Impact-Based Forecasting Impact Tables

Refinement of Impact Tables & additional tools/resources which can help with the assessment of risk in an IBF approach

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Rainfall Impact Table

Example of impacts relating to the severity, extent, duration

Sector ↓ / Impact Level →	Minimal Impacts (Very Low)	Minor Impacts (Low)	Significant Impacts (Medium)	Severe Impacts (High)
Risk to life	No risk	Injury from fast flowing water or falling debris possible	Possible danger to life	Extensive search and rescue operations needed. Many regions/municipalities evacuations needed. Danger to life is expected from fast flowing deep water
Transport	Some traffic congestion. Small delays.	Airport: Delay-hours? Road: Traffic congestion, water on roads, driving conditions affected by water, slight delays. Water: Southwest region: delays (short term few hours)?	Airport: Long delays/some cancellations? Roads: Significant damage of several village roads (mud) Vehicles submerged under water	Prolonged closure airports/ports? Days? Weeks? Several international airports closed? Roads: Complete destruction of several village roads (mud)
Utilities	Power interruptions	Power loss, temporary. Hours?	Significant power loss across several areas/regions? Hospitals/school affected?	Destruction of power sources. Long power loss to important sectors (hospitals)days/weeks?
Agriculture/ Fishing	Slight damage to fishing boats	Slight damage to plantations during season. Slight to moderate damage to fishing boats	Large areas of damage to plantations during season. Severe damage to fishing vessels.	Widespread loss, complete destruction of whole harvests and plantations. Complete damage or loss of fishing and ship vessels?
Communications	Some areas may see temporary communication interruptions	Some areas may see temporary communication interruptions	Communication interruptions for large areas	Complete loss of Communications weeks?
Communities	Isolated slight flooding of low-lying areas, small damage.	Areas cut off temporarily, slight damage to houses and building structures	Areas cut off for several days. Partial damage to houses and building structures	Widespread: more than two local municipalities affected. Complete loss or widespread damage to houses and building structures across several areas.

Example

Rain National Severe Weather Warning (UK)

Escalation of extent of flooding from BaU (those in susceptible or flood prone locations) to highly disruptive (widespread flooding of homes and businesses) – all derived from "flooding" as the overarching impact

Escalation of impacts of spray and standing water on roads, again localised in the very low impact column, to dangerous levels in the high impact – but all essentially derived from the same initial impact "road conditions/driving conditions"

Very Low	Low	Medium	High
A few places will have flooding of low-lying land and susceptible roads.	Some flooding of homes and businesses and susceptible roads	Flooding of homes and businesses.	Widespread flooding of homes and businesses.
		Danger to life from fast flowing/deep water.	Danger to life from fast flowing/deep water.
		Damage to buildings/ structures.	Extensive damage to and/or collapse of buildings/ structures.
A few transport routes affected.	Some transport routes and travel services affected. Some journeys require longer travel times.	Transport routes and travel services affected. Longer journey times expected. Some road closures.	Transport routes and travel services disrupted for a prolonged period. Long travel delays. Widespread road closures.
Road conditions affected with spray and some standing water in a few places.	Road conditions affected by spray and standing water.	Difficult road conditions due to spray and standing water.	Dangerous driving conditions due to spray and standing water.
	Short term disruption to utilities and services in some places.	Interruption to utilities and services.	Prolonged disruption to or loss of utilities and services.
		Some communities temporarily inaccessible due to flooded access routes.	Communities become cut off for a prolonged period, perhaps several days, due to flooded access routes.

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That’s not quite the end of it…

- How do we consider the thresholds / tipping points at which these impacts, at different levels might occur?
- What vulnerability and exposure considerations are there?
- How do these vary spatially or temporally?
- How do we document and understand these elements?
- **These are all vitally important questions in the creation of impact tables!**

Aim

To further explore the use additional tools and/or resources, to support the impact assessment in an IBF approach to forecasts and warnings.

Objectives

By the end of this session delegates will have had the opportunity to…

- Discuss the assessment, and impact of (dynamic) vulnerability and exposure, in the issuance of Impact-based Forecasting
- Consider methodologies to document and account for these considerations, to aid decision making related to overall risk assessment in an IBF approach

How do we know when impacts are likely to (start) occurring?

Thresholds

Rainfall Impact Table

Sector ↓ / Impact Level →	Minimal Impacts (Very Low)	Minor Impacts (Low)	Significant Impacts (Medium)	Severe Impacts (High)
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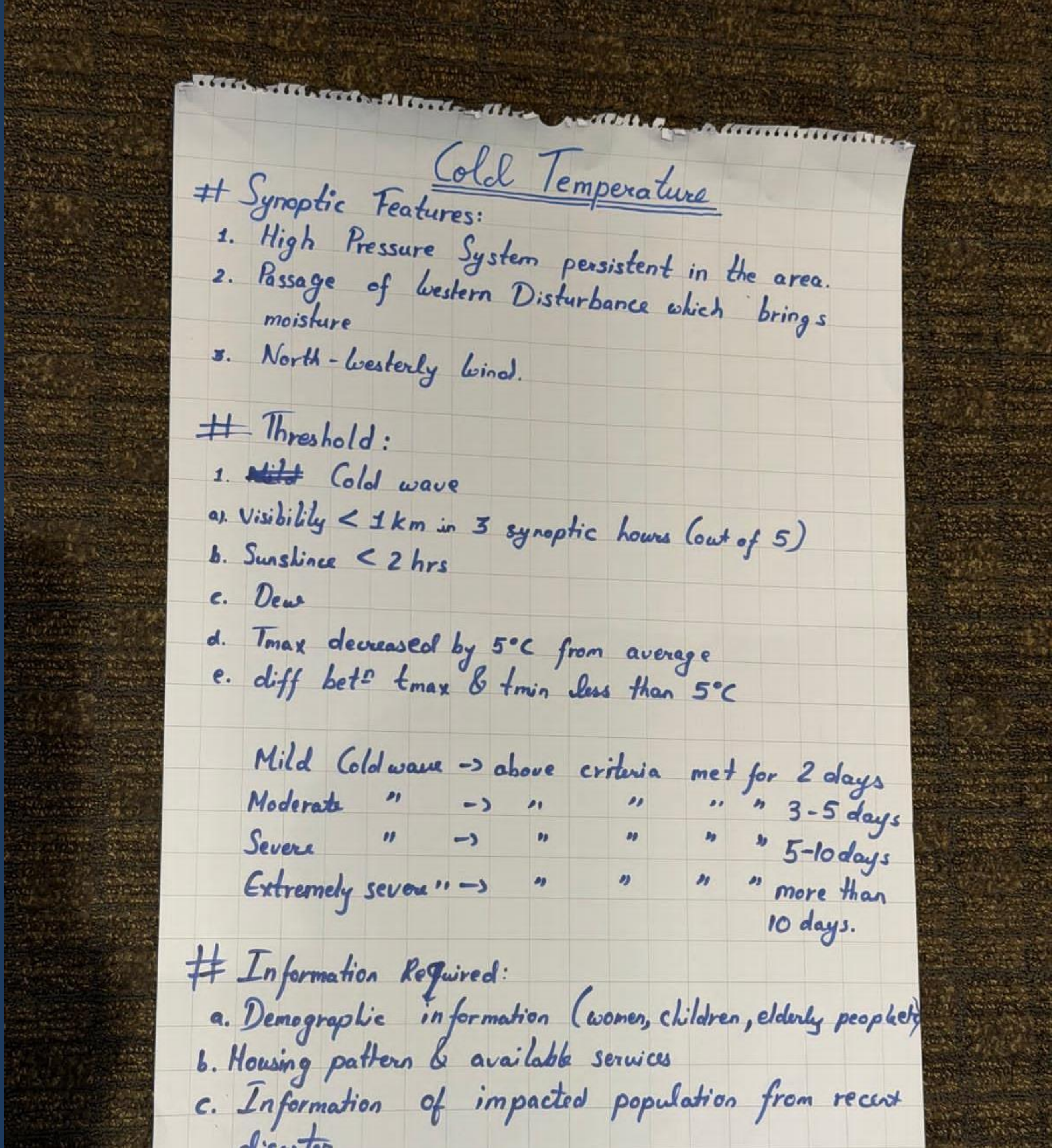
1-hour Rainfall > 20mm (urban etc) 6-hour Rainfall > 50mm

