THE CLIMATE ADAPTATION PLATFORM

# Strengthening Resilience through Performance Based Contracts

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# Coverage

- ***Understanding Natural Hazard Risk Management***
- ***Define Performance Based Contracts***
- ***Network Criticality***
- ***Resilience in PBC***

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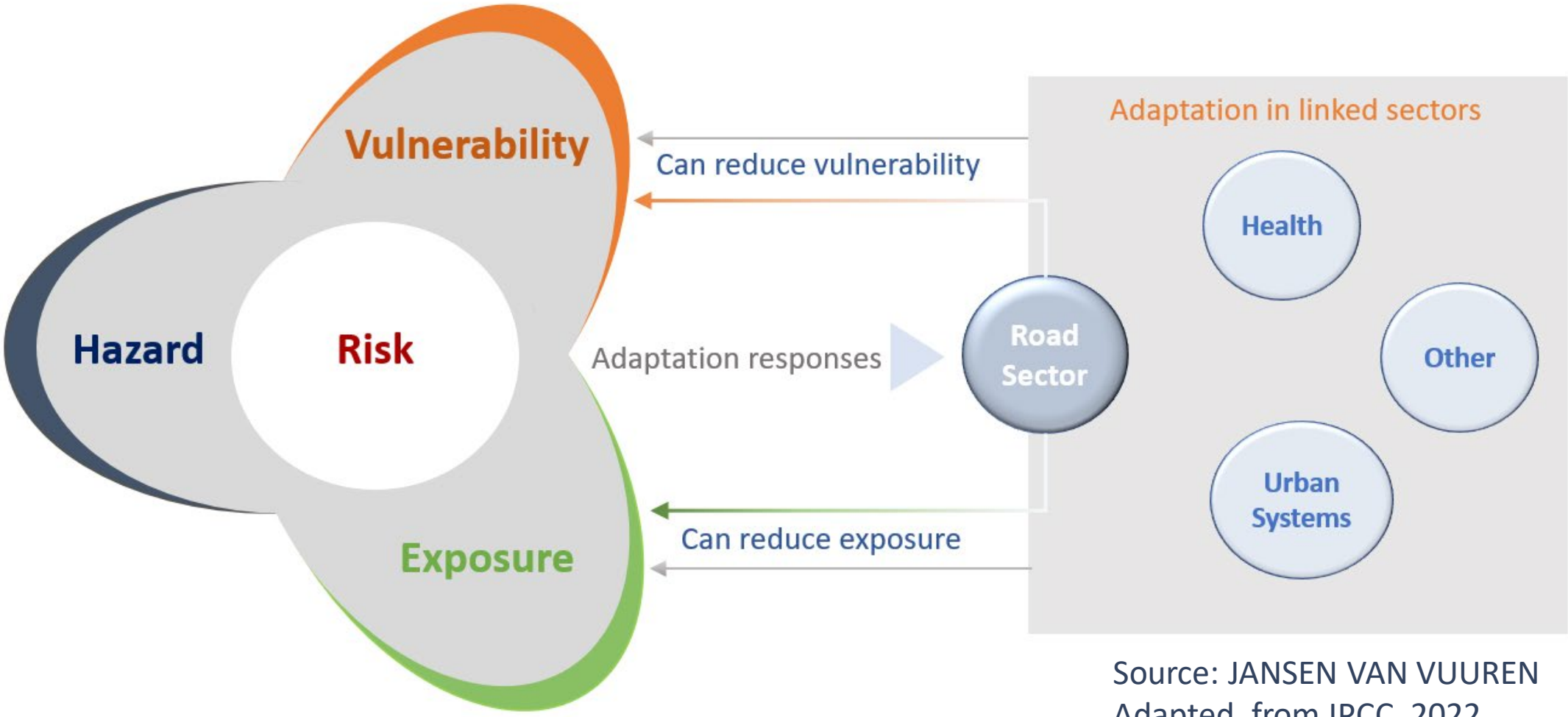
# Adaptation that will Reduce the Natural Hazard Risk




