



#### Version Control

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## Introduction

*'Climate change adaptation is about responding to the changes that we have seen in Scotland's climate over the last few decades, and preparing for the challenges and opportunities that we will face as our climate continues to change in the decades ahead'* (Adaptation Scotland, 2018)<sup>1</sup>.

As a public body, the University of Glasgow has a legal duty under the Climate Change (Scotland) Act 2009 to address our changing climate and take adaptation measures to ensure that our estate is resilient in the future.

As an organisation, we are already taking steps to plan for a climate resilient future. The new buildings we construct as part of the Gilmorehill campus redevelopment will all be designed to perform efficiently, with future climate scenarios taken into consideration. In addition, we will implement a Sustainable Urban Drainage System to cope with water run-off from the former Western Infirmary site. We also plan to collaborate with Historic Environment Scotland, learning from their experiences, to ensure that our existing and historic buildings are able to cope with future changes in climate.



Finally, it should be highlighted that the University cannot hope to safeguard its future climate resilience by working in isolation. While it is important to ensure that our own estate is in order, we must recognise that we do rely heavily on a number of external organisations for a variety of business critical services (e.g. energy and water supply, transport services and ICT networks). Thus, it is also important that we continue to work in wider partnership, as part of the Climate Ready Clyde initiative, in order to deliver a well-adapted city region.

**Dr David Duncan and Prof Dan Haydon  
Co-Chairs; Sustainability Working Group**

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<sup>1</sup> Adaptation Scotland (2018). The concept of adaptation. [online] Available at: <https://www.adaptationscotland.org.uk/what-adaptation/concept-adaptation> [accessed 01/06/18].

**Vision**

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“A robust and resilient estate, able to withstand shifting weather patterns brought about by climate change”

**Mission**

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“To ensure that our estate is maintained and developed in a manner that takes Climate Change Adaptation into consideration”



## **Policy and Legislative Context**

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### **University Strategy (2015-2020)**

- World Class environment for learning and research
- Creating forward-looking, cohesive settings that inspire us and transform the way we live, learn and work together
- Engaging with the City of Glasgow to ensure that it flourishes

### **Estates Strategy (2014- 2024)**

- Campus that is “fit for today and the future” and “is innovative and courageous in design”
- Adaptable, future-proofed buildings that are effective and efficient

### **Estates five-year Business Plan (2016-2021)**

- Delivering resilient infrastructure
- Improving building performance and management
- Climate Change Adaptation Plan developed

### **Capital and Maintenance Plan**

- Supporting delivery and operation of the £1b of new property assets
- Maintaining operation of the existing estate

### **University Sustainability Strategy (2016-2020)**

- A whole of institution approach to sustainability
- Respecting the environment
- Building knowledge and sharing best practice
- Impacting positively on people and communities

### **Climate Change (Scotland) Act 2009**

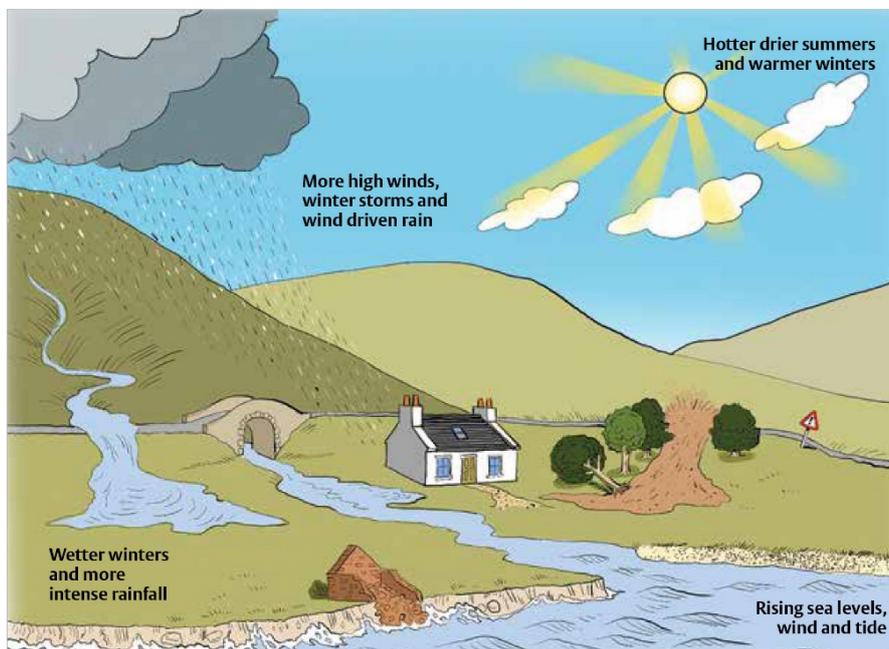
- Addressing our changing climate and taking adaptation measures to ensure that our estate is resilient in the future

## Future climate projections for the West of Scotland

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While the University of Glasgow remains strongly committed to reducing its future carbon emissions, we are aware that should current commitments to reduce global carbon emissions under the Paris agreement be implemented, then it is expected that the planet would still be on course for a 2-3°C increase in mean global temperatures (Climate Action Tracker, 2018)<sup>2</sup>. Thus, the use of a high carbon emissions scenario for climate resilience planning, is regarded as a realistic choice.