1-hour Rainfall > 30mm 6-hour Rainfall > 100mm

1-hour Rainfall > 40mm 6-hour Rainfall > 200mm

Thresholds

Example from Nepal (in development)


Cold Temperature

Synoptic Features:
1. High Pressure System persistent in the area.
2. Passage of Western Disturbance which brings moisture
3. North-Westerly Wind.

Threshold:
1. ~~Mild~~ Cold wave
a) Visibility < 1km in 3 synoptic hours (out of 5)
b. Sunshine < 2 hrs
c. Dew
d. Tmax decreased by 5°C from average
e. diff betⁿ tmax & tmin less than 5°C

Mild Coldwave -> above criteria met for 2 days
Moderate " -> " " " " 3-5 days
Severe " -> " " " " 5-10 days
Extremely severe " -> " " " " more than 10 days.

Information Required:
a. Demographic information (women, children, elderly people etc)
b. Housing pattern & available services
c. Information of impacted population from recent disaster

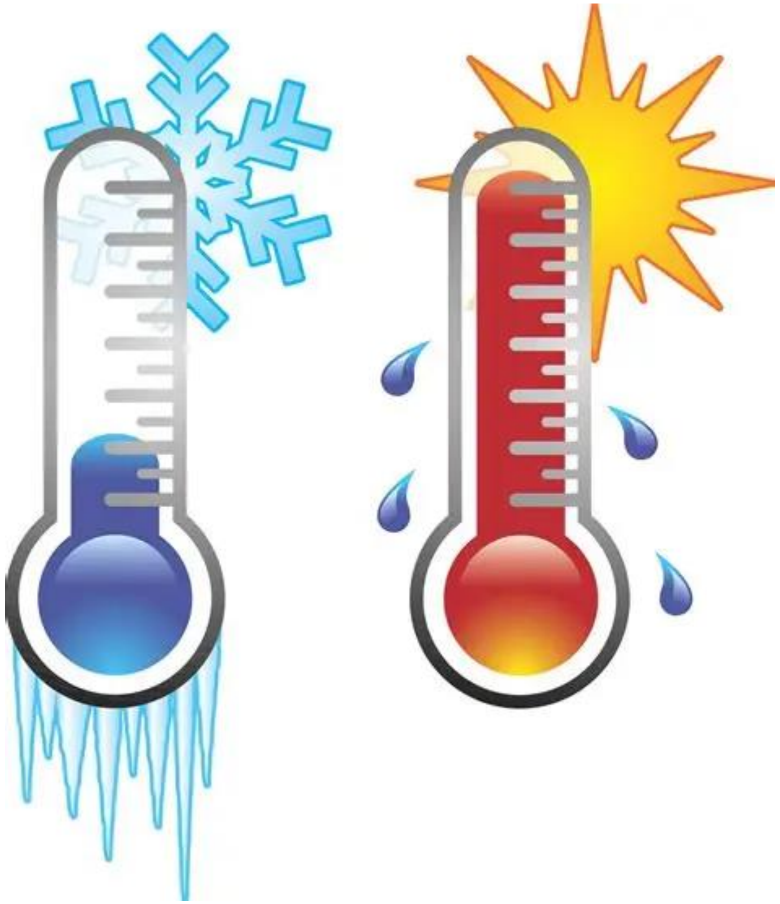
How do we create thresholds? What values should be used?

Thresholds for temperature related hazards

- What sector(s) are you warning for? What temperatures are important to those sectors?

- Do you, or sectoral representatives, have evidence for impacts relating to temperatures previously?

