Draft of minimum requirements for climate-resilient health facilities in the CAREC region

1. Introduction

1.1 About this report

The overarching aim of this project is to develop minimum requirements for climate-resilient health facilities, informed by engagement with the Central Asia Regional Economic Cooperation Countries (CAREC) Working Group on Health (WGH) and Working Group on Climate Change (WGCC).

This report presents a draft of the minimum requirements for climate-resilient health facilities which will be presented at the WGH and WGCC meetings on 7-9 April 2025. Following the meeting, these requirements will be updated.

1.2 Purpose of the Minimum Requirements

The aim of the minimum requirements (hereafter referred to as 'the requirements') for climate-resilient health facilities is to guide stakeholders in developing and maintaining health facilities that are not only resilient to climate impacts but also capable of delivering continuous and effective health services in a changing climate.

Climate-resilient facilities support the delivery of high-quality and accessible health care throughout periods of acute and chronic climate stresses. Ultimately, we hope that the requirements will serve as a comprehensive framework to guide the development and implementation of climate-resilient health facilities, thereby contributing to improved health outcomes and greater community resilience in the face of climate-related challenges.

1.3 Expected Users

The requirements are intended for a diverse range of stakeholders involved in the planning, design, construction, and operation of health facilities. Key users are expected to include:

- **Development Partners** – who will support implementation of these requirements through investments in health facilities (e.g. construction/upgrading).
- **Government health departments, policymakers, and regulatory bodies** – who are responsible for procuring facilities, and setting and enforcing requirements for health facilities.
- **Architects, engineers, and construction firms** – who will implement these requirements to ensure that new and existing health facilities are designed and built to withstand climate-related impacts.
- **Health facility managers and administrators** – who will implement these requirements in daily operations and maintenance practices.

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By providing a list of requirements, we aim to guide all relevant stakeholders in developing health facilities that are resilient and capable of delivering essential health services in the face of climate change.

1.4 Scope of the Minimum Requirements

These requirements have been developed to set out minimum requirements for health facilities with regards to climate resilience. Health care facilities are classified as those which provide direct health treatment procedures for patients and include hospitals and health care clinics. More critical facilities may require higher standards.

These requirements are designed to enhance the ability of healthcare facilities to be prepared for, respond to, recover from, and adapt to climate-related shocks and stresses. This includes extreme weather events like heavy rain, cyclones and strong winds, floods, and heatwaves, as well as long-term changes such as rising temperatures and sea levels.

There are many other features which contribute to high quality design of healthcare facilities which should be considered alongside these requirements. These include but are not limited to:

- Environmental sustainability and decarbonisation
- Universal accessibility and inclusive design
- Infection resilience and healing environments
- Design of occupant safety to structural, fire and electrical hazards.

The requirements will encompass a range of considerations aimed at ensuring the climate-resilience of the physical asset components of health facilities. They will:

- Be structured against five health facility asset types, including 1) Building infrastructure, 2) Equipment & products, 3) WASH & waste, 4) Energy, and 5) Systems and processes.
- Include multi-hazard requirements and climate-specific requirements (e.g. flooding, extreme heat, extreme cold, tropical cyclones).

2. Background and Rationale

2.1 Background to ADB Technical Assistance

The TA 6535 – Addressing Regional Health Threats in Central Asia Regional Economic Cooperation Countries and the Caucasus[1] supports strengthening joint, cross-border approaches to regional health challenges with a focus on health security. It has supported the WGH in the development of the CAREC Health Strategy and Regional Investment Framework (RIF) 2022-2027 and supports their implementation. The 5th WGH meeting held in November 2023 in Almaty highlighted the importance of linking climate and health actions with regional health security, the need for closer regional cooperation and opportunities to leverage the CAREC platform. Building on the meeting in Almaty, the

[1] 54124-001: Addressing Health Threats in Central Asia Regional Economic Cooperation Countries and the Caucasus | Asian Development Bank

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ADB's Climate and Health Initiative and aligned with CAREC Climate Change Action Plan[2], this year's WGH meeting will focus on addressing climate change and health in the context of health security and discuss two deliverables on climate and health to be tabled to the CAREC Ministerial Conference later this year. This report presenting the Draft of minimum requirements for climate-resilient health facilities constitutes one of the two deliverables.

2.2 Climate Hazards in CAREC Countries

Across the 11 CAREC countries, all climate hazards exist (see Appendix 2 for sample data sources on climate hazards) but there is considerable variability both across and within countries.

Figure 1: High Level Summary of Climate Hazards across CAREC Countries (ThinkHazard!). Refer to Appendix 2 for example data sources.

To understand the exposure of a specific site to climate hazards, it is required to collect data on climate variables, relevant to each hazard (as shown in Table 1). The extent to which this has already been done and collated into hazard maps with sufficient resolution to inform building design, will be dependent on each country and likely to vary between different hazards [to be updated pending results of survey]. The required resolution will depend on the hazard type and location but will need to be able to inform the design criteria on which the new or upgraded facility will be based. For example, this could include expected flood levels, design wind speeds, ambient temperature ranges for plant operation.

Table 1: Summary of climatic hazards and associated climate variables[3]

Climate Hazard	Climate Variable
Flood	Rainfall intensity

[2] CAREC Ministers Endorse Climate Change Action Plan and 2030 Strategic Priorities, Launch Regional Climate Fund | Asian Development Bank

[3] https://aushfg-prod-com-au.s3.amazonaws.com/Climate%20resilience%20and%20adaptation%20guide.pdf

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Drought	Average annual rainfall, soil moisture, evapotranspiration
Extreme heat, extreme cold	Mean temperature, number of hot days, number of cold days, solar radiation, heatwaves – number, duration, amplitude, cumulative days
Cyclone	Wind speed
Coastal inundation and erosion	Sea level
Wildfire	Temperature, rainfall, wind speed, humidity
Humidity	Relative Humidity, Wet-Bulb Temperature

2.3 Benefits and Drivers of Designing Health Facilities for Climate Resilience

There are number of drivers and benefits for designing health facilities for climate resilience. These include:

- Increasing Frequency and Intensity of Climate-Related Hazards: Health facilities face growing threats from extreme weather events like floods, cyclones, and heatwaves which can disrupt utilities and essential services (e.g. water, electricity) and damage infrastructure (e.g. buildings, transport networks).
- Health System Vulnerability: Many health facilities are not equipped to handle the additional impact from climate hazards on the building and infrastructure, making it harder to maintain essential services during extreme events. Climate-resilient facilities can maintain operations during and after extreme weather events, ensuring continuous care for communities.
- Regulatory and Policy Requirements: Governments and international bodies are increasingly mandating climate resilience and sustainability measures in health care infrastructure.
- Improved Health Outcomes: By being prepared for climate-related shocks, health facilities can better protect public health, reducing morbidity and mortality associated with climate events.
- Cost Savings: Investing in resilience can lead to long-term financial savings by reducing damage costs and operational disruptions
- Community Trust and Safety: Resilient health facilities enhance community trust and provide a sense of safety, knowing that essential services will be available during crises.