For the West of Scotland, under a high carbon emissions scenario, it is expected that the day-to-day weather will remain variable, but that generally summers will be hotter and drier, winters will become milder and wetter and that sea levels will continue to rise (UK Climate Projections [Met Office], 2009)<sup>3</sup>.



**Figure 1 – Future climate change in Scotland (adapted from Historic Environment Scotland, 2016)<sup>4</sup>**

In addition, we can also expect to see an increase in the frequency of summer heat waves and droughts, an increase in the frequency of extreme rainfall events/storms and a reduced occurrence of frost and snow. (Note: an update to the UK Climate Projections is due in 2018, however current

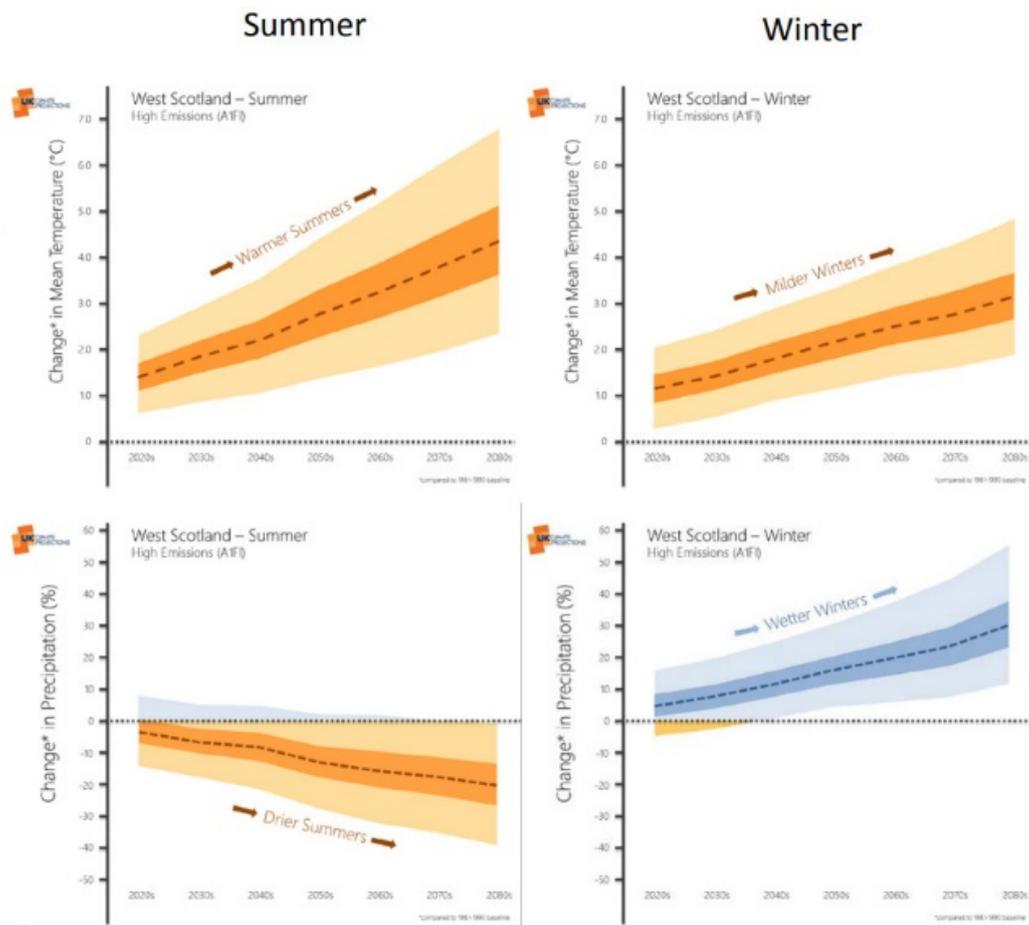
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<sup>2</sup> Climate Action Tracker (2018). The highway to Paris. [online] Available at: <https://climateactiontracker.org/> [accessed 01/06/18].

<sup>3</sup> UK Climate Projections (2009). Using climate projections. [online] Available at: <http://ukclimateprojections.metoffice.gov.uk/21678> [accessed 01/06/18].

<sup>4</sup> Historic Environment Scotland (2016). Climate Change Adaptation for traditional buildings. [online] Available at: <https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=a0138f5b-c173-4e09-818f-a7ac00ad04fb> [accessed 01/06/18].

advice from Adaptation Scotland is that the revised projections will not differ significantly from UK Climate Projections, 2009).