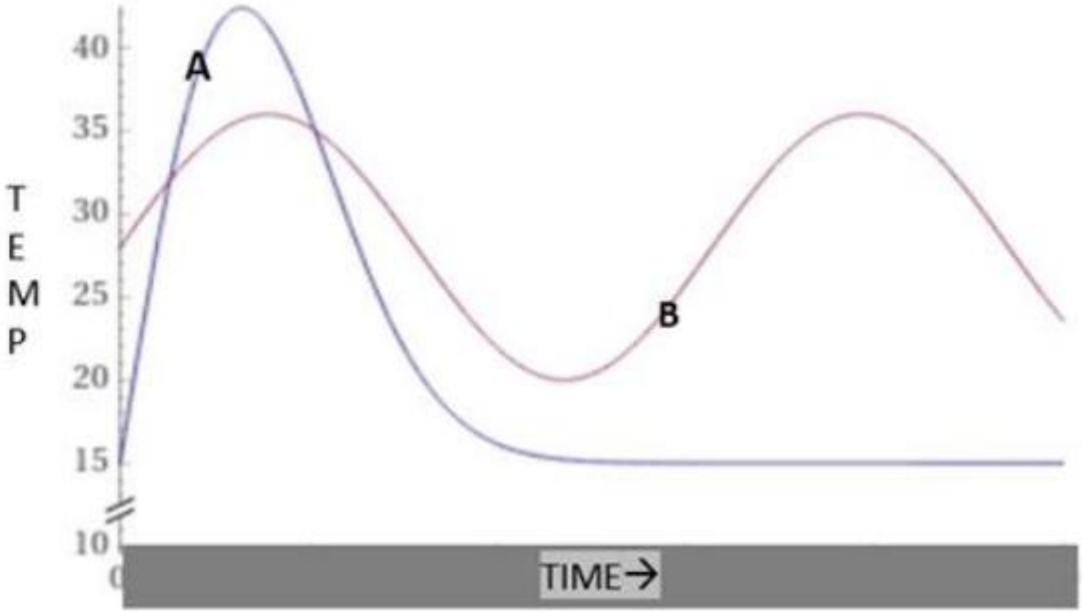
- **Consider;** duration of event, extremity of the heat or cold, location of the event, seasonality (what is normal at one time of the year may not be so at another).



Thresholds for temperature related hazards

Duration / longevity of an event;

- Absolute maximum temperatures (and record-breaking highs) not necessarily best tracer of impacts.
- In general, localised and intense short-lived heat (like curve A) are likely to be less impactful than longer duration, widespread, but slightly less intense events (like curve B).



Thresholds

Thresholds may give us a first "estimate" of potential impacts and may be what meteorologists use to first realise the potential need for an IBF warning...

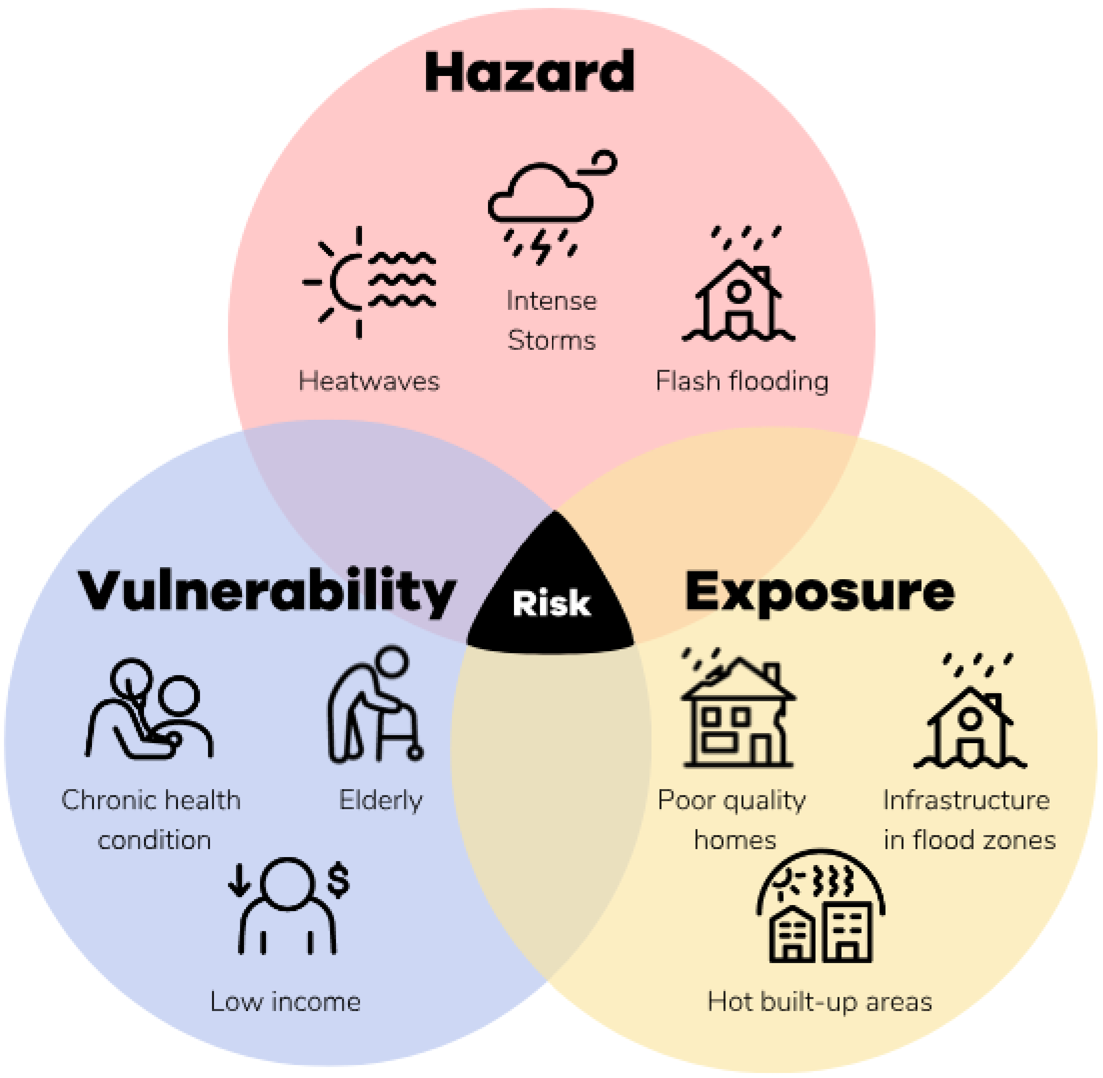
BUT

What else do we need to consider?

What is exposure in an IBF context?