2.4 Impacts on Healthcare Infrastructure of Climate Hazards

Climate hazards can have a variety of impacts on health infrastructure which reduce the ability of the facility to provide health services during and immediately after an extreme weather event.

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For example, building infrastructure can be affected by high winds damaging roofs and windows as well as damage due to fire spread or changes in ground conditions. Climate hazards can also affect the lifespan of buildings increasing the severity of carbonation and corrosion of structural elements.

Aside from the building itself, the infrastructure within, and supplied to, the building can also be affected. Water and electricity supplies can be affected by climate hazard either through physical damage such as floodwater intrusion causing short circuits or water contamination or demand surges during extreme weather events (e.g. AC during heatwaves).

Additionally, facilities rely on a number of systems and processes to function effectively, these can also be affected if appropriate planning and mitigation is not implemented by the management of the facility. These include medical information systems, evaluation a

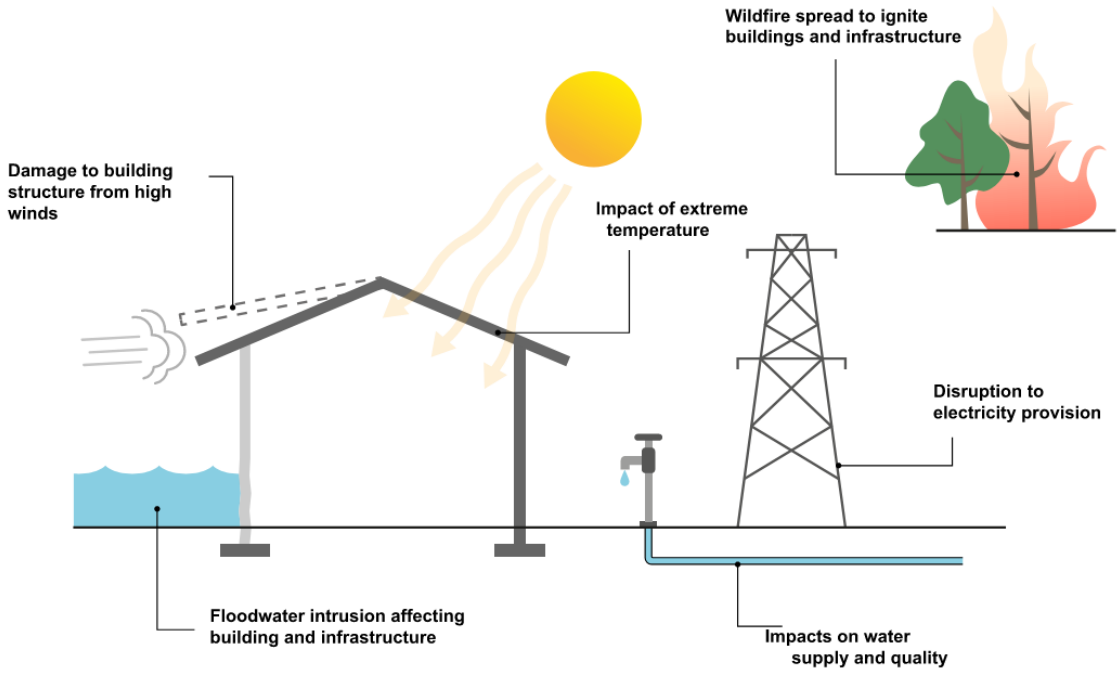

Figure 2: Potential Impacts from Climate Hazards

See Appendix 3 for more detail on the impact of climate hazards on different asset types.

3. Methodology

This section of the document sets out the development process and literature review.

3.1 Development Process

We developed the draft requirements through the following process:

1. **Produce a long list of documents** – we produced a long-list of documents for review including international guidelines and standards (e.g. WHO, World Bank); country

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specific guidelines or regulations from a range of countries for global benchmarking and academic publications.

2. **Prioritise documents based on relevance to scope** – we prioritised the long-list of documents to create a short-list for detailed review based on three aspects: 1) documents that specifically addressing physical infrastructure for healthcare; 2) documents that cover climate hazards relevant to CAREC countries; and 3) to ensure a diverse evidence base, other independent documents
3. **Set framework for organisation of requirements** – the requirements could be organised by climate hazard (e.g. Australasian Health Infrastructure Alliance, AHIA and US Department of Health and Human Services, USDHHS standards) or by asset type (e.g. WHO and Indian standard). We agreed with the ADB team to organise the framework by asset type to ensure that it is accessible to the end users who are likely to be responsible for the design and/or operation of a specific type of facility.
4. **Extract and organise requirements under each framework element** – we created a raw data list with references from each of the prioritised documents. We then amalgamated similar requirements from different documents to create a draft set of requirements.
5. **Categorise draft requirements** – we categorised the draft requirements by applicable climate hazard and by applicable facility type.

3.2 Literature Review

A literature review was undertaken to identify existing documents and guidelines which set out requirements for climate resilience in healthcare facilities. These were identified through pre-existing knowledge and research of the team, google keyword searches and review of academic papers (using the Arup in-house tool "Arup Discovery"). These are presented in the document registers provided in Appendix 1.

A prioritised shortlist of documents was selected for inclusion within the review of existing practice to include:

- 3 international guidelines
- 3 country specific standards
- 1 academic paper
- 1 "validation" document which is not healthcare specific

Documents were selected to represent a range of document types, to select

The documents selected are those highlighted red in the Document Register and are shown in Figure 3, below.