**Figure 2 – Future climate projections for the West of Scotland (adapted from UKCP, 2009)<sup>3</sup>**

When considering future climate projections it is also important to appreciate the difference between the ‘weather’ (the obvious daily changes in atmospheric conditions) and ‘climate’ (the average daily weather over an extended period of time at a certain location). Thus, while the overall future trend may be for drier summers and milder winters in the West of Scotland, we will still experience rainfall in July and August, and we will still have seasonal incidences of frost and snow, albeit less frequently.

## Key themes

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The Scottish Climate Change Adaptation Programme (Scottish Government, 2014)<sup>5</sup> has identified the likely consequences of climate change at a national level; these range from impacts to the natural environment (on agricultural productivity, coastal erosion and flood risk) to impacts on business (adverse effects on buildings, infrastructure and supply chains) and impacts on human health (on patterns of disease and mortality rates).

We have worked as a member of the Climate Ready Clyde partnership, to try and better understand how these more general 'national' consequences might translate into specific risks and opportunities at the Glasgow city-region level. Through a process of both literature review and evidence gathering from relevant stakeholders, the partnership has identified a list of approximately 80 potential risks and opportunities at the city-region level; roughly 30 of these are related to city-wide infrastructure, while 15 apply directly to the University of Glasgow estate and its operation<sup>6</sup>.

This Climate Change Adaptation Plan is intended to address these climate risks and opportunities and is based on the following key themes:

### At the city-region level

#### Infrastructure

We will use our membership of both the Sustainable Glasgow and Climate Ready Clyde initiatives, to influence relevant partners in order to address key risks to infrastructure (road and rail network, airport, sewer network, electricity, gas and water supply) from flooding, altered rainfall patterns, alterations in temperature and storm damage (see Appendix 1 for details).

### At an institutional level

#### Governance and Organisational Knowledge

We will:

- 1.1 - ensure that Climate Change Adaptation risks are embedded in an appropriate organisational risk register
- 1.2 - develop a mechanism for formally reviewing the progress of the Climate Change Adaptation Plan
- 1.3 - report annually on Adaptation progress via our Public Sector Climate Change Duty data return
- 1.4 - ensure that data relating to the ongoing impact of climate is collected at an organisational level
- 1.5 - ensure that relevant staff undertake appropriate training, in order to better understand issues relating to Climate Change Adaptation

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<sup>5</sup> Scottish Government (2014). Scottish Climate Change Adaptation Programme. [online] Available at: <http://www.gov.scot/Resource/0045/00451392.pdf> [accessed 01/06/18].

<sup>6</sup> Personal communications with Kit England at Climate Ready Clyde; formal report to be published in autumn 2018.

1.6 - adaptation progress is communicated to staff/students, learning is shared with partner organisations and opportunities for academic research are harnessed

### **Built Environment**

We will address the:

- 2.1 - risk to our estate from flooding
- 2.2 - risks to building fabric from moisture, wind and driving rain
- 2.3 - specific risks to historic environment, with respect to the above
- 2.4 - increased use of green spaces due to warmer weather
- 2.5 - increased maintenance requirements of green space due to warmer weather
- 2.6 - opportunity to reduce heating demand to buildings and the need for increased cooling demand in buildings from rising temperatures

### **University Community**

We will address the risks to:

- 3.1 - health and wellbeing from high temperatures
- 3.2 - health from changes in air quality
- 3.3 - business from reduced employee productivity due to infrastructure disruption
- 3.4 - business from disruption to supply chains and distribution networks
- 3.5 - business operations from water scarcity

### **Natural Environment**

We will address the risks:

- 4.1 - to species and habitats due to inability to respond to changing climatic conditions
- 4.2 - to soils from increased seasonal aridity and wetness
- 4.3 - of land management practices exacerbating flood risk
- 4.4 - to urban, historic and semi-natural woodlands from pests and disease and rising temperatures

## Climate Change Adaptation Plan for 2018-2023

### 1.0 Governance and Organisational knowledge

- 1.1 ensure that Climate Change Adaptation risks are embedded in an appropriate organisational risk register
- 1.2 develop a mechanism for formally reviewing the progress of the Climate Change Adaptation Plan
- 1.3 report annually on Adaptation progress via our Public Sector Climate Change Duty data return
- 1.4 ensure that data relating to the ongoing impact of climate is collected at an organisational level
- 1.5 ensure that relevant staff undertake appropriate training, in order to better understand issues relating to Climate Change Adaptation
- 1.6 adaptation progress is communicated to staff/students, learning is shared with partner organisations and opportunities for academic research are harnessed