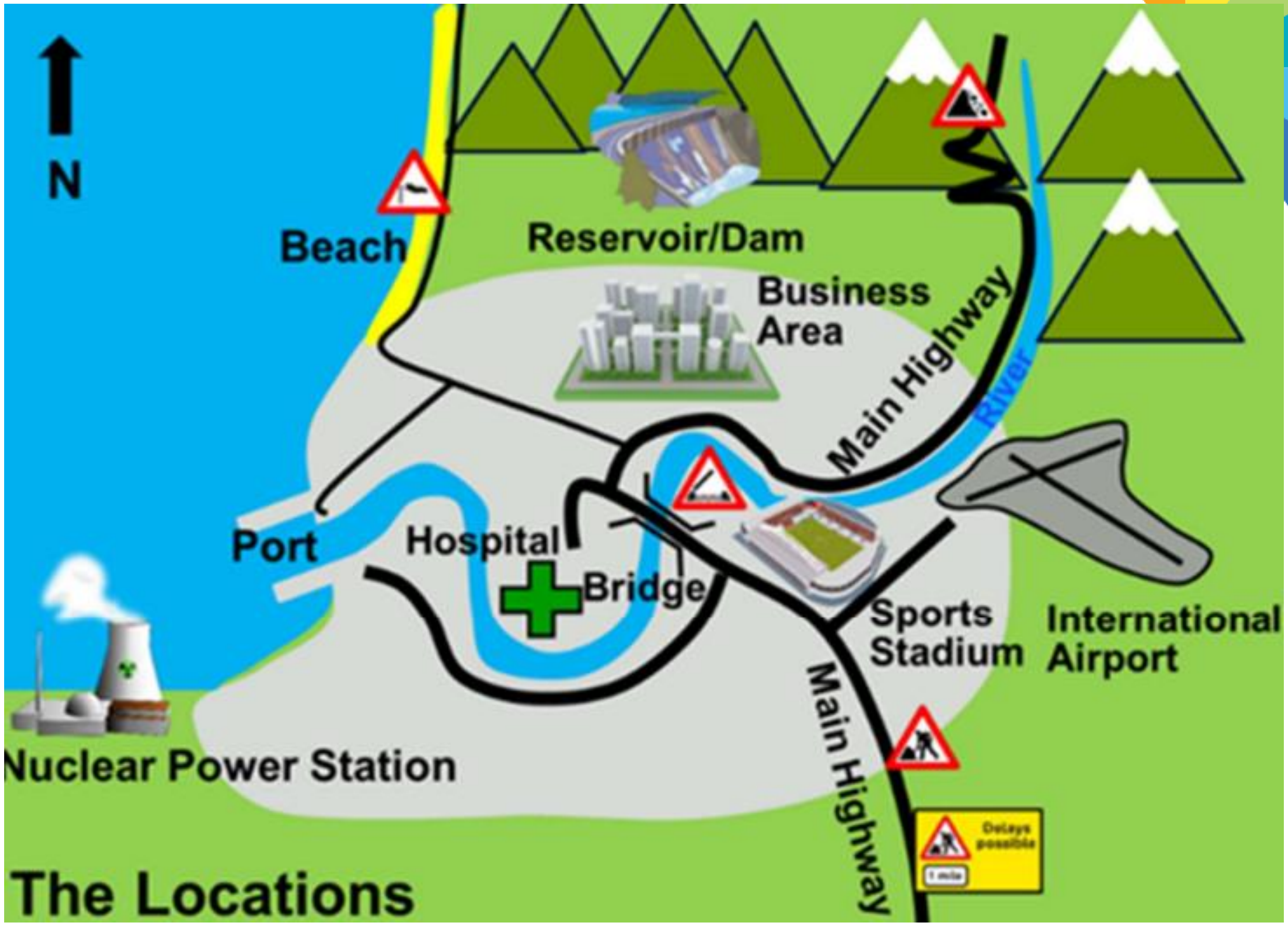
Exposure

People, property or systems, or other elements, present in hazard zones that are therefore subject to potential losses.



Exposure

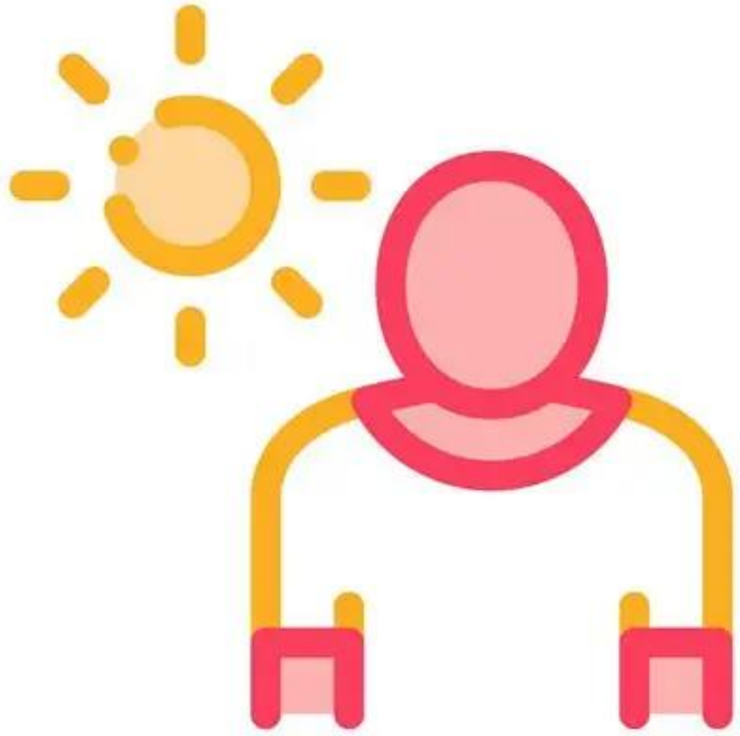
Exposure may vary depending on the hazard in question (i.e. different locations exposed to one hazard and not another, or to a greater or lesser extent).



How can we understand (and document) exposure?

Exposure

- What datasets and resources are available to quantify the level of exposure in your national demonstration sites?
- Does the exposure change in an area (e.g., seasonally)?



Answers

- Exposure databases / datasets
- Participatory mapping
- Local focal persons and contacts
- SOPs and best-practice documentation
- Seasonal calendars (e.g., cropping calendars, health data etc.,)

What is vulnerability?