Source: JANSEN VAN VUUREN
Adapted from IPCC, 2022

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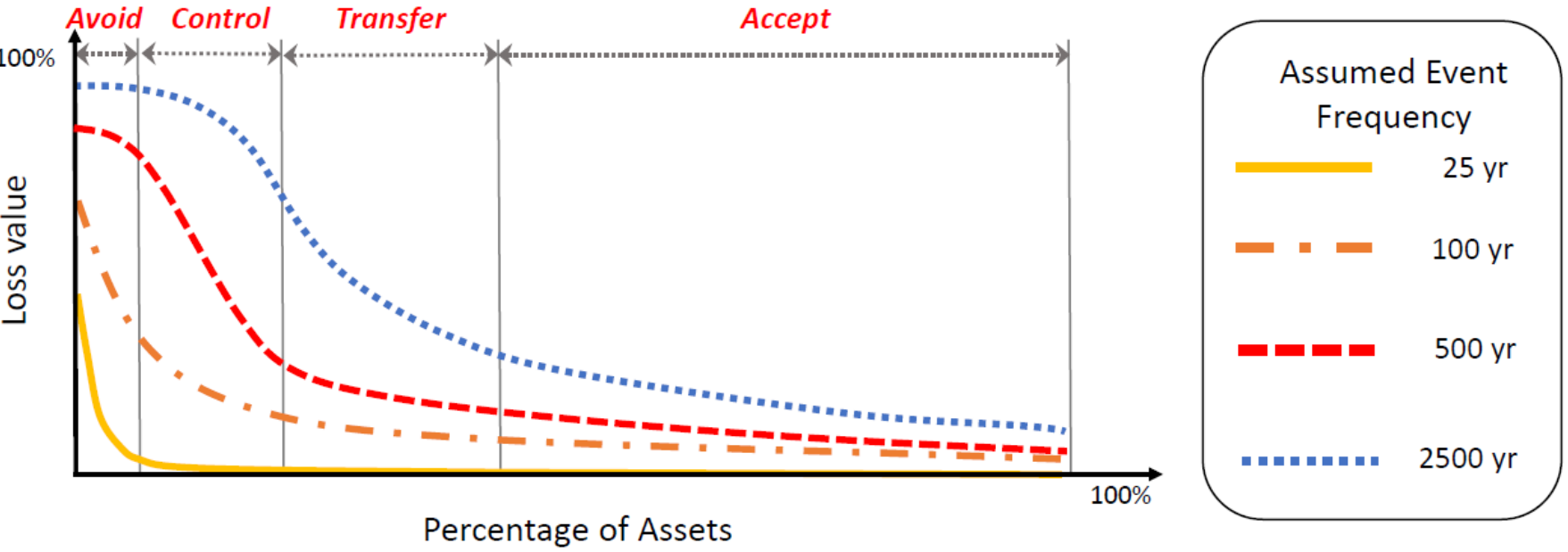
# Options for Dealing with Natural Hazard Risks

**A**VOID - Reduce exposure

**C**ONTROL - Mitigate physical impact

**T**RANSFER – Limit financial loss and aid recovery

**A**CCEPT - Adaptive response arrangements




**Consider multiple possible futures, where risk(s) change with time**

## Considerations:

- We treat the different magnitudes of risks differently
- Asset criticality is a key input
- Our infrastructure responses include:
  - Avoid -> relocate/retreat
  - Control -> reduce the impact
  - Transfer -> Physical, financial or contractual adaptation
  - Accept -> focus on response 'when' something happens