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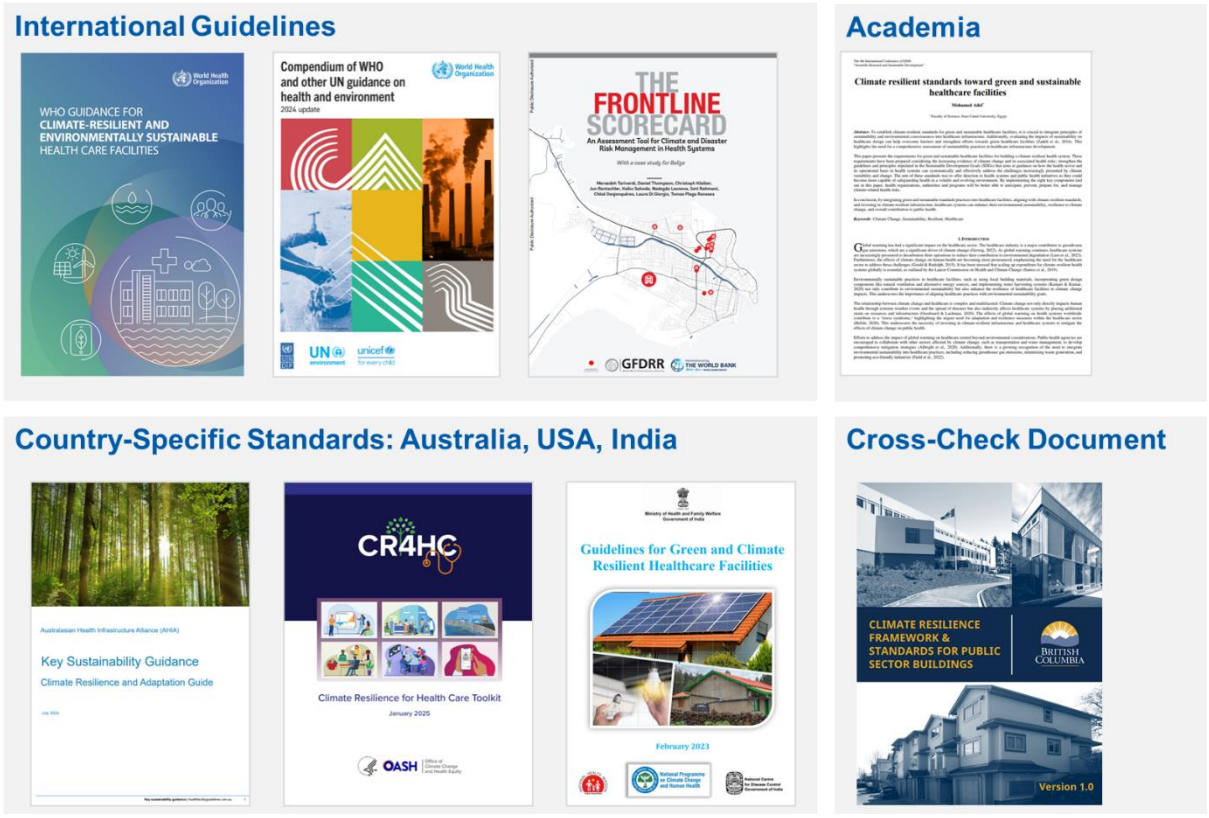

Figure 3: Reference Documents Used in the Development of the Minimum Requirements

4. How to use this document

This document outlines a set of requirements that health facilities can implement to enhance their resilience to climate-related hazards. Not all requirements will be applicable to every user or facility. It is essential for users to identify the areas most impacted by climate change to prioritize requirements that effectively mitigate these specific impacts, acknowledging the difficulty of addressing all climate risks across all time periods.

Therefore, users should review these requirements according to the criteria provided below to determine which measures will most effectively improve their facility's resilience.

4.1 Structure of the Minimum Requirements

Section 5 of this document sets out the requirements organised under five asset type headings:

1. Building infrastructure
2. Equipment & products
3. WASH & waste
4. Energy
5. Systems and processes

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Under each of these asset types, the requirements are further categorised by:

- Hazard type: Multi hazard or hazard-specific; and
- Phase of implementation: Design and Construction or Operation and Maintenance.

4.2 Selecting Relevant Requirements

When using this guide, the user should determine which of the requirements are pertinent to their specific context. This process should involve an assessment of several factors to ensure that the selected requirements are both applicable and effective.

The user should consider the following aspects:

- **Relevance of climate hazards:**

  Requirements which are specific to a climate hazard should be selected based on which hazards are prevalent in the location where the facility is situated and the level of hazard that the specific site is exposed to for each. Some requirements contradict other requirements and therefore, understanding which climate hazards present the highest levels of exposure to the facility is useful to prioritise interventions.

  A hazard exposure assessment should be conducted to determine the extent to which health facilities are exposed to various climate hazards over selected time periods. This assessment should use available hazard maps and models from local government authorities, such as flood data, maps, and wildfire hazard mapping considering also past hazard events which have occurred in that location. Existing hazard mapping and modelling should be reviewed to verify whether they represent current or future exposure based on climate change projections. If existing data or maps are not available, additional hazard and exposure mapping should be carried out for priority climate hazards. Geographic information systems (GIS) can be used to overlay climate hazard data and health facility location to facilitate analysis of relevant climate hazards.

  Once climate hazards have been identified, a risk analysis is required to qualitatively assess the likelihood and consequence levels for each risk impact. Climate risk is a function of hazard likelihood (likelihood of hazard occurring), vulnerability (impact on receptor if hazard occurs) and exposure (presence of receptor in location affected by the hazard). Risk criteria typically established at a Ministry level (or regional health agency, depending on government structure), define what level of risk is acceptable. These criteria should be based on a comprehensive understanding of potential impacts and be regularly reviewed and updated. This assessment can be done in line with established frameworks such as those provided in ISO 14091 and the assessed risks used to determine priority climate hazards. Stakeholder engagement is crucial to confirm the outcomes of the risk analysis (risk levels based on assessment of consequence and likelihood) and the priority risks for mitigation through the application of the minimum standards.

Risk analysis begins by identifying hazards and asset components, followed by a qualitative assessment of the likelihood and consequence levels for each risk impact. This produces a qualitative risk level using a risk rating matrix, which can align with established criteria like AS5334:2013 or existing risk management frameworks. For more complex scenarios, quantitative analysis and modelling are necessary to inform cost-benefit analyses and support decision-making for adaptation investments. These assessments estimate direct risks, such as financial loss from asset damage and life safety risks, as well as indirect risks like economic

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costs of downtime and community impacts. Qualified climate risk professionals should conduct these quantitative assessments.

Risk evaluation compares the determined risk levels with established risk criteria to prioritize risks for treatment. These criteria, typically defined at the enterprise level or per industry standards, outline acceptable, tolerable, or unacceptable risk levels. High-priority risks exceed the acceptable threshold and require treatment through adaptation planning. Stakeholder engagement is essential to validate the risk analysis outcomes and prioritize risks for treatment according to the organization's risk appetite and established criteria.

- **Phase of Implementation:**

  The stage of implementation will impact what the available scope of interventions. For example, some requirements highlight actions which require a specific set of construction works to be undertaken (either new buildings or alterations of existing buildings). While others should be integrated into regulation operation and maintenance practices. The relevance of these will depend on the scope of the proposed intervention or investment programme.

  Design and Construction: this can be works on either for proposed or existing buildings.

  – *New construction:* For new construction, requirements may reference incorporating resilient design principles and materials from the outset.

  – *Repair or retrofit of existing buildings:* When dealing with existing structures, requirements may reference assessment of the current condition of the building and identify areas that require strengthening or upgrading.