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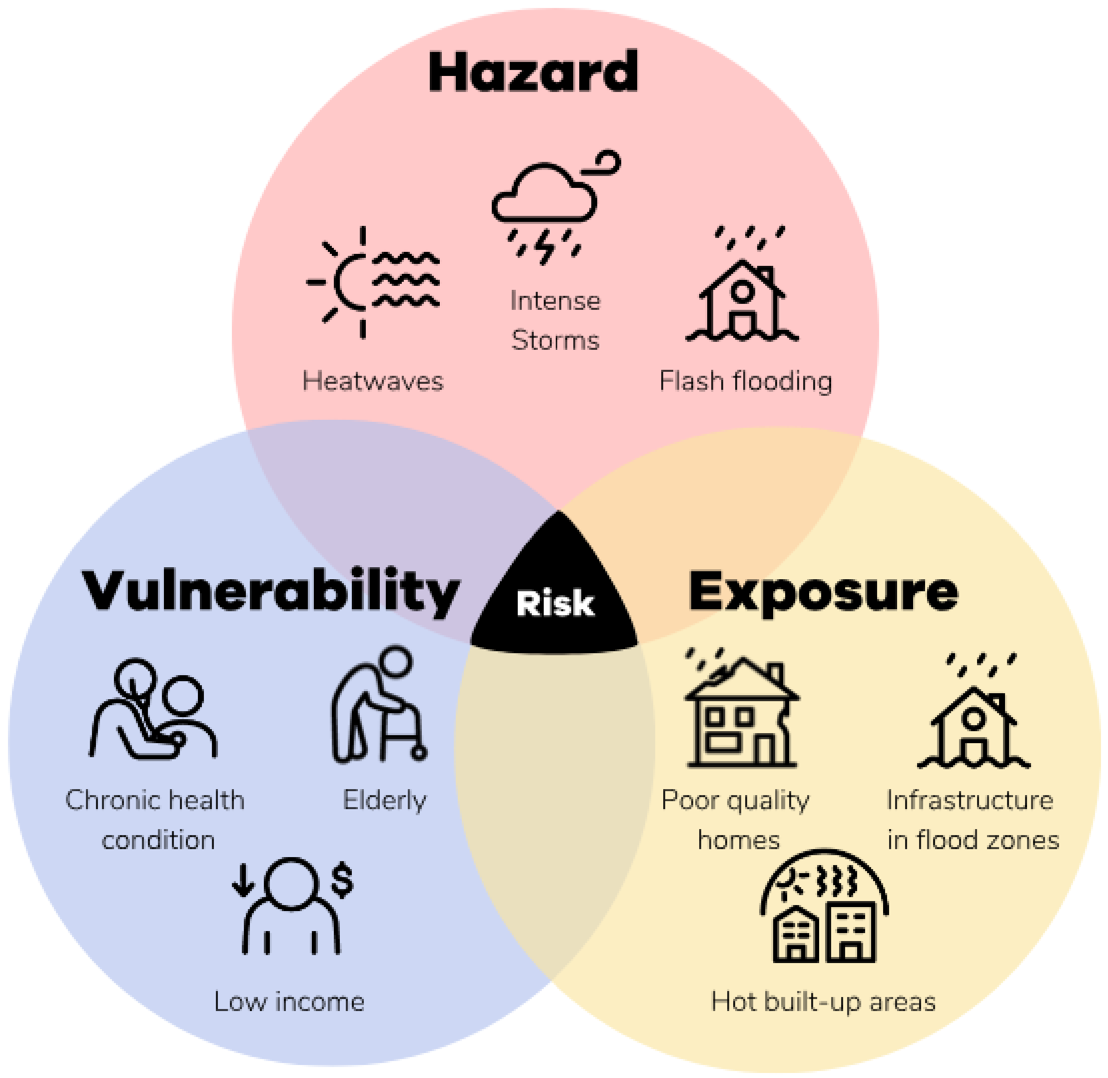
Vulnerability

The characteristics of a community, system or asset that make it susceptible to the damaging effects of a hazard.



Vulnerability

- What datasets and resources are available to help quantify the vulnerability in your national demonstration sites?
- Does vulnerability change?
- How can we account for dynamic vulnerability?

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Answers - Vulnerability

- Participatory mapping (where are the more vulnerable population centres)
- Focal persons in key sectors (those most impacted/most vulnerable to temperature hazards)
- Regular review and updating as vulnerability/resilience of areas/populations change
- Seasonal variation (e.g., temporary migration)

Vulnerability

- What datasets and resources are available to help quantify the vulnerability in your national demonstration sites?
- Does vulnerability change?
- How can we account for dynamic vulnerability?

Answers - Vulnerability

- Local focal persons and/or feedback mechanisms and loops (dynamic vulnerability) – and a way of recording this.
- How do we factor this into our ways of working and forecast process?
- Are there examples to share?

Confidence

Assessing Likelihood…

- What do(es) the user(s) need?

- Do we need to use the warning to highlight the most likely scenario or the reasonable worst-case (RWC) scenario?

What does
“*most likely*”
and
“*reasonable worst case*”
mean?

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Assessing Likelihood (from a UK experience)

Most likely

- The scenario we feel is most likely to occur.
- Perhaps the most likely scenario is most appropriate when there is a large-scale synoptic system which looks likely to produce impacts across a large area.
- Details, area and timing will still be subject to uncertainty but there is the potential for a particular level of impacts to be widespread.
- This doesn't preclude the possibility of very localised impacts at a higher level.

Reasonable Worst Case

- The scenario "designed to exclude theoretically possible scenarios which have so little probability of occurring that planning for them would be likely to lead to a disproportionate use of resources".
- Typically, the scenario which it is felt could feasibly occur although is not considered the most probably outcome.
- Appropriate to use when there is a low point probability of medium or high impacts at any one location, but when considered helpful to alert public and responders to that possibility.

Summary

- To be able to effectively assess the potential severity of the impact (and the likelihood of it occurring) additional information is required; typical thresholds of concern, vulnerability and exposure.
- This information should be documented and routinely referred to, updating as relevant.
- For national demonstrations, key invitees should include those who can support an assessment of exposure, vulnerability and provide ongoing engagement regarding dynamic vulnerability).

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Group Exercise

Groups (ToT)

For your national demonstration projects;

- **Step 1** – completed as a general group
- **Step 2** – completed by sectors OR depending on numbers and/or who the warning is for, by target warning area.
- **Step 3** – again target warning dependent, by group or by sector. Important thing is to document what is relevant to stakeholders.

For the purpose of the exercise today you will *complete in country groupings.*

Participatory Mapping

Step 1

- Draw a map of the demonstration area(s)*
- Mark any key physical or human features (e.g., urban areas, rural areas, roads, bridges, rivers, forests, schools, hospitals, transport hubs etc.,)
- This is the ***exposure*** (the people and assets present in a setting which may be exposed to the hazard).