Source: Hugh Cowan

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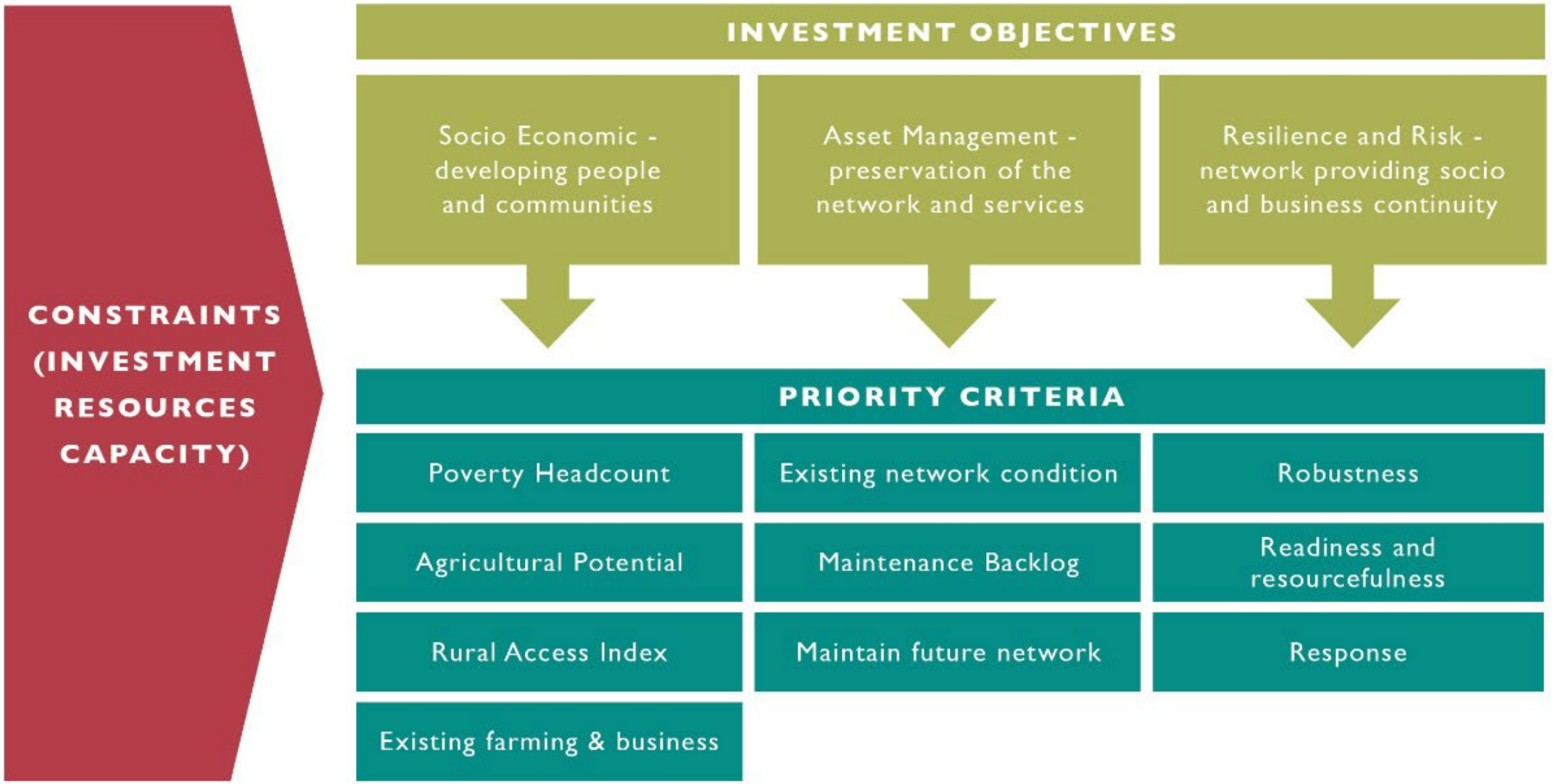