#### Short Term Objectives (by 31<sup>st</sup> July 2019)

Objective	KPI	What does good look like?	Owner	Progress
(1.1) Climate Change Adaptation risks are embedded in the Estates & Commercial Services risk register, by Dec'18	Adaptation risks added to Estates & Commercial Services risk register	Adaptation risks are well understood across the organisation (cross over with Business Continuity Plan)	Director of Estates and Commercial Services	
(1.2) Chief Operating Officer takes responsibility for delivery of the Climate Change Adaptation Plan, by June'18	Climate Change Adaptation Plan is implemented with respect to agreed timescales	Need for Adaptation clearly understood at senior management level	Chief Operating Officer	
(1.2) Develop a mechanism for formally reviewing future climate risks and the success of mitigating actions, by July'19	Adaptation Plan is reviewed at appropriate Committee level	Adaptation Plan is annually reviewed and updated	Chief Operating Officer	
(1.3) Report on Climate Change Adaptation progress, annually each November	Public Sector Climate Change Duty data return submitted	Public Sector Climate Change Duty data return contains detailed information on Adaptation progress (cross over with Environmental Communications Strategy)	Sustainability Officer	
(1.6) Annual Public Sector Climate Change Duty data return is published on UofG webpages, annually	Public Sector Climate Change Duty data return uploaded to sustainability intranet pages	Staff and students see clear evidence of progress with respect to Climate Change Adaptation at institutional level (cross over with Environmental	Sustainability Officer	

		Communications Strategy)		
(1.6) Contribute organisational experience to the update of Adaptation Scotland's guidance for public sector bodies, by Jun '18	UofG representative attends update workshops/provides feedback on draft frameworks	UoG sharing Adaptation learning with other public sector organisations	Sustainability Officer	
(1.6) Initiate dialogue with Crichton Foundation around approach to climate change adaptation at the Dumfries campus, by Dec'18	Key adaptation contact at Crichton Foundation identified	Landlord and tenant responsibilities with regard to climate change adaptation are understood	Director of Property Development and Investment/Senior Asset and Estate Manager	
<b>Medium Term Objectives (over the next 5 years)</b>				
<i>Objective</i>	<i>KPI</i>	<i>What does good look like?</i>	<i>Owner</i>	<i>Progress</i>
(1.4) Data relating to the ongoing service and financial impact of climate is collected at an organisational level, by Dec'19	Mechanisms in place to gather data relating to impact of data on helpdesk job lines and staff absences	Current climate impacts are well understood at an organisational level	Director of Human Resources/Head of Technical Services	
(1.5) Ensure that relevant staff undertake appropriate training, in order to better understand issues relating to Climate Change Adaptation, ongoing	Appropriate UofG staff attend 'Adaptation Scotland' training events / make use of external resource (e.g. Historic Environment Scotland)	Adaptation risks are well understood across the organisation	Head of Technical Services/Head of Construction and Project Management	
(1.6) Climate Change Adaptation is addressed via the Environmental Communications Strategy, biannually	Bi-annual Adaptation updates issued via campus e-news	Adaptation successes are celebrated at an institutional level (cross over with Environmental Communications Strategy)	Sustainability Officer	
<b>Long Term Objectives (over the next 10 years)</b>				
<i>Objective</i>	<i>KPI</i>	<i>What does good look like?</i>	<i>Owner</i>	<i>Progress</i>
(1.6) Estates and Commercial Services will help deliver opportunities for academic staff to use the developing estate in order to carry out research, ongoing	Number of academic research projects facilitated	University Services supports academic research and helps to foster a 'Living Lab' approach on campus	Head of Construction and Project Management	

## 2.0 Built Environment

- 2.1 - risk to our estate from flooding
- 2.2 - risks to building fabric from moisture, wind and driving rain
- 2.3 - specific risks to historic environment, with respect to the above
- 2.4 - increased use of green spaces due to warmer weather
- 2.5 - increased maintenance requirements of green space due to warmer weather
- 2.6 - opportunity to reduce heating demand to buildings from rising temperatures and need for increased cooling demand in buildings from rising temperatures

### **Short Term Objectives (by 31<sup>st</sup> July 2019)**

<i>Objective</i>	<i>KPI</i>	<i>What does good look like?</i>	<i>Owner</i>	<i>Progress</i>
(Risk 2.1) Review flood risk assessments carried out for the Gilmorehill and Garscube campus redevelopments, by Dec'18	Review carried out	New campus developments at reduced risk of flooding; any potential problems are effectively addressed	Senior Asset and Estate Manager	
(Risk 2.1) Effective monitoring of building projects to ensure Redevelopment Plans, Masterplans and Sustainability Design Standards are adhered to in terms of SUDS, appropriate planting schemes and hard standings, in order to mitigate any flood risk, ongoing	Appropriate reviews are carried out	New campus developments at reduced risk of flooding (cross over with Design Standards)	Head of Construction and Project Management	
(Risk 2.1) 'Lessons learned' from Jun '18 flash flooding of Stoker Building carried out, by Aug'18	Review carried out	Clear understanding of works required to prevent similar incidences in the future; appropriate works instructed	Head of Technical Services	
(Risk 2.1 and 2.6) All new builds achieve BREEAM points for Climate Change Adaptation, ongoing	BREEAM points for Climate Change Adaptation achieved on new buildings	New builds are future-proofed, with regard to climate resilience (cross over with Sustainability Design Standards)	Head of Construction and Project Management	
(Risk 2.2) Future climate risks are considered in the corporate asset management strategy, by 2021	Corporate asset management strategy highlights importance of addressing future climate risks	Climate resilience of existing university buildings is improved (cross over with Corporate Asset Management Strategy)	Senior Asset and Estate Manager	
(Risk 2.2) Develop post-adverse weather event inspection protocols for	Inspection protocol in place	Reduced Health & Safety risks from damage to building	Head of Technical Services	