  Regular operation and maintenance: for facilities in regular operation, requirements may prioritise ongoing maintenance and operational practices that enhance resilience.

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5. Minimum Requirements

This section sets out the draft requirements, organised under the asset type headings of 1) Building infrastructure, 2) Equipment & products, 3) WASH & waste, 4) Energy, and 5) Systems and processes. Requirements are tagged to design and construction or operation and maintenance phases.

The proposed list of interventions does not cover every action that may be needed. However, this list provides a minimum set of interventions that would significantly increase climate resilience across short- and long-term horizons.

5.1 Building Infrastructure

Buildings Infrastructure refers to the physical structures and facilities that house healthcare services. It includes the design, construction, and maintenance of buildings such as hospitals, clinics, and laboratories.

5.1.1 All / Multi-Hazard:

Design and Construction

When constructing new infrastructure, consider a range of climate-related risk scenarios, such as flood, drought, prolonged rainfall, strong winds and heatwaves. Consult available climate data relevant to the facility's location.
Undertake and regularly update site specific assessments of climate hazard vulnerability and integrate findings into regular upgrade and maintenance programmes.
Design buildings adhering local building codes and standards. Where the relevant Building Codes are not yet considering climate change, exceeding these standards for hazard load cases (e.g. wind load) and climate conditions (e.g. temperature and rainfall) is recommended to ensure future resilience.
Integrate backup water, power and internal communication systems.
Undertake a holistic fire strategy which considers means of escape, detection, compartmentation, materials and firefighting requirements at site and building level.
Ensure windows are resistant to high winds, protected from the sun, and leak-proof.
Install vapour barriers and waterproofing to prevent water ingress.
Maximize green space on ground level and on facility roofs to mitigate heat and flooding considering constraints on water usage and fire load.
Provide and maintain safe, shaded pathways between the property line or patient drop-off point and the facility entrance for multiple modes of transportation
Ensure roof structure has sufficient capacity for loading from solar installations (including uplift).
Ensure roofing materials are securely fastened and maintain adequate roof drainage systems.
Construction or retrofitting considers corridors with exterior walls to maximize use of daylight and natural ventilation. Include openable windows with screens where appropriate (e.g. non-clinical areas).
Orient buildings to minimise exposure to prevailing winds and potential fire spread

Operation and Maintenance

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Conduct regular stress tests of the healthcare facility's ability to continue providing clinical care during extreme weather events.
Building is regularly inspected, both internally and externally, for signs of deterioration such as broken plaster, cracks or sinking structural elements, and the causes determined with appropriate remedial action taken.
Ensure Facility Emergency Plans are in place for staff to access, operate and maintain critical systems during climate events. The Plan should have a clear budget line and be known and understood by all staff to enable pre-positioning in advance of events.

5.1.2 Climate Hazard-Specific

Changes in temperature including extreme heat	Relocate HVAC systems into optimal spaces for efficiency (for example, well-ventilated shaded areas or within buildings).
	Introduce internal electrical load shedding capability in the building management system to turn off non-essential equipment when needed to ration power to critical equipment.
	Use building design strategies, like insulation and shading devices, to maintain safe temperatures inside the healthcare facility during extreme heat and cold events.
	Install reflective white roofs to reduce heat impact.
Wildfire	Orient buildings to minimise exposure to prevailing winds and potential fire spread
	Install native, drought- and wildfire-resistant landscaping at an appropriate distance from the building to reduce the production of fuel before a wildfire and the risk of erosion afterward
	Incorporate underground services where possible including power and communications and gas supply lines.
Flooding	Incorporate water-sensitive urban design infrastructure including porous paving/surface, rainwater tanks, desalination basins and swales
	Raise (essential) external services including sewage pumping stations and associated electricity supply to levels above future flood levels, accounting for climate change amplification over the life of the service (100 years +). This may require liaison with the utility supplier if outside the ownership of the facility.
	If locating in flood-prone areas is unavoidable, elevate new buildings, infrastructure and equipment above future flood levels to minimise the risk of inundation. If not possible to elevate the entire building, consider the level of key services and arrange layouts to minimise impact of water ingress into lower levels.
	Relocate and raise external switchboards. Location should ensure safe access during intense rainfall events
	Elevate internal power sockets on the ground level.
Extreme storms and cyclones	Ensure that the structure (including windows and roofs) are resistant to winds of at least 200–250 km/h.
	Use strategic placement of trees and shrubs to create buffer zones and minimise the impact of windborne debris on structure
Drought	Ensure foundations are designed to withstand changes in soil moisture content during drought conditions. Use deep foundations or pile systems to reach stable soil layers unaffected by drought induced subsidence
	Install moisture barriers beneath concrete slabs and foundations to prevent excessive moisture loss and soil shrinkage during drought periods

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	Monitor subsidence on and near the healthcare campus and modify facility infrastructure in affected areas to reduce the risk of disruption to utility and transportation infrastructure.

5.2 Equipment and Products

Equipment and Products encompasses all the tools and devices necessary for healthcare delivery. It includes:

- Medical Equipment: Devices used for diagnosis, treatment, and monitoring of patients (e.g., MRI machines, ventilators).
- IT Infrastructure: Systems for managing patient data, electronic health records, and telemedicine services.
- Essential Tools: Other necessary items like surgical instruments, laboratory supplies, and personal protective equipment (PPE).

5.2.1 All / Multi-Hazard

Design and Construction

Implement climate-resilient standards for healthcare facilities, such as providing natural shade for facility users to mitigate the impact of extreme heat events.

Operation and Maintenance

Secure equipment and supplies to satisfy the facility's demand for at least three days.
Store essential medical supplies, food, and fuel for 5–7 days to enable rapid deployment when extreme weather events disrupt supply chains and/or infrastructure.
Identify and prepare suitable storage space for additional supplies.
Maintain an updated inventory of equipment monthly.
Establish contingency agreements with vendors to ensure the procurement and prompt delivery of equipment, supplies, and other resources in times of shortage (e.g. clauses for priority access, expedited deliveries flexible payment terms).
Protect critical supplies such as emergency power, medicines, and patients' records, in case of flood.
Ensure backup arrangements for water, power, and oxygen.
Provide vaccine refrigerators with adequate holdover times through periods of power outages.
Store medical gases and chemicals securely in well-ventilated areas.
Purchase equipment and supplies locally when possible.
Train staff on effective procurement practices.
Establish procedures for procuring, storing, dispensing, and proper disposal of all pharmaceuticals.
Conduct preventive maintenance for building systems to ensure that service is not compromised during climate events.
Review and establish backup telecommunications channels to ensure power and communications outages are mitigated.
Regularly test emergency generators, water supplies, and transportation plans to ensure that they are ready to deploy in the event of an emergency.

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Integrate climate change projections into the organisation's supply chain emergency planning process.