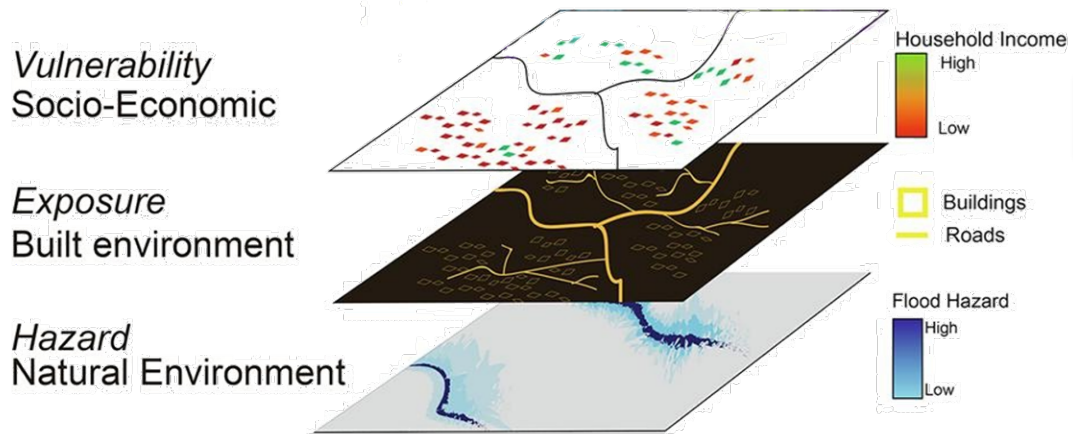
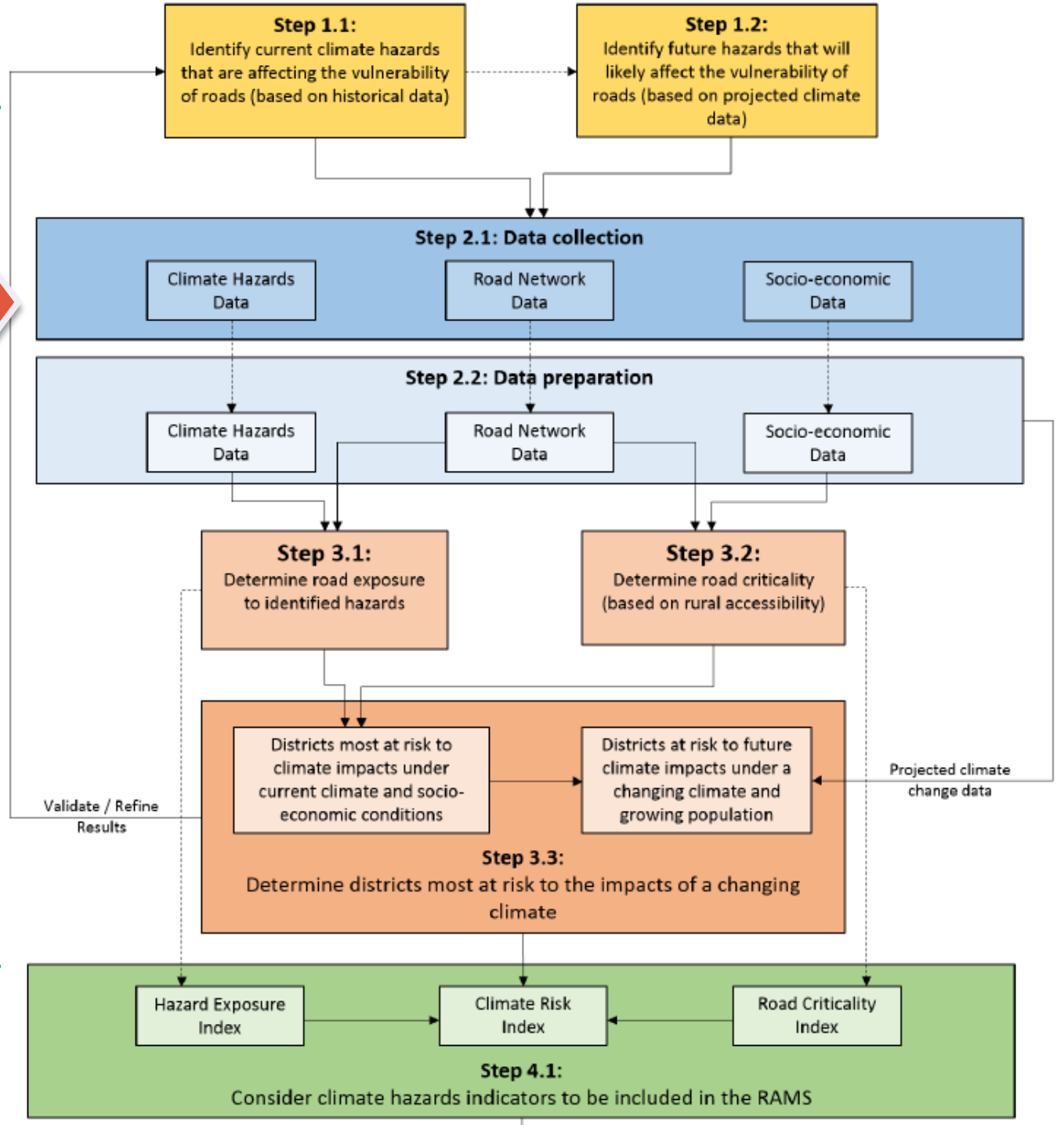
# Investment Priority