**For any national demonstration workshops you can pre-print maps of the areas in advance and have stakeholders annotate these.*

Participatory Mapping

Step 2

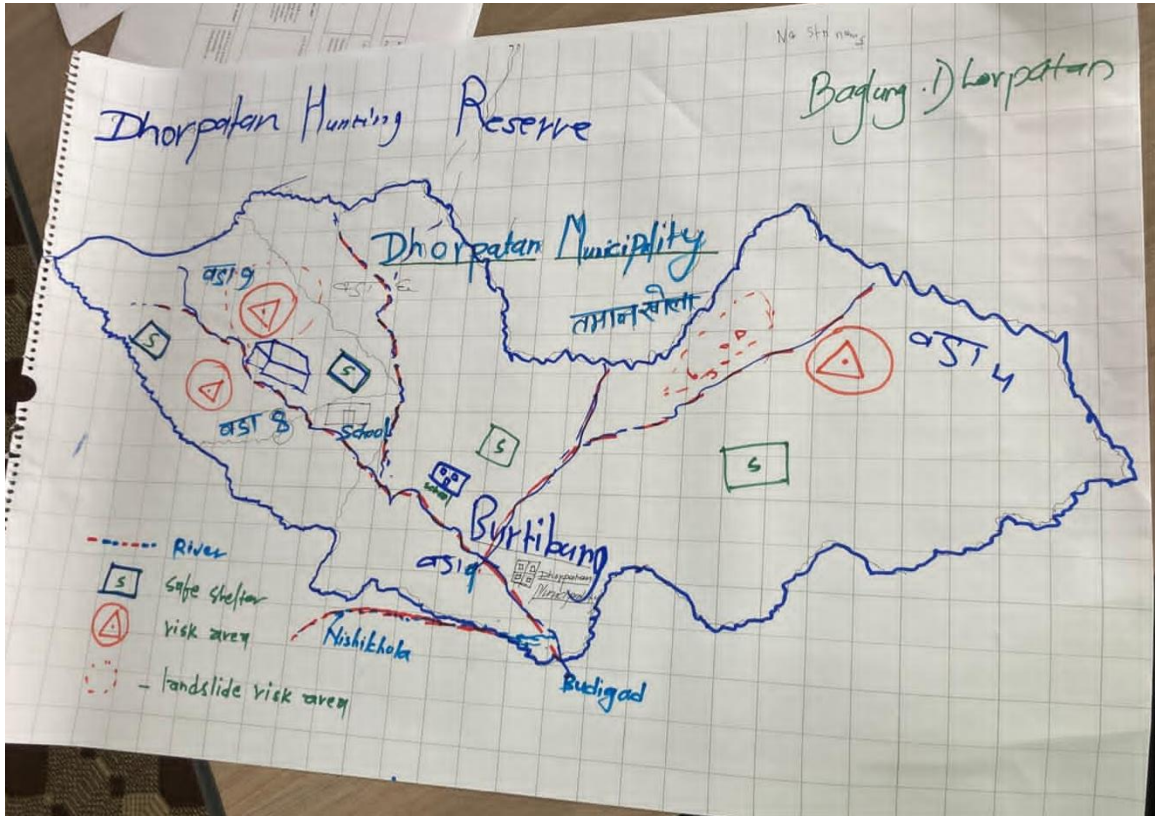
- Decide whether you have enough stakeholders to do this by sector (best as you get more detail) or by general population (which may be more relevant if a public warning than a sector warning)
- Document who / what is vulnerable to the temperature hazard in this area
- Are there areas of increased vulnerability (e.g., large GEDSI vulnerable populations)?
- Are there dynamic vulnerabilities to consider (e.g., time of the day, time of the year – how does “normal” change)?

Participatory Mapping

Step 3

- Threshold discussion
- NHMSs should share the thresholds they consider to be relevant
- Allow for open conversation and debate on what thresholds are relevant for stakeholders (i.e., high temperatures may impact on transport before they impact health – if not prolonged)

Example Maps



Summary

- Participatory mapping can be very effective in gathering the relevant information which may not be formally available in databases.
- Encourages buy-in and engagement from stakeholders and reinforces the consideration of shared-ownership in an IBF warnings approach.
- These maps should not be treated as static, dynamic vulnerability is a key component in a IBF framework and mechanisms should be in place to encourage routine dialogue during hazard seasons.

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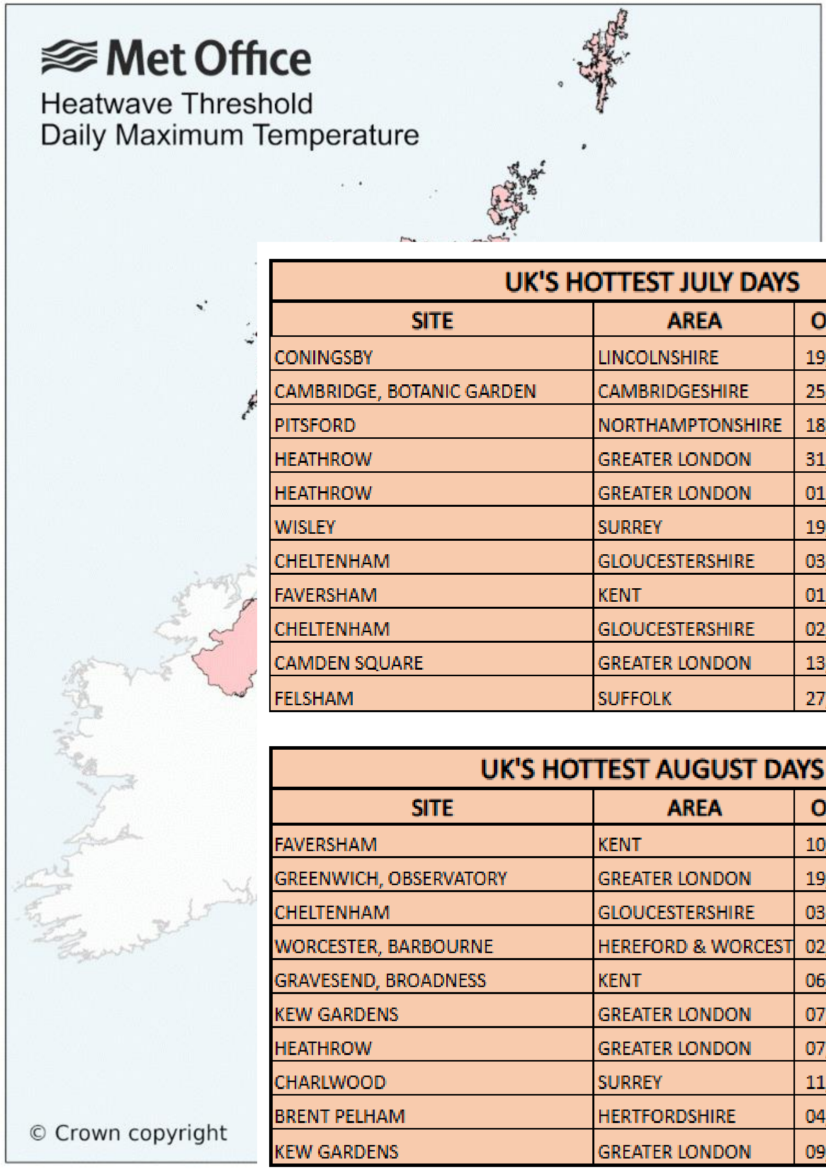
Heat Warnings in UK

