of Hydrogen Fuel Cell and Electric Vehicles for transport around the site and to the main museum site in London. This strategy will continue, and be enhanced, through the operational phase of this development. This will include the opportunity for the provision of one electric vehicle charging point and a covered cycle parking area as part of this project.

Visitors to site, where appropriate, are encouraged to make use of public transport and this philosophy will continue as part of the proposals.

4.3 FABRIC AND MATERIALS

The design of the Building ONE facility aims to create a high quality development incorporating sustainable design features and materials. These sustainable features and materials include the following:

- The use of thermal fabric insulation products that provide a high thermal performance, minimising potential heat losses / gains and reducing the need for mechanical heating and cooling;
- Providing building materials and construction techniques which reduce the air permeability of the envelope, improving the thermal performance of the building and helping to regulate air quality - minimising the requirement for heating / cooling and air handling;
- Include internal and external durability / protection measure to protect vulnerable areas. These include the use of raised kerbs and bollards to protect against transit vehicle movement, as wells as impact protection at the end of racking aisles to protect against forklift vehicle movement;
- Sourcing of insulation materials with a low embodied energy relative to their thermal properties;
- Where possible source major building material elements and hard landscaping materials which are A or A+ rated within the green guide to specification;
- Re-use areas of existing hardstanding (existing runways) to provide vehicle access and service yard hardstandings, thus reducing the requirement for the provision of new hardstandings.

4.4 DRAINAGE AND POLLUTION

Drainage & Pollution

There is no drainage infrastructure available at the location of Building ONE. The site geology is appropriate for infiltration drainage to be used, refer to the additional reports listed below for further details.

- 5161116-ATK-ZZ-XX-RP-G-102 Phase 1 Geotechnical and Geoenvironmental Desk Study
- 5161116-ATK-ZZ-XX-RP-C-108 Flood Risk Assessment
- 5161116-ATK-ZZ-XX-RP-C-110 Drainage Strategy

Geo-Environmental Concerns

Information from the Environment Agency indicates that the chalk formations underlying the site have the following classifications:

- Principal Aquifer
- Groundwater Source Protection Zone: Zone 3
- Groundwater Vulnerability: High leaching potential

It will be necessary to consider these classifications in consideration for the site drainage. Drainage from roofs will be separated from drainage of hardstanding areas that will be used frequently by vehicles.

Flood Risk

Reference to the Atkins Flood Risk Assessment and mapping indicates that the site is not at risk of flooding.

- 5161116-ATK-ZZ-XX-RP-C-108 Flood Risk Assessment

Surface Water Drainage

Surface water drainage from the roof shall discharge directly to soak-away trenches on either side of the building, interceptors are not required for this discharge. Within the small car park and delivery bay area, small petrol/oil interceptor and the use of permeable paving will be installed (where required) to reduce the risk of pollution resulting from occasional spillages.

Surface water design shall take account of the greenfield run off rate with an additional 30% allowance for climate change.

Foul Water Drainage

Foul water drainage shall be provided in the form of a package sewage treatment plant buried close to the building. The plant shall biologically treat effluent generated before discharging treated water to a specific soak-away drainage field. It is proposed to use a Klargester BioDisc type treatment tank or similar for this purpose with 3 stone filled manhole structures forming the soak-away.

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