# Climate Risk Assessment



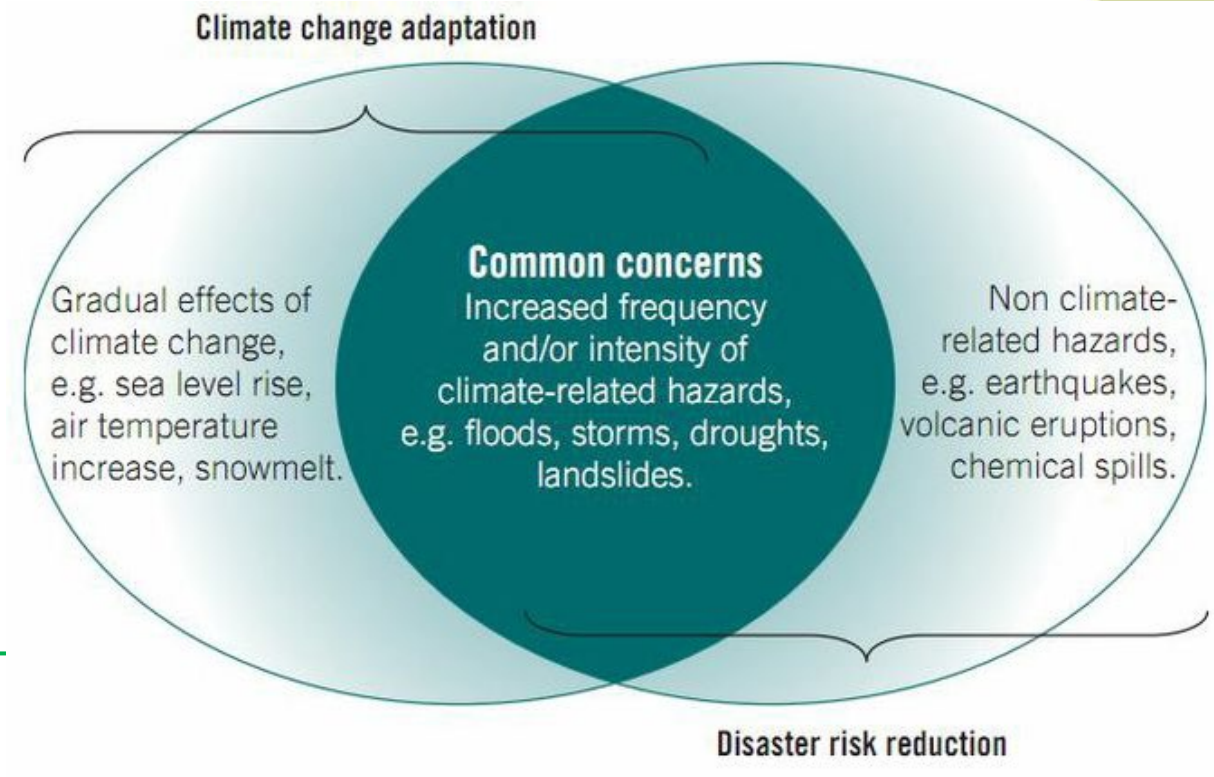

Source: ReCAP UK Aide


# Performance Based Contracts

- Traditional – Pay for work completed
- PBC – Pay for outcome

With PBC, you will get what you ask