Heat in UK…

1. **Extreme Heat Warning** – an impact-based warning designed to highlight the potential impacts of extreme heat to protect lives and property, helping people make better decisions to stay safe and thrive.
2. **UK Health Security Agency (UKHSA) Heat Health Alert** - An England only service considering the impact of prolonged extreme heat on public health, especially those with long-term health conditions.
3. **Heatwave definition** - a threshold-based meteorological definition designed to provide the media and public with consistent and reliable messaging.

A UK **heatwave threshold** is met when a location records a period of at least three consecutive days with daily maximum temperatures meeting or exceeding the heatwave temperature threshold.
The geographical differences reflect the differences in climate across the UK. The threshold temperatures have been calculated using the 1991-2020 climatology of daily maximum temperature at the mid-point of the meteorological summer (15 July).



UK'S HOTTEST JULY DAYS			
SITE	AREA	OB DATE	MAX TEMP
CONINGSBY	LINCOLNSHIRE	19/07/2022	40.3
CAMBRIDGE, BOTANIC GARDEN	CAMBRIDGESHIRE	25/07/2019	38.7
PITSFORD	NORTHAMPTONSHIRE	18/07/2022	38.2
HEATHROW	GREATER LONDON	31/07/2020	37.8
HEATHROW	GREATER LONDON	01/07/2015	36.7
WISLEY	SURREY	19/07/2006	36.5
CHELTENHAM	GLOUCESTERSHIRE	03/07/1976	35.9
FAVERSHAM	KENT	01/07/2025	35.8
CHELTENHAM	GLOUCESTERSHIRE	02/07/1976	35.7
CAMDEN SQUARE	GREATER LONDON	13/07/1923	35.6
FELSHAM	SUFFOLK	27/07/2018	35.6

UK'S HOTTEST AUGUST DAYS			
SITE	AREA	OB DATE	MAX TEMP
FAVERSHAM	KENT	10/08/2003	38.5
GREENWICH, OBSERVATORY	GREATER LONDON	19/08/1932	37.2
CHELTENHAM	GLOUCESTERSHIRE	03/08/1990	37.1
WORCESTER, BARBOURNE	HEREFORD & WORCEST	02/08/1990	36.6
GRAVESEND, BROADNESS	KENT	06/08/2003	36.4
KEW GARDENS	GREATER LONDON	07/08/2020	36.4
HEATHROW	GREATER LONDON	07/08/2020	36.4
CHARLWOOD	SURREY	11/08/2020	36.2
BRENT PELHAM	HERTFORDSHIRE	04/08/1990	36.1
KEW GARDENS	GREATER LONDON	09/08/2003	36

Weather Warning and Alerting Co-production in action….

https://assets.publishing.service.gov.uk/media/67f3aeaed3f1efd2ce2ab897/WHA_User_Guide.pdf

GRN: Summer / winter preparedness
YLO: Response
AMB: Enhanced Response
RED: Emergency Response

Figure 1. Typical cascade of Weather-Health Alerts

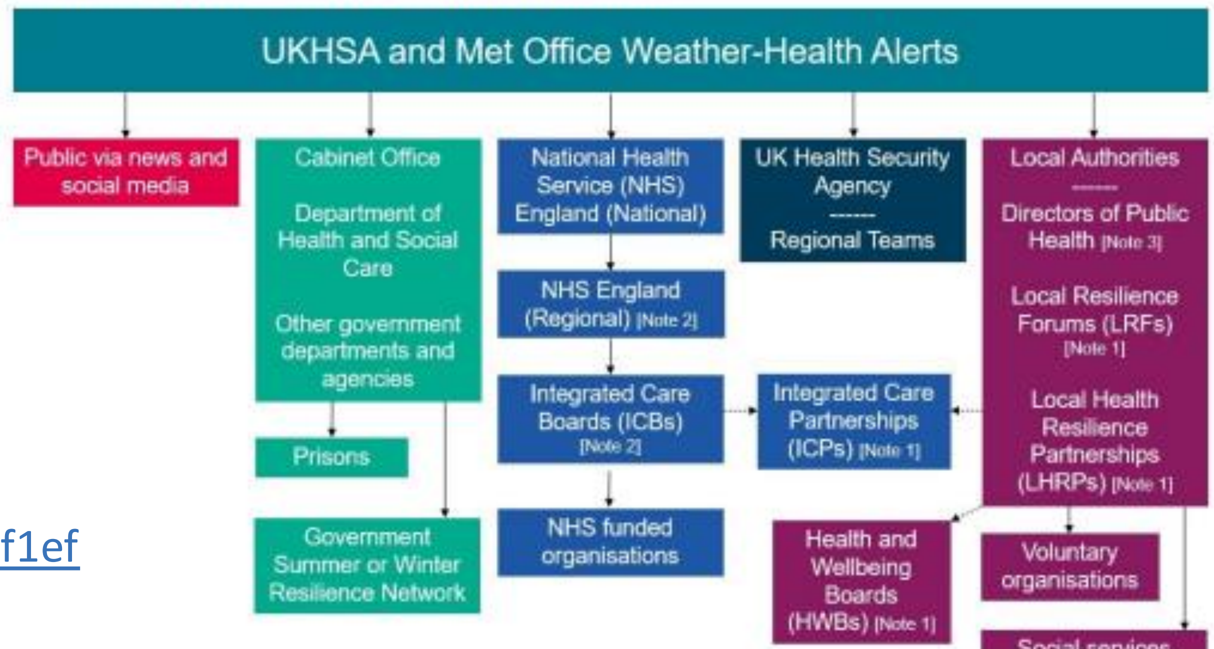
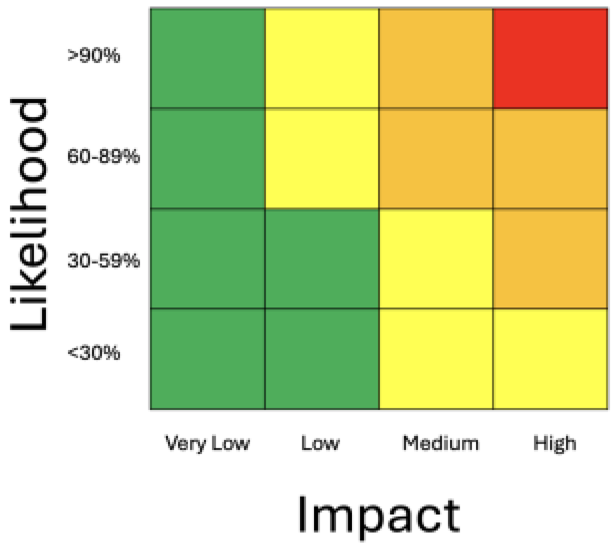