5.2.2 Climate Hazard-Specific

Wildfire	Implement wildfire mitigation and smoke protocols.
Flooding	Place EMR servers in climate-controlled spaces above the flood line.
	Consider storage locations and setup in lower ground, basement, and ground floor levels to avoid flood damage to stored equipment or products.
Extreme heat / cold	Ensure that all critical equipment (e.g., HVAC systems, medical devices, refrigeration units) is specified to be rated for operation in expected temperature ranges that include relevant extreme heat and cold conditions.

5.3 Energy

Energy infrastructure in health facilities ensures a reliable and sustainable power supply. This includes:

- Electricity: For lighting, medical equipment, and IT systems. Prevent overloading during high demand periods and mitigate impact of power outages.
- Backup Power: Generators and alternative energy sources to maintain operations during outages.

5.3.1 All / Multi-Hazard

Design and Construction

Install and optimize hybrid energy systems - this includes renewable energy sources, batteries, and backup generators, ensuring they are optimized for on-site use.
Develop a comprehensive plan to address intermittent energy supplies or system failures. The plan should include provisions for an adequate backup energy source, to maintain continuity if the primary energy source fails during extreme weather events. For supplies which require uninterrupted supply (such as oxygen concentrators), install charger-inverters with automated transfer switches.
Power health care facilities with decentralized, renewable energy sources (e.g., solar photovoltaic cells with batteries) with sufficient capacity for essential installations such lighting, life-preserving equipment and provision of uninterrupted cold chain.
Install solar water heaters for provision of hot water for health care facilities
Design features that maximize natural ventilation such as high ceilings, large windows and skylights (without compromising the structural integrity of the building)
Assess the location of energy backup or renewable energy infrastructure for exposure to extreme weather events (such as strong winds, hail, floods).
Ensure mechanisms are in place to filter indoor and ambient air pollutants
Install voltage stabilizers to protect equipment from electrical damage that may be caused by voltage frequency fluctuations (when using a generator), or voltage surges (such as due to power transmission problems in the grid)

Operation and Maintenance

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Assess all heating, ventilation and air conditioning ductwork pipes, ensuring they are in good condition and supported adequately by the facility building structure at least once annually.
Perform regular audit processes for energy and loads.
Use devices to measure the heat and humidity for monitoring all the electrical equipment; and the results are documented and integrated into planning of maintenance.

5.3.2 Climate Hazard-Specific

Flood	For new installations ensure critical energy equipment is raised above future flood levels, accounting for climate change amplification over the life of the service (100 years +).
Wildfire	Clean and cool solar arrays during and after wildfire smoke events to reduce the risk of impaired performance caused by smoke residue
	Ensure that tanks containing combustible liquids (including fuel for generators) are accessible clearly marked and labelled and are a safe distance from key clinical and nonclinical facilities.
Extreme heat	Use building design strategies, like insulation and shading devices, to maintain safe temperatures inside the healthcare facility during extreme heat and cold events
Landslide	Consider utility routes to avoid landslide prone areas where possible (e.g. location of pylons and buried services)

5.4 WASH and Waste

WASH stands for Water, Sanitation, and Hygiene. This aspect covers:

- Water Supply: Ensuring clean and safe water for drinking, sanitation, and medical use.
- Sanitation: Proper facilities for waste disposal and sewage management.
- Hygiene: Practices and infrastructure to maintain cleanliness and prevent infections.
- Waste Management: Systems for disposing of medical and non-medical waste safely and sustainably

5.4.1 All / Multi-Hazard

Design and Construction

Undertake an assessment of climate change risks to the WASH infrastructure of health care facilities in place to identify where services (supply and sanitation) could be disrupted from floods, water scarcity, landslides, sea-level rise.
Water supply system has sufficient reserves or storage, with backup arrangement, to satisfy the facility's demand for at least three days, at all times.
Separate stormwater (i.e. rainwater) or greywater drainage system from blackwater systems (including contaminated water) so that stormwater can be diverted away from the facility into a safe drainage or leach field and does not carry contamination from the healthcare setting to the surrounding environment
Separate potable and process water systems from each other and source an emergency water supply to maintain water pressure during water outages
Install non-return valves on water supply and wastewater pipes to prevent back flows

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Long term water collection system in place with safe storage to ensure water access during extreme climate events (such as capturing rain during the monsoon season and storing water in tanks for use during the dry season)
Improved storage areas for storing extra waste generated through higher demands on health care facilities (such as in outbreaks or impacts from climate related events)
Waste pits are built to withstand climate events and emergencies

Operation and Maintenance

Plan in place for water system supplies (such as chlorine, filters or other water treatment technology, rapid water testing kit), during an emergency and disaster response.
Water supply and quality monitored regularly during emergencies to ensure adequate access throughout the duration of the event, ensuring that protocols are in place to guide rationing if required
Health care facility drinking water treated with a residual disinfectant to ensure microbial safety up to the point of consumption or use, especially after a flood related disaster
Health workforce trained to an appropriate standard to maintain the correct level of safety of water quality controls, supplies and alternative sources to the health care facility in both routine and emergency/disaster situations.
Ensure only authorized staff have access to waste storage areas, and waste is not stored for longer than the maximum storage times for infectious waste, which depend on the temperature
Increased health workforce knowledge on waste stream constituents and waste related health care hazards for better monitoring and control in climate related emergency situations
Health care waste transport (including health care facility hazardous waste) properly managed in case of extreme weather events

5.4.2 Climate Hazard-Specific

High winds	Water storage tanks supported and anchored to resist strong winds
Flood	Natural floodwater infiltration in place to reduce risk of facility flooding
	Planned schedule for emptying latrines in advance of flood seasons to avoid overflows
	Installation of sealed covers for septic tanks and non-return valves on pipes to prevent back flows
	Vents on sewers and septic tanks are above expected flood lines
Wildfire	Ensure that water storage tanks and covers are made from fire-resistant materials to prevent melting or burning during fire incidents, enhancing the facility's resilience to fire hazards.
Landslide	Consider water supply and drainage routes to avoid landslide prone areas where possible (e.g. location supply pipes, sewer lines and storage infrastructure)

5.5 Systems and Processes

Systems & Processes includes the operational frameworks that support the health facility operation:

- Maintenance processes: routine upkeep of facility assets.

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- Disaster risk management: planning for during and immediately extreme weather events.
- Operational Systems: Procedures and protocols required within the facility which support patient care, staff management, and facility maintenance.

5.5.1 All / Multi-Hazard

Design and Construction

Ensure clinical space allocation/design and supplied equipment and medication in the facility address the likely health issues arising from climate-related hazards. E.g. oxygen provision to address respiratory illnesses resulting from poor air quality.