for – important to know what to ask for

# 3 ‘R’s of Resilience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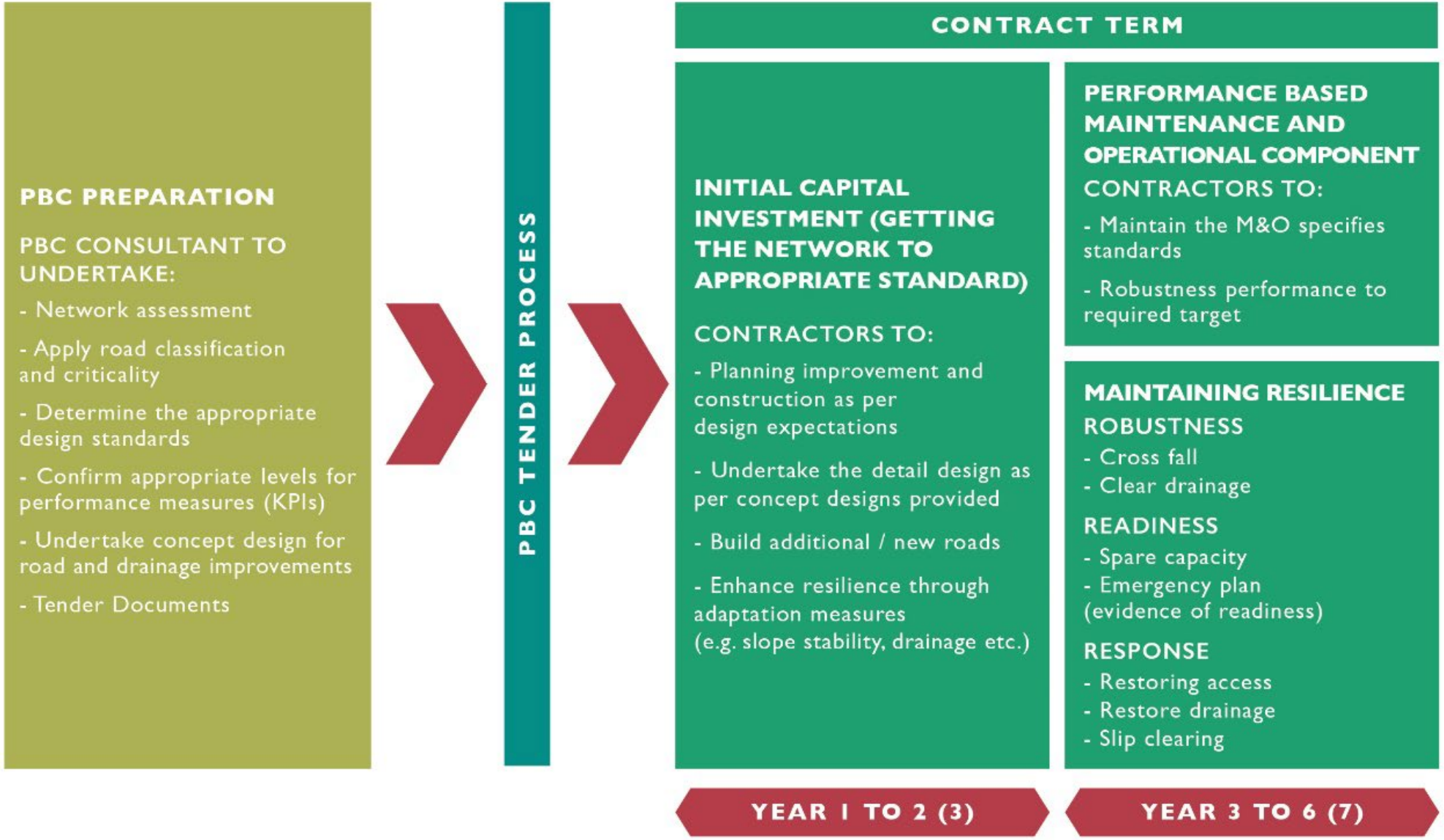
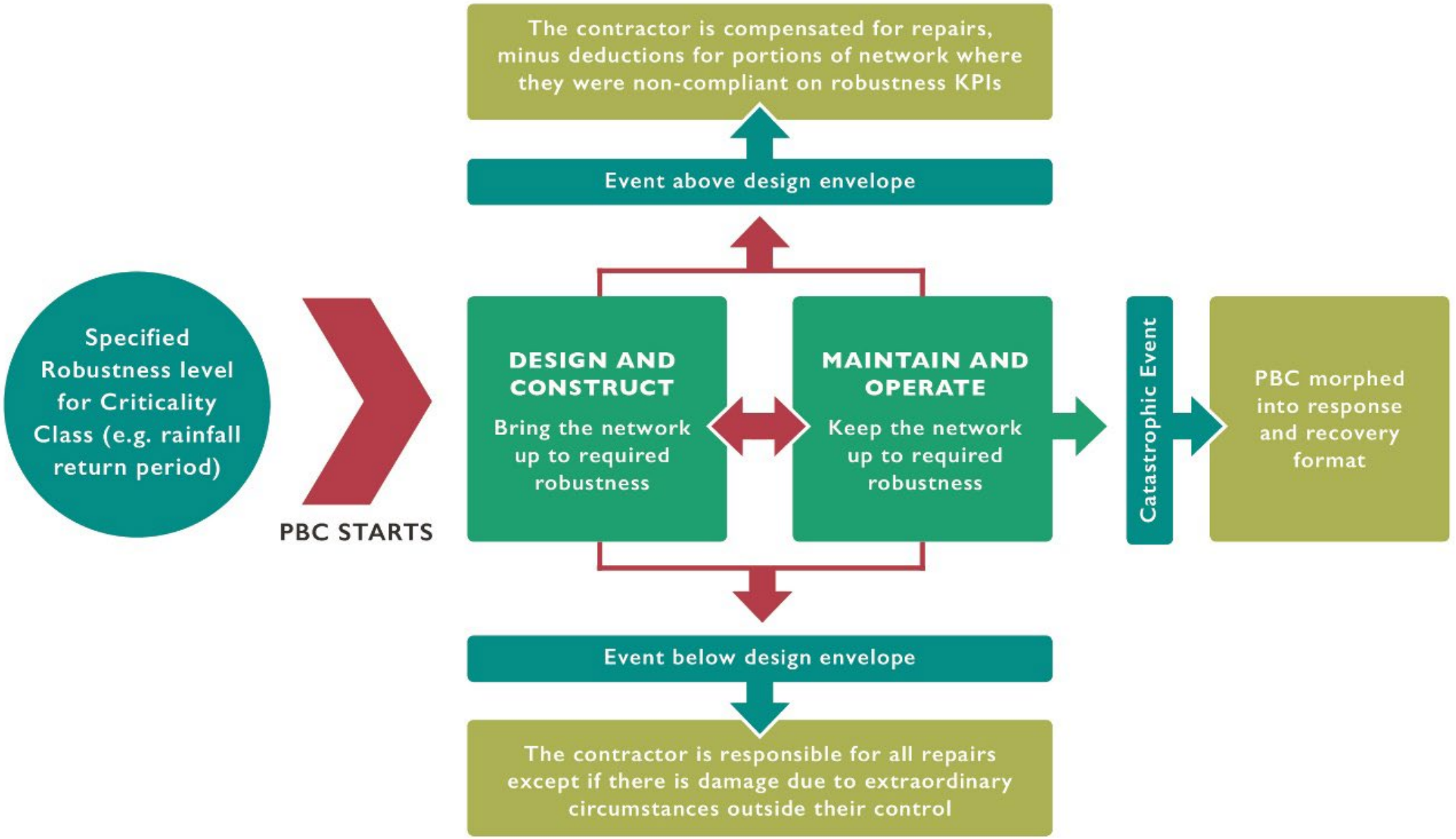
# Framing up the PBC Contract