building fabric, by Jan'19		fabric (cross over with Health and Safety Strategy)		
(Risk 2.3) Initiate collaboration with Historic Environment Scotland regarding Adaptation measures for traditional buildings, by Aug'18 (See Appendix 2)	Collaboration scoped and agreed upon by both parties	Strong relationship with HES is established; facilitates sharing of knowledge and expertise	Sustainability Officer/Head of Technical Services	
(Risk 2.3) Appropriate building selected for energy efficiency and adaptation case study by HES technical team, by July'19	Technical inspection of case study building carried out	Improved understanding of suitable energy efficiency and adaptation measures for our traditional buildings (cross over with Energy Strategy)	Sustainability Officer/Head of Technical Services	
(Risk 2.4) Ensure new green spaces (campus redevelopment) are planted appropriately and with adequate shading, ongoing	Landscaping design for campus redevelopment facilitates climate resilience	Future species selection takes account of changing climate conditions and biodiversity priorities (cross over with Biodiversity Strategy)	Head of Construction and Project Management	
(Risk 2.5) Carry out estate-wide review for potential to replace lawns/mowed areas with wildflower meadows, by July'18	Unnecessarily mowed areas reduced by 2000m <sup>2</sup>	Reduced mowing intensity allows lawn areas to revert to more semi-natural conditions, improving biodiversity potential and reducing ongoing maintenance costs (cross over with Biodiversity Strategy)	Head of Technical Services	
<b>Medium Term Objectives (over the next 5 years)</b>				
<i>Objective</i>	<i>KPI</i>	<i>What does good look like?</i>	<i>Owner</i>	<i>Progress</i>
(Risk 2.1) Determine risk of flooding for Rowardennan Field Station, Cochno Farm and University Boathouse, by Jul'20	Flood risk assessments carried out	Flood risks understood for existing buildings; mitigating actions may be proposed, if required	Senior Asset and Estate Manager	
(Risk 2.2) Planned preventative maintenance regime in	Planned preventative maintenance	Climate resilience of existing university buildings is	Head of Technical Services	

place to help alleviate climate impacts on buildings, by July'19	schedules (fabric) in place for each building	improved (cross over with Planned Preventative Maintenance Strategy)		
(Risk 2.3) HES recommendations for case study building are actioned and implemented, by July'20	Case study building upgrade completed	Energy efficiency and climate resilience of an existing building are improved (cross over with Energy Strategy)	Head of Technical Services	
(Risk 2.3) Review lessons learned from HES case study and amend scope of quinquennial building condition survey accordingly to identify adaptation requirements, by July'20	Review carried out	Increased understanding of necessary steps to improve climate resilience of existing buildings (cross over with Corporate Asset Management Strategy)	Head of Technical Services/Senior Asset and Estate Manager	
(Risk 2.4) Western Infirmary redevelopment to contain rain gardens (dual benefit of greenspace/SUDS), by July'21	Rain gardens installed	New green spaces increase carbon capture and retention, reduce storm water run-off, enhance biodiversity, impact on urban heat levels and contribute to cooling (cross over with Biodiversity Strategy)	Head of Construction and Project Management	
(Risk 2.4) Ensure adequate provision of green space in Western Infirmary redevelopment, July'19	Planning conditions discharged	New green spaces increase carbon capture and retention, enhance biodiversity, impact on urban heat levels and contribute to cooling (cross over with Biodiversity Strategy)	Head of Construction and Project Management	
(Risk 2.4) Develop a litter action plan for the University Estate, by July'19	Litter prevention action plan produced	Reduced impact of litter, both on the estate and the wider community (cross over Waste Management Strategy)	Head of Facilities Services/Head of Technical Services	
(Risk 2.6) Heating and Cooling guidance developed, by July'19	Guidance in place	Clear understanding of acceptable temperature range for buildings across the estate; reduced	Head of Technical Services	

		incidences of overheating (cross over with Energy Strategy)		
(Risks 2.1 - 2.6) Develop climate change adaptation strategy for the Dumfries campus, by July'22	Adaptation strategy for Dumfries campus in place	Responsibility for addressing climate change adaptation on Dumfries campus is clearly defined	Sustainability Officer	
<b>Long Term Objectives (over the next 10 years)</b>				
<i>Objective</i>	<i>KPI</i>	<i>What does good look like?</i>	<i>Owner</i>	<i>Progress</i>
(Risk 2.5) Carry out review for future planting of the estate with slow growing species, July'20	Review carried out	Future tree maintenance costs are reduced (cross over with Biodiversity Strategy)	Estates Services Manager/Grounds Supervisor/Arboriculture and Biodiversity Coordinator	
(Risk 2.6) Optimisation of BEMS system to ensure that internal temperatures are maintained within an acceptable range, by July'22	BEMS optimisation completed	Heating and cooling guidance is implemented effectively across the university estate (cross over with Energy Strategy)	Head of Technical Services	
(Risk 2.6) Develop a programme for improving local heating controls across the estate, by July'22	Improvement programme implemented	Improved ability to regulate internal temperature at a local level (cross over with Energy Strategy)	Head of Technical Services	