Figure 2. Impact and likelihood risk matrix



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Extreme Heat in NSWWS

(Heat) High Likelihood (H/H)

What should I do?

Keep yourself safe by following these simple steps to reduce the likelihood of the heat making you feel unwell; drink plenty of fluids, keep out of the sun and avoid any exercise between 11am-3pm when the sun is strongest and close curtains in rooms that face the sun. If you are going out take water with you, stay in the shade, wear sunscreen and a wide brimmed hat.

Give yourself the best chance of avoiding delays by checking road conditions if driving, or bus and train timetables, amending your travel plans if necessary. If using public transport, there are many simple things you can do to keep yourself safe; carry water with you, take a small hand-held battery powered fan, if you feel unwell get off at next stop for some fresh air, dress in light fabrics in light colours to help stay cooler, keep an eye on fellow passengers for signs they may be struggling.

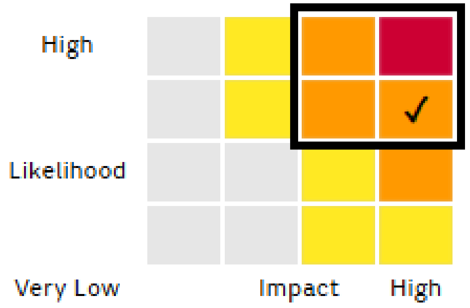
Help to protect vulnerable people that you know including older people, those with underlying conditions and those who live alone; they may need support to keep cool and stay hydrated. If you are worried about your health, or that of somebody you know, ring NHS 111 (or consult NI:DIRECT if in Northern Ireland).

Keep yourself safe whilst enjoying the water in this weather by following these simple steps: enter the water gradually, avoiding jumping or diving straight in, to reduce your risk of cold-water shock, go to a lifeguarded beach or a supervised swimming area, and, if you, or anyone else, get into difficulty in the water, float on your back.

People cope better with power cuts when they have prepared for them in advance. It's easy to do; consider gathering torches and batteries, a mobile phone power pack and other essential items.

Stay up to date with the weather forecast for your area and follow any advice from emergency services and local authorities.

Impact matrix



Rule of thumb;

We should be looking for the following type of events for at least a medium impact AMBER extreme heat warning;

- *At least 2 consecutive days with widespread maxima in the mid-30s Celsius in SE England and at least one very warm night (minima of 18-20C or higher) OR as above, but maxima in the low to mid-30s Celsius but over a longer duration (e.g., 3-5 days)*
- *A few degrees lower for other parts of the UK, roughly using the geographical pattern established in the heatwave definition (this gives us our "normal")*
- *Conversely 31-32C (in the SE) and 28-31C elsewhere will usually be insufficient to warrant a warning unless other factors are known to apply.*

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Heat Alerts

Table 1. Heat-Health Alert temperature thresholds

Region	Impact level	Percentage increase in mortality above expected levels	Maximum daytime temperature	Night-time temperature
London	Very low	Not applicable	<28.0°C	95th percentile or higher*
	Low	10%	28.0°C to 31.9°C	
	Medium	20%	32.0°C to 39.9°C	
	High	50%	40.0°C<	
All other regions	Very low	Not applicable	<27.0°C	95th percentile or higher*
	Low	10%	27.0°C to 29.9°C	
	Medium	20%	30.0°C to 37.0°C	
	High	50%	38.0°C<	

* Top 5% of night-time temperature. Ninety-fifth percentile indicates evenings on which the night-time temperature is higher than 95% of all other summer nights. Only the top 5% of evenings in any summer are likely to fall within this upper range of night-time temperatures.

Table 2. Heat impact criteria

	Very low	Low	Medium	High
Population at risk	Little impact observed on health, healthcare services and social care provision.	Increased mortality amongst vulnerable population groups (for example an increase in those aged 65 years and over daily mortality dependant on time of year).	Observed increase in mortality across the population, particularly in those aged 65 years and over or those with health conditions, but impacts may also be seen in younger age groups.	Increased mortality expected across the whole population with significant mortality observed in older age groups.
Demand for and impacts on health and social care services		Potential for increased usage of healthcare services by vulnerable population. Internal temperatures in care settings (hospitals and care homes) maybecome very warm increasing risk of indoor overheating.	Increased demand for GP services, ambulance call out, remote healthcare services (NHS111) likely. Impact on ability of services delivered due to heat effects on workforce possible. Many indoor environments likely to be overheating, risk to vulnerable people living independently in community as well as in care settings. Staffing issues due to external factors. Patient medication regime may lead to increased risk of dehydration.	Significant increased demand on all health and social care services. Impact on ability of services to be delivered due to heat effects on workforce. Indoor environments likely to be hot makingprovision of care challenging and leading to increased risk of heatstroke and dehydration.
Other sectors			Non-health sectors starting to observe impacts (for example travel delays).	National critical infrastructure failures – power outages or major roads and rail lines closed due to melting roads or overheating rail lines.

Table 3. Interaction between the HHA and NSWWS extreme heat

HHA impact level	NSWWS
Very low	Not applicable
Low	Not applicable
Medium	Potential for amber extreme heat warning within high impact column – that is potential for severe impacts
High	Potential for red extreme heat warning

Any questions?