Operation and Maintenance

Track national and/or local early warning systems to be notified of extreme weather events and enable prompt action. Implement mechanisms to notify healthcare facility staff, patients, and visitors of air pollution advisories and warnings.
Regularly update climate-related disaster risk reduction plans and train the health workforce on their implementation.
Define and implement security measures and evacuation plans for safe hospital evacuation during extreme events.
Create and update contingency plans for the transportation of personnel and critically ill patients during emergencies. Provide alternative transportation and housing for healthcare staff during extreme weather events.
Train facility staff on protecting their health and safety during emergencies. Train facility staff in increased clinical demand areas, such as post-traumatic stress disorder following climate-related events.
Have a communication plan in place between Heads of Department regarding critically ill patients and time decision-making to allow adequate time for each to respond accordingly to facilitate strong communication and patient safety.
Offer post-disaster support through multidisciplinary psychosocial teams for staff, their families, and patients. Engage the health workforce in community health programs to improve community health during particular climate risks.
Ensure rapid clean-up and recovery from extreme weather events to prevent indoor air quality issues like mould growth.
Supervise compliance with related laws and regulations, and work on improving environmental performance, carbon footprint, and climate resilience through a multidisciplinary committee
Implement measures to diminish disease burden of climate-related hazards by increasing health actions of staff and community through prevention and education programs. Train the health workforce to address climate change risks to health through WASH.
Raise awareness among the health workforce about approaches to childhood development and social outcomes related to nutrition and avoidance of stunting and impaired neurological development due to climate change impacts on water supply, food production, and infectious diseases.
Raise ongoing awareness among healthcare facility staff, patients, visitors, and the community about risks to health from climate-related hazards and effective health protection measures.
Coordinate across the healthcare system to redistribute staff to facilities they can access during transportation disruptions – even if they are not at their “home” facility. Ensure that staff have alternate transport plans and routes, as needed.

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Establish protocols for the healthcare facility's food service to respond and recover from an extreme weather event and food-borne outbreaks.
Identify minimum needs in terms of healthcare workers to ensure the operational sufficiency of every healthcare facility department in case of climate-related disaster or emergency.
Develop emergency standard operating procedures for extreme weather events including evacuation plans, disaster recovery steps, site preparation e.g. tree maintenance.
Enhance climate disaster preparedness by adding climate-related illness screening to the healthcare organization's electronic medical record system and increase analytical skills to identify changes in human health due to climate change.

5.5.2 Climate Hazard-Specific

Flooding / wildfires	Ensure patient medical records are safely stored, particularly in flood- and fire-prone areas, and have a plan in place for relocating hospital equipment, medicines, and medical devices during floods and fires or permanent relocation to higher floors..
Extreme heat	Schedule outdoor work for cooler parts of the day and reduce physical demands during hot days or heatwaves. Set staff expectations for their role during climate-related extreme weather events, including collaboration with local communities.

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6. Monitoring and Evaluation

This section provides a high-level process for countries to collect data on and report on progress in achieving the above requirements

To be further completed in Deliverable 4 following feedback from stakeholders via survey and workshop.

Phases of work	*Potential Progress Milestones*
Develop the Healthcare Infrastructure Baseline • to determine the condition and functionality of the portfolio of health facilities within the country	• Database of health facilities with relevant attribute data. • Climate hazard mapping
Creation of a Prioritised Investment Plan • based on the baseline analysis, create an intervention prioritisation framework for upgrade works to health facilities	• Costed intervention options • Prioritisation framework • Identified funding sources
Implementation of the planned investment • Procurement and delivery of works • Monitoring and evaluation of impact on health facility following climate hazard events.	• Percentage completion of works • Monitoring of facility downtime post climate hazard event.

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Appendix 1: Document Register

No.	Document Title	Author(s)	Date	Category	Link	Main content	Prioritisation
1	AHIA Climate resilience and adaptation guide	AHIA	Jul-24	Country Specific - Australia	Link	Climate risks for healthcare facilities and adaptation measures for new and existing facilities in Australasia	Selected for review
2	Envisioning the sustainable and climate resilient hospital of the future	Pascale et al.	2024	Academia	Link	Creates a vision of how future hospitals would look like	
3	Primary Protection - Enhancing Health Care Resilience for a Changing Climate	US DHHS	Dec-14	Country Specific - USA	Link	Climate risks for healthcare facilities, Hazard and Vulnerability assessment and Infrastructure solutions in US	Secondary priority
4	Safe, climate-resilient and environmentally sustainable health care facilities	WHO	03-Nov-24	International Guidelines	Link	Actions to achieve safe, climate-resilient and environmentally sustainable health care facilities	Same content as #11
5	Checklists to Assess Vulnerabilities in Healthcare Facilities in the Context of Climate Change	WHO	08-Apr-21	International Guidelines	Link	Checklist document supports users in establishing a baseline with regards to climate change resilience in health care facilities (Can be used to develop survey questions/ Indicators)	Secondary priority
6	Frontline Scorecard	WB	03-Apr-24	International Guidelines	Link	Country assessment tool that evaluates the resilience of a country's health system to natural hazards (disasters) and climate change	Selected for review
7	Resilience Strategies of Healthcare Facilities Present and Future	Achour et al.	01-Oct-10	Academia	Link	Explores UK healthcare resilience strategies; define gaps and provide suggestions based on international best practice	
8	Target setting for low carbon sustainable health systems	WHO	24-Sep-24	International Guidelines	Link	Advice and resources on how to set credible and ambitious decarbonization targets for low carbon sustainable health systems	
9	Report of the WHO South-East Asia Regional meeting on nutrition and climate	WHO	2025	International Guidelines	Link	Highlights the interlinkages between climate change, biodiversity, nutrition and its impact on health outcomes	

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No.	Document Title	Author(s)	Date	Category	Link	Main content	Prioritisation
	change 14–16 May 2024 Kathmandu, Nepal						
10	Compendium of WHO and other UN guidance on health and environment	WHO	03-Jul-24	International Guidelines	Link	Contains standards of climate resilient healthcare facilities	Selected for review
11	WHO Guidance for Climate-Resilient and Environmentally Sustainable Health Care Facilities	WHO	2020	International Guidelines	Link	Informs on indicators for climate resilient HCF	Selected for review
12	Operational framework for building climate resilient and low carbon health systems	WHO	09-Nov-23	International Guidelines	Link	Contains framework for implementing climate resilient and low carbon health systems	Secondary priority
13	Safe Healthcare Facilities	Nenkovic et al.	2024	Academia	Link	Defines a methodology of determining resilience of healthcare facilities through determining the hospital safety index and compares this climate change. Case study of a private hospital in Serbia	
14	Exploring context-specific perspectives: a qualitative study on building climate resilience health-care facilities in southeast Asias - a qualitative study	Gan et al.	2021	Academia	Link	Research focuses on the practical implementation of climate resilient facilities strategies	
15	ISO 14091	ISO	02-Mar-21	International Guidelines	Link		
16	NHS Net Zero Building Standard	NHS	22-Feb-23	Country Specific - UK	Link	Provides technical guidance to support the development of sustainable, resilient, and energy efficient buildings	
17	Climate Resilience for Health Care Toolkit	OASH	Jan-25	Country Specific - USA	Link	Has climate risks and strategies for mitigation for healthcare facilities	Selected for review
18	Towards Climate Resilient and Environmentally Sustainable Health Care Facilities	Corvalan et al	28 - Nov- 20	Academia	Link	Focuses on green energy for public hospitals in Philippines	