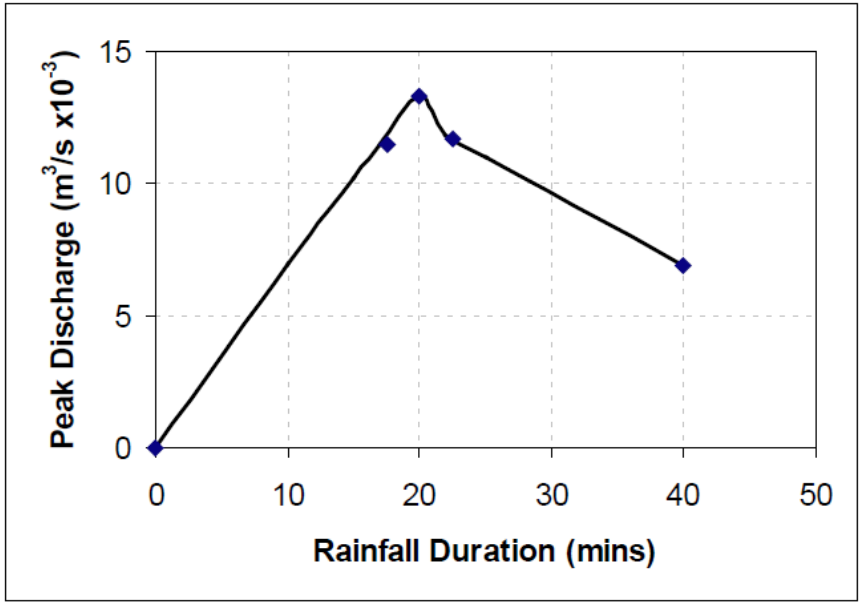


# Risk Sharing Arrangements for PBC

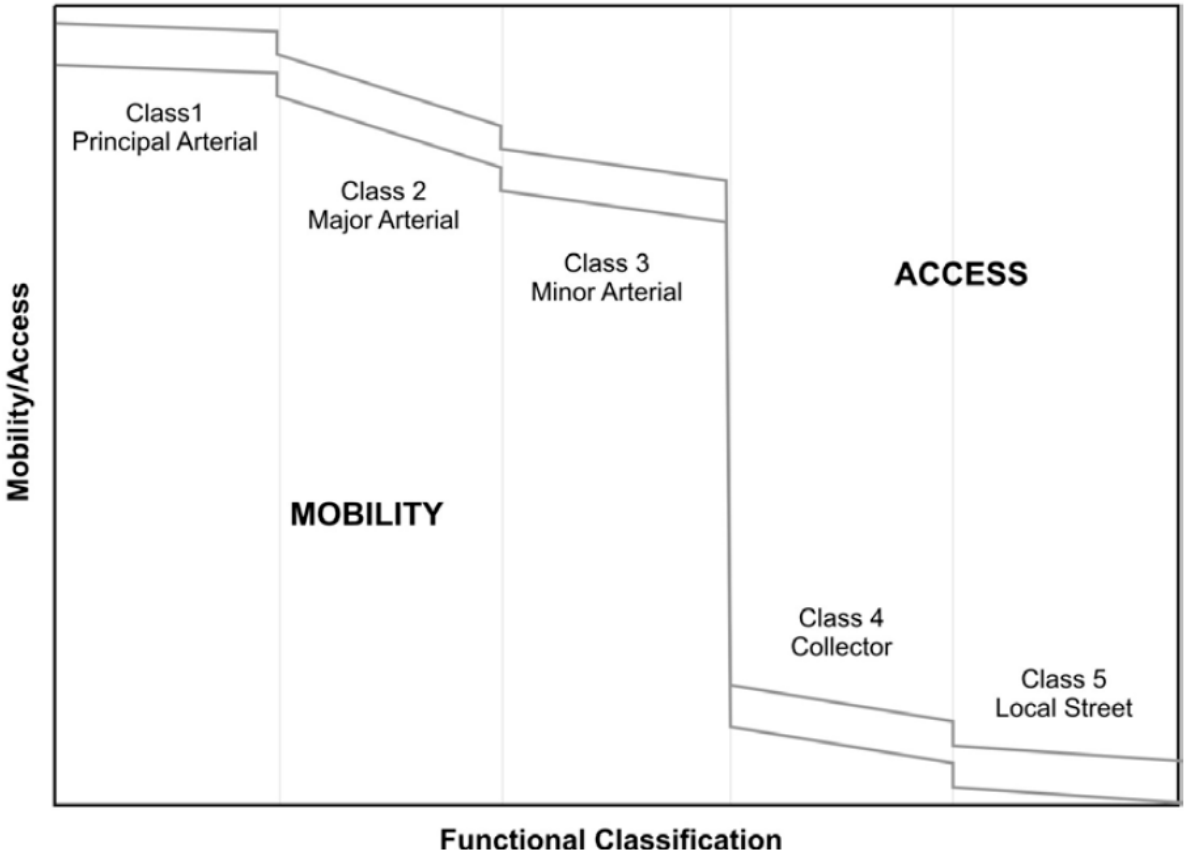


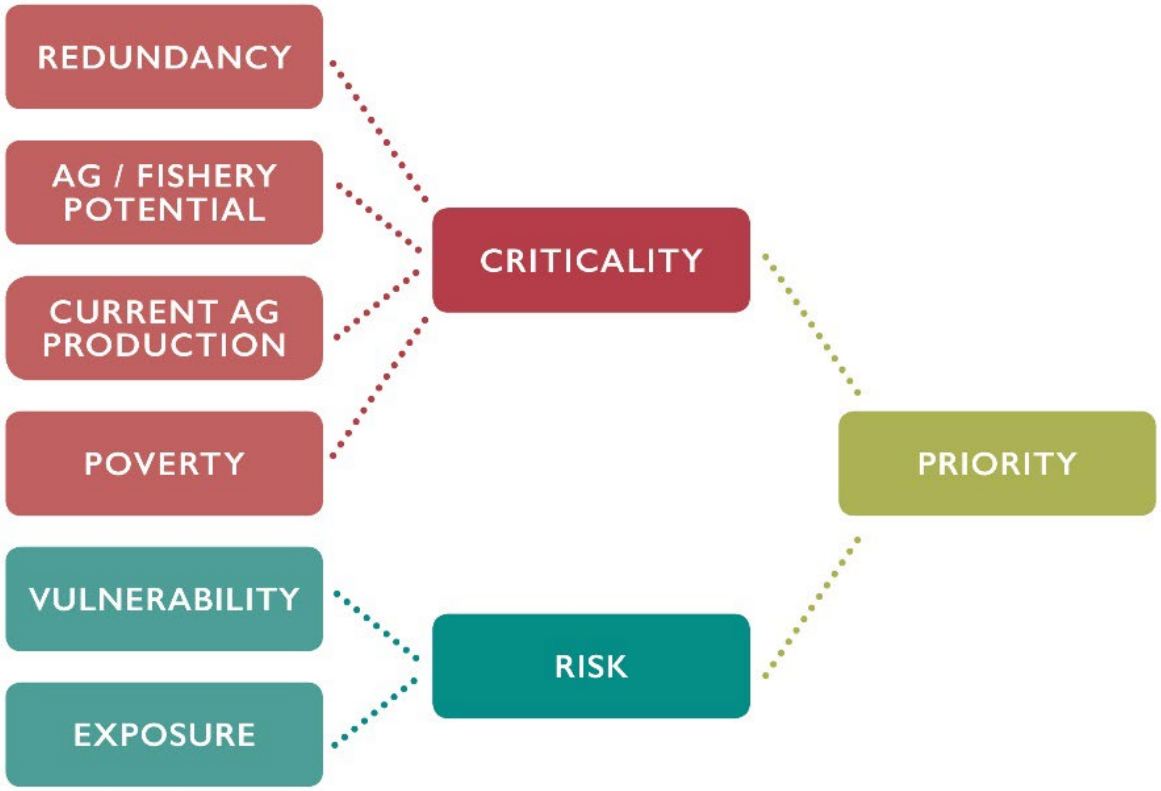
# Linking Design/Risk Thresholds with Physical Benchmarks