### 3.0 University Community

- 3.1 - risk to health and wellbeing from high temperatures
- 3.2 - risk to health from changes in air quality
- 3.3 - risk to business from reduced employee productivity due to infrastructure disruption
- 3.4 - risk to business from disruption to supply chains and distribution networks
- 3.5 - risk to business operations from water scarcity

#### **Short Term Objectives (by 31<sup>st</sup> July 2019)**

<i>Objective</i>	<i>KPI</i>	<i>What does good look like?</i>	<i>Owner</i>	<i>Progress</i>
(Risk 3.1) Heating and Cooling guidance developed, by July'19	Guidance in place	Clear understanding of acceptable temperature range for buildings across the estate; reduced incidences of overheating (cross over with Energy Strategy)	Head of Technical Services	
(Risk 3.1) Scoping study carried out to determine suitability of current provision of plumbed in water fountains on campus, by July'19	Scoping study completed	Clear understanding of current water fountain provision and gaps in the service (cross over Waste Management Strategy)	Head of Technical Services/Engineering Services Manager	
(Risk 3.3) Use our membership of both the Sustainable Glasgow and Climate Ready Clyde initiatives, to influence relevant partners in order to mitigate key risks to infrastructure (road and rail network, airport, sewer network, electricity, gas and water supply), ongoing	Attendance of UofG representatives at Sustainable Glasgow and Climate Ready Clyde Board meetings	Partnership approach across public and private sector leads to climate-resilient city region (cross over with University Strategy)	Director of Estates and Commercial Services/UofG representatives on Climate Ready Clyde Board	
(Risk 3.5) A review of the existing water mains infrastructure on the Gilmorehill and Garscube campuses, including determination of leakage rate, by July'19	Review carried out	Key areas for investment/improvement are identified	Head of Technical Services	

#### **Medium Term Objectives (over the next 5 years)**

<i>Objective</i>	<i>KPI</i>	<i>What does good look like?</i>	<i>Owner</i>	<i>Progress</i>
(Risk 3.1) Plumbed-in water fountains to be provided in every building, by July'21	Water fountain rollout completed	Staff and students have free access to drinking water across our campuses; improved health and wellbeing,	Head of Technical Services/Engineering Services Manager	

		reduction in plastic bottle waste (cross over Waste Management Strategy)		
(Risk 3.1) Data relating to incidences of overheating are recorded at an organisational level, by July'22	Database established and maintained	Improved understanding of building function (cross over with Energy Strategy)	Head of Technical Services/Engineering Services Manager/Energy and Carbon Manager	
(Risk 3.2) Work in partnership with GCC/SPT to ensure effective implementation of STTP, ongoing	% modal split data from biannual staff/student travel survey	Staff/students increasingly use active travel/ public transport to travel to University, thus helping to reduce air pollution (cross over with STTP)	Travel and Transport Coordinator/Town Planning Manager	
(Risk 3.2) Increase proportion of fleet vehicles running on electric motors, by July'23	30% of fleet composed of electric vehicles	Reduced particulate emissions from university-owned vehicles in and around our estate (cross over with STTP & Servicing and Delivery Strategy)	Head of Facilities Services	
(Risk 3.2) Develop a delivery and servicing strategy for the estate, by July'19	Delivery and servicing strategy established	Reduced number of delivery vehicles in and around our estate; Reduced particulate emissions from delivery vehicles (cross over with STTP)	Head of Facilities Services/Head of Technical Services	
(Risk 3.3) Review IT strategy to ensure business systems can be accessed in an agile manner/at home, in the event of transport infrastructure disruption, by July 2023	Review carried out	Employee productivity and business services maintained during times of infrastructure disruption (cross over with IT strategy)	Assistant Director of IT Services	
(Risk 3.3) Review IT strategy to ensure the service can adequately support academic research/student learning in an agile manner in the event of infrastructure disruption, by July 2023	Review carried out	Research, teaching and learning is supported during times of infrastructure disruption (cross over with IT strategy)	Assistant Director of IT Services	
(Risk 3.4) Review the Environment Agency's 'assessing and managing climate change risks in supply chains' document, by 2020	Review carried out	University understands the potential for unpredictable weather and a changing climate to disrupt its supply chain (cross over with Procurement Strategy)	Head of Procurement	
(Risk 3.5) A coherent water metering	Strategy in place	Improved ability to understand and	Head of Technical Services	

strategy will be developed, by Dec'19		effectively monitor water consumption on a building-by-building basis		
(Risk 3.5) A strategy for improving water efficiency on a building-by-building basis will be developed, by Dec '20	Strategy in place	Reduced demand for water across the UofG estate	Head of Technical Services	
<b>Long Term Objectives (over the next 10 years)</b>				
<i>Objective</i>	<i>KPI</i>	<i>What does good look like?</i>	<i>Owner</i>	<i>Progress</i>
(Risk 3.4) If appropriate, use the Environment Agency's resilience framework to assess and manage climate risks to each part of our supply chain, by 2028	Proportion of supply chain with adaptation plans in place	Risk of climate-related disruption to our supply chain is reduced (cross over with Procurement Strategy)	Head of Procurement	