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No.	Document Title	Author(s)	Date	Category	Link	Main content	Prioritisation
19	Guidelines for Green and Climate Resilient Healthcare Facilities	National Centre for Disease Control, Govt of India	01-Feb-23	Country Specific - India	Link	Contains standards for climate resilient health facilities in India	Selected for review
20	Guidelines for climate-resilient and environmentally sustainable health care facilities in Fiji	Ministry of Health and Medical Services	01-Feb-20	Country Specific - Fiji	Link	Contains standards and monitoring for climate resilient health facilities in Fiji	Same content as #11
21	Climate resilient standards toward green and sustainable healthcare facilities	Mohamed Adel	01-Feb-24	Academia	Link	Presents the requirements and indicators for green and sustainable healthcare facilities for building a climate resilient health system.	Selected for review
22	The Climate Resilience Guidelines for BC Health Facility Planning & Design (Version 2.0)	Green Care	01-May-24	Country Specific - Canada	Link	Contains high level climate resilient strategies for health care facilities in BC	
23	Climate change resilient health facilities: a scoping review of case studies in low and middle-income countries	Schwerdtle et al	25-Jun-24	Academia	Link	Presents concrete examples of activities to build resilience under 11 elements in LMICS	Secondary priority
24	Learning from Practice: A Rapid Review of Climate Resilient and Low Carbon Health Systems Case Studies in Six Western Pacific Countries	Schwerdtle et al	04-Dec-24	Academia	Link	Assesses case studies of interventions implemented towards climate resilient and low carbon health systems in six Western-Pacific countries (Australia, Fiji, South Korea, Laos PDR, Mongolia, and Viet Nam) - Just list of documents reviewed. No examples of practical case studies	
25	Towards sustainable health facilities: Developing green, safe, and climate resilient design principles and practices for DOH hospitals in the Philippines	June Philip Obsania Ruiz	2020	Academia	Link	Focuses on green energy for public hospitals in Philippines	
26	Building climate-resilient WASH services in health-care facilities	WHO	2024	International Guidelines	Link	Provides instructions on how to conduct tabletop simulation on building climate-	

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No.	Document Title	Author(s)	Date	Category	Link	Main content	Prioritisation
						resilient WASH services in health-care facilities	
27	Health Care Facilities Resilient to Climate Change Impacts	Paterson et al	Dec-24	Academia	Link	Toolkit developed for health care facility officials to assess the resiliency of their facility to climate change impacts. Also Informs on indicators for climate resilient HCF	Secondary priority
28	Climate resilient and environmentally sustainable health systems special focus on health care facilities PPT	WHO	2020	International Guidelines	Link	Same as 11 (PPT for the document)	Same content as #11
29	Building Climate Resilient and Environmentally Sustainable Health Systems in Africa	WBG		Country Specific - Africa	Link	Focuses on climate resilient health systems	
30	Climate Resilience Framework and Standards for Public Sector Buildings	British Columbia (B.C.) Climate Action Secretariat	2023	Country Specific - Canada	Link	Comprehensive standards but not specific to healthcare facilities	Cross-check document

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Appendix 2: Climate Hazard Data Sources for CAREC Countries

The following tables extract climate hazard levels for CAREC countries from a number of data sources. This is not intended to represent a comprehensive multi-hazard risk assessment for each country, more to provide insight into a selection of the data that is publicly available in order to demonstrate that between them, CAREC countries are exposed to all climate hazards.

6.1 InformRISK 2025[4]

INFORM RISK

COUNTRY (a-z)	ISO3 (a-z)	River Flood (0-10)	Tropical Cyclone (0-10)	Coastal flood	Drought (0-10)
Afghanistan	AFG	7.3	0.0	0.0	8.7
Azerbaijan	AZE	6.6	0.0	0.0	5.3
China	CHN	9.3	7.8	9.0	4.6
Georgia	GEO	6.1	0.0	6.0	5.1
Kazakhstan	KAZ	7.6	0.0	0.0	6.1
Kyrgyzstan	KGZ	4.8	0.0	0.0	6.3
Mongolia	MNG	6.7	0.0	0.0	6.2
Pakistan	PAK	9.5	7.1	4.4	4.9
Tajikistan	TJK	6.6	0.0	0.0	7.6
Turkmenistan	TKM	8.3	0.0	4.3	5.0
Uzbekistan	UZB	8.3	0.0	0.0	6.6

[4] https://drmkc.jrc.ec.europa.eu/inform-index

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6.2 ThinkHazard! Climate Hazard Levels[5]

Country	River Flood	Urban Flood	Landslide	Wildfire	Water Scarcity	Extreme Heat	Cyclone	Coastal Flood
Afghanistan	High	High	High	High	High	High	Low	No Data
Azerbaijan	High	High	High	High	Low	Medium	No Data	No Data
China	High	High	High	High	High	High	High	High
Georgia	High	High	High	High	Low	High	No Data	No Data
Kazakhstan	High	High	High	High	Low	Medium	Very Low	No Data
Kyrgyzstan	Low	High	High	High	Medium	Medium	Very Low	No Data
Mongolia	High	High	High	High	High	Medium	Low	No Data
Pakistan	High	High	High	High	High	High	High	High
Tajikistan	High	High	High	High	Medium	Medium	Very Low	No Data
Turkmenistan	High	High	Low	High	High	High	Very Low	No Data
Uzbekistan	High	High	High	High	High	High	Very Low	No Data

[5] https://thinkhazard.org/

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Appendix 3: Climate hazard Impacts on Healthcare Infrastructure[6]