#### 4.0 Natural Environment

- 4.1 – risk to species and habitats due to inability to respond to changing climatic conditions
- 4.2 – risk to soils from increased seasonal aridity and wetness
- 4.3 – risk of land management practices exacerbating flood risk
- 4.4 – risk to urban, historic and semi-natural woodlands from pests and disease, rising temperatures and severe weather/storm events

#### **Short Term Objectives (by 31<sup>st</sup> July 2019)**

<i>Objective</i>	<i>KPI</i>	<i>What does good look like?</i>	<i>Owner</i>	<i>Progress</i>
(Risk 4.1) Carry out estate-wide review for potential to replace lawns/mowed areas with wildflower meadows, by July'18	Unnecessarily mowed areas reduced by 2000m <sup>2</sup>	Reduced mowing intensity allows lawn areas to revert to more semi-natural conditions, improving biodiversity potential and reducing ongoing maintenance costs (cross over with Biodiversity Strategy)	Head of Technical Services	
(Risk 4.1) Investigate the potential for developing green corridors on the Gilmorehill and Garscube campuses, by Dec'18	Review carried out	Improved connectivity of green spaces supports biodiversity under conditions of climate stress (cross over with Biodiversity Strategy)	Head of Technical Services	
(Risk 4.4) Develop post-adverse weather event inspection protocol for trees, by March'19  Identify and remove potentially unstable trees, ongoing	Tree inspection protocol established  Regular tree inspections carried out and formally documented	Reduced risk of tree fall on the estate (cross over with Health and Safety Strategy)	Head of Technical Services	

#### **Medium Term Objectives (over the next 5 years)**

<i>Objective</i>	<i>KPI</i>	<i>What does good look like?</i>	<i>Owner</i>	<i>Progress</i>
(Risk 4.1) Investigate the potential to plant/improve shelter belts adjacent to grass pitches on the Garscube estate, improving biodiversity potential, creating more shade for spectators and reducing	Review carried out and appropriate planting instructed	Appropriate species selection for shelter belts will also deliver biodiversity benefits, especially if the belts form part of a wider woodland network (cross over with Biodiversity Strategy)	Director of Sport/Head of Technical Services	

the impact of prevailing winds and rain, by July'23				
(Risk 4.2) Carry out review of path network on Garscube campus to ensure appropriate surfacing, number of paths, alignment (avoiding areas adversely affected by erosion) and drainage, by Dec'19	Review carried out	Properly located, constructed, drained and maintained paths with reduced levels of path erosion. Safe movement around the campus is facilitated (cross over with Health and Safety Strategy)	Head of Technical Services	
(Risks 4.2 and 4.3) Investigate options for capture and retention of rain water from buildings on the Gilmorehill and Garscube estates, so that this can be used for irrigation of planted beds during drier periods, by Dec'19	Review carried out	Improved capture and storage of rainwater reduces storm run off during wet periods and supply pressure/irrigation costs during drier periods (cross over with Energy Strategy)	Head of Technical Services	
(Risk 4.3) Review the drainage performance of grass pitches on the Garscube estate, by July'23	Review carried out	A balance between maintaining playable conditions and the requirements of sustainable drainage is achieved	Director of Sport	
(Risk 4.3) Investigate the potential to create new pond areas on the Garscube estate, by July'23	Feasibility study carried out	New ponds function as sustainable drainage features, wildlife habitats, and cooling features (cross over with Biodiversity Strategy)	Head of Technical Services/Grounds Supervisor	
(Risk 4.4) Hotter, drier summers – develop silviculture management plan, including replanting of trees with drought resistant species/provenance, by July '20	Silviculture management plan in place	Reduction in failure or impaired establishment for new planting (cross over with Biodiversity Strategy)	Head of Technical Services	
(Risk 4.4) Hotter, drier summers – assess risk of increased incidence of woodland fires, by July'23	Risk assessment carried out	Improved resilience planning for wild fires (cross over with Health and Safety Strategy)	Head of Technical Services/Head of Safety and Environmental Protection	
(Risk 4.4) Warmer, wetter winters –develop silviculture management plan, including thinning, in order to reduce the likelihood and impact of	Silviculture management plan in place	Reduced likelihood and impact of pathogen attack on tree stock (risk increased due to reduction in number	Head of Technical Services	

pathogen attack, by July'20		of frost days and greater soil instability and root damage due to water-logging (cross over with Biodiversity Strategy)		
(Risk 4.4) Investigate the potential for new planting and woodland expansion on the Garscube and Cochno estates, by July '23	Review carried out	Expanded woodlands increase carbon capture and retention, enhance biodiversity, impact on urban heat levels and contribute to cooling (cross over with Biodiversity Strategy)	Head of Technical Services	
<b>Long Term Objectives (over the next 10 years)</b>				
<i>Objective</i>	<i>KPI</i>	<i>What does good look like?</i>	<i>Owner</i>	<i>Progress</i>
(Risk 4.2) Investigate options for capture and retention of rain water (ponds/tanks) on the Garscube estate, so that this can be used for irrigation of playing fields during drier periods, by Dec '19	Review carried out	Improved capture and storage of rainwater reduces storm run off during wet periods and supply pressure/irrigation costs during drier periods (cross over with Energy and Biodiversity Strategy)	Head of Technical Services	
(Risk 4.4) Hotter, drier summers – develop silviculture management plan, highlight locations of drought-prone /shallower rooted tree species, by July'20	Silviculture management plan in place	Improved understanding of potential need for irrigation	Estates Services Manager/Grounds Supervisor/Arboriculture and Biodiversity Coordinator	

## Appendix 1

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Climate risks relating to infrastructure that have been identified by the Climate Ready Clyde initiative as being of particular importance to the Glasgow City Region.

### *Flood Risks*

- Risks to road & rail network from river, surface water and groundwater flooding.
- Risks to road & rail from coastal flooding and erosion
- Risks of sewer flooding due to heavy rainfall
- Risks to Scottish Power Energy Networks sub-stations and Scottish Gas Networks Pressure Reducing Installations (PRIs), pipelines and supporting infrastructure from both surface water and coastal flooding
- Risks to Glasgow Airport buildings and surfaces from groundwater flooding

### *Altered rainfall pattern and high/low river flows*

- Risks to public water supplies from drought and low river flows
- Risks to bridges and pipelines from high river flows and bank erosion
- Risks to road & rail network from slope and embankment failure
- Risks to hydroelectric generation from low or high river flows
- Risk to Scottish Power Energy Networks underground cables from drought leading to ground movement
- Risks to Glasgow Airport infrastructure from fracture and subsidence

### *Alterations in temperature*

- Risks to road & rail network from extreme heat
- Risk to railway embankments from changes to freeze-thaw cycles
- Risks to energy infrastructure and rail network from increase in vegetation growth rates/longer growing season
- Risks to infrastructure from wildfires
- Risks to Scottish Power Energy Networks cables, transformers, sub-stations, and network access from extreme heat

### *Storm Damage*

- Risks to Scottish Power Energy Networks sub-stations from storms and high waves
- Risks to road & rail network due to high winds and waves.
- Risks to offshore infrastructure from storms and high waves
- Risks to Glasgow Airport from storms (including high winds and lightning)

## Appendix 2

Climate change	Impact on buildings	Potential damage	Adaptation measures
Warmer winters	Higher internal humidity	Greater prevalence of insect pests and fungal attack Warping of timber elements	Improved ventilation
	Increased moss and algal growth	Staining and discolouration of masonry, dampness	Improved weathering detailing
Wetter winters	Rising ground water levels	Dampness in basements and wall footings	Enhanced drainage adjacent to buildings Improved water vapour handling on retaining walls
	Prolonged saturation of masonry	Algal growth, vegetation	Improved weathering details Repointing of masonry External coatings
Hotter, drier summers	Increased thermal stress on building fabric	Cracking of hard materials	Repair with flexible traditional materials such as lime mortars
	High internal temperatures	Thermal discomfort for occupants Warping/splitting of timber elements	Improved natural ventilation Install traditional blinds and/or canopies
	Ground shrinkage	Movement of foundations	Adapt surface drainage and landscaping/planting
More frequent, intense rainfall	Water penetration into fabric	Masonry decay and binder loss, rot and decay of internal woodwork, staining, reduced thermal efficiency	Improved weathering details More frequent maintenance Repair of mortar joints
	Blockage of gutters	Water overflows into/onto fabric	Increase size at critical points More frequent maintenance
	Splash back from hard surfaces	Wetting of adjacent masonry	Remove hard surfaces adjacent to walls Improve drainage around site
	Run off from adjacent areas	Flooding of under-floor or basements	Minimise hard landscaping Improve natural drainage of driveways and pavements
	Flash flooding from watercourses and roads	Physical damage; saturation of fabric. Damage from hasty clearing up. Sewage contamination	Attend to culverts and adjacent burns Routes for surge waterflows around buildings
Wind driven rain	Penetration of render/harling	Progressive wetting of walls	Better detailing
	Water penetration under roof covering	Roof leaks	Improved slating detailing Vapour open materials to disperse water
High winds/storms	Impact damage to fabric	Damage to slates/leadwork	Additional fastenings to ridges and slates Higher codes of lead Improved clips and raggle details
	Collapse of unstable masonry	Chimney damage	Maintenance of chimney fabric Improved haunching of chimney cans

(Adapted from Historic Environment Scotland, 2016)<sup>4</sup>