	External building structure	Internal assets (mechanical, electric)	Interdependent infrastructure	Building users and occupants
Changes in temperature including extreme heat	• Greater instances of superficial peeling, cracking and corrosion to facades including glazing and cladding, structures and surfaces • Greater instances of material degradation to facades, structures and surfaces	• Increased energy and water demand across the site • Higher frequency heating, ventilation and air conditioning (HVAC) system replacement requirements • Increased need to cool buildings or work sites • Increased stress on vital equipment and services (for example, elevators and plant) leading to greater response demands	• Deterioration of utilities (such as telecommunications and energy network) or increased incidence of blackouts/brownouts due to heat • Need for increased waste disposal or storage due to risk of pest, disease or nuisance risk with warmer conditions Impact to quality of water supply, with increased contamination and algae blooms • Impacts on landscaping and plantings, including loss of biodiversity and ecosystem function • Higher evaporation rates of water storage sites • Greater failure of transport infrastructure, making it difficult for staff and patients to access services	• Impacts on the thermal performance levels of buildings leading to reduced comfort levels for building occupants (patients, staff, visitors) • Unsafe working conditions due to extreme heat, with increased heat stress • An exacerbation of urban heat island effects affecting comfort and amenity • Health outcomes for vulnerable patients (for example, cardiovascular and respiratory conditions) compromised by exposure to hotter conditions inside building • Increased occupancy or load on services with extreme events • Staff unable to travel to work due to failure of support services – for example, road closures and transportation failure • Increased demand for outdoor respite and refuge areas resulting in insufficient capacity • Increased demand on the building as a potential area of respite
Wildfire	• Reduced accessibility to external wellness and recovery spaces • An accumulation of ash in roof drainage • Full or partial fire damage to buildings and public spaces	• Reduced air quality within internal areas • Smoke and embers affecting the ventilation and air-conditioning systems • Internal smoke damage as a result of unsealed areas	• Damage to infrastructure and assets that deliver public services (for example, buildings, telecommunications) • Impacts on landscaping and plantings, including loss of biodiversity and ecosystem function • Higher evaporation rates of water storage sites • Greater failure of transport infrastructure, making it difficult for staff and patients to access services • Higher levels of water contamination (for example, ash or fire retardant entering waterways) • Interrupted access to site due to road closures	• Health outcomes for vulnerable patients (for example, heart and respiratory conditions) compromised by exposure to hotter conditions • Increased occupancy or load on services with extreme events • Staff unable to travel to work due to failure of support services – for example, road closures and transportation failure • Increased demand on the building as a designated ‘safer place’ or evacuation centre • Increased demand on emergency services and health services, including increased hospital presentations

[6] Derived from AHIA, Climate Resilience and Adaption Guide

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	External building structure	Internal assets (mechanical, electric)	Interdependent infrastructure	Building users and occupants
Flooding	• Full or partial flood damage to buildings and public spaces • Increased levels of rain/moisture penetration in the building and facades affecting durability and functionality • Greater strain on drainage systems • Floodwater intrusion increasing degradation of building materials (for example, foundations)	• Higher frequency HVAC system repair/replacement requirements • Internal flood damage as a result of unsealed areas • Damage to underground services (for example, plant machinery, car parking) during flooding requires more frequent repair or replacement • Damage to ground floor services (for example, plant machinery) during flooding requires more frequent repair or replacement	• Damage to infrastructure and assets (for example, buildings, telecommunications) • Impact to water quality and water supply with contamination • Greater failure of transport infrastructure, making it difficult for staff and patients to access services • Sewerage services can be disrupted if sewerage pipes are compromised during flooding (for example, sewerage back flow) • Interrupted access to site due to road closures	• Increased occupancy or load on services with extreme events • Ponding of water can increase disease risks, particularly from vector-borne diseases and impact on vulnerable building users • Staff unable to travel to work due to failure of support services – for example, road closures and transportation failure • Increased demand on the building as a designated 'safer place' or evacuation centre • Increased demand on emergency services and health services, including increased hospital presentations
Drought	• Degraded building foundations and other below-ground infrastructure (for example, wiring) as a result of decreased soil moisture	• Degraded integrity of building materials (for example, adhesives, wiring) as a result of warmer and drier conditions	• Damage to infrastructure and assets (for example, buildings, telecommunications) • Reduced access to water leading to potential restrictions, particularly affecting irrigation • Higher levels of water contamination and algae	• Increased occupancy or load on services with extreme events
Extreme storms and cyclones (including dust and sand)	• Increased storm and hail damage to building structure and façade • Increased levels of rain/moisture penetration • Structural damage due to greater wind load being exerted on assets Greater strain or loss on building fixtures, fittings and fastenings • Damage from unsecured debris	• Increased levels of rain/moisture penetration into buildings and assets • Reduced air quality within internal areas • Dust and sand affecting ventilation and air-conditioning systems • Internal wind/rain/dust/sand damage as a result of unsealed areas	• Impact to water quality and water supply • Interruption to power supply and communications • Impacts on the transport network reducing accessibility • Sewerage services can be disrupted if sewerage pipes are compromised during flooding	• Increased occupancy or load on services with extreme events • Staff unable to travel to work due to failure of support services – for example, road closures and transportation failure • Impacts on the spread of water-borne diseases and distribution of pest species affecting vulnerable users • Increased incidence of hospital presentations including mental health and emergency department presentations • Increased safety issues for patients, visitors and staff (including operations and maintenance staff) • Increased demand on the building as a place of refuge and/or as a designated evacuation centre
Humidity	• Accelerated carbonation of concrete structures, which decreases the durability of concrete structures • Greater instances of material degradation to facades, structures, and surfaces	• Build-up of mould and condensation leading to increased operations and maintenance requirements and costs • Increased energy demand across the site	• Interruption to power supply and communications • Impacts on the transport network reducing accessibility to buildings	• Increased occupancy or load on services with extreme events • Changes in relative humidity resulting in decreasing thermal comfort resulting in health impacts or decreased productivity • Impacts on the spread of water-borne diseases and distribution of pest species affecting vulnerable users

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	External building structure	Internal assets (mechanical, electric)	Interdependent infrastructure	Building users and occupants
		• Internal moisture damage as a result of unsealed areas and air leaks		
Coastal inundation and erosion	• Drainage capacity issues for buildings and hard landscaping • Corrosion of exterior infrastructure from salt spray (for example, concrete) • Saltwater intrusion, contaminating water sources, increasing degradation of building materials (for example, foundations) • More frequent and higher storm surges, including localised flooding causing damage to assets and higher maintenance costs • Increased coastal erosion impacting on building foundations • Drainage capacity issues for buildings and hard landscaping	• Internal water damage as a result of unsealed areas • Increased levels of moisture penetration • Higher frequency HVAC system repair/replacement requirements	• Damage to infrastructure and assets (for example, buildings, telecommunications) • Sewerage services can be disrupted if sewerage pipes are compromised during coastal inundation • Impact to water quality and water supply with contamination of salt water • Greater failure of transport infrastructure, making it difficult for staff and patients to access services	• Increased occupancy or load on services with extreme events • Staff unable to travel to work due to failure of support services – for example, road closures and transportation failure • Increased demand on the building as a designated ‘safer place’ or evacuation centre

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