- Specifying a return period for events will be very difficult to apply as it is difficult to relate a return period to actual damage a specific event may cause
- The peak flow is directly related to a return period -> record the actual peak flow that is then related back to the performance specifications.
- Risk or hazard related Key Performance Measures should, therefore, be related to the actual measurement of key parameters such as:
  - Temperature;
  - Rainfall;
  - Peak flow at critical locations ; and,
  - Seismic activity as recorded by seismological stations.




# Road Classification and Criticality

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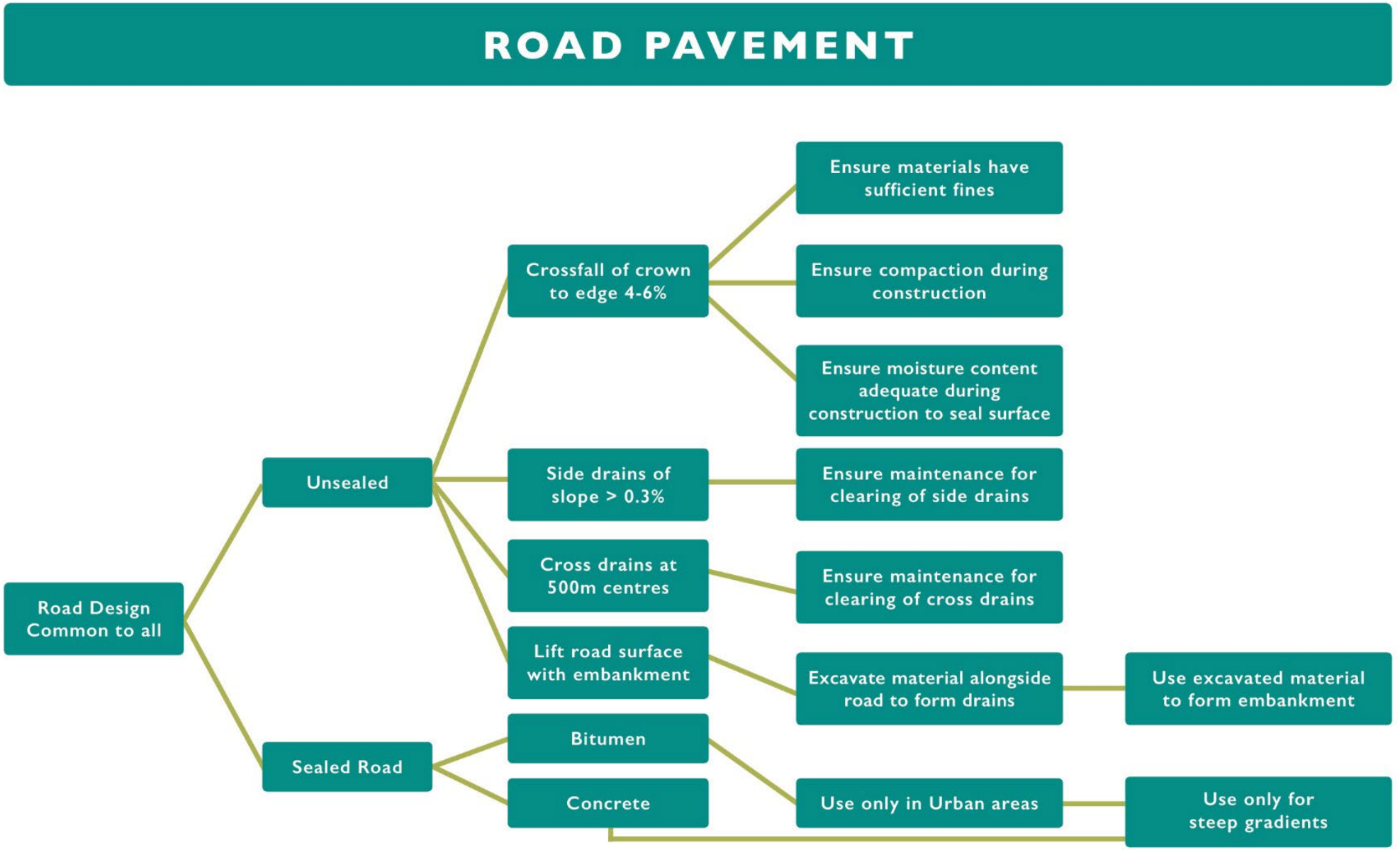
# Route/Road Criticality

| Criticality Level: | Critical Level 0 | Criticality Level 1 | Criticality Level 2 |
|---|---|---|---|
| **Description:** | A local route or section of the road whose failure would have a minor local economic or social impact, or plays a minor role in access to lifeline/ essential services. | A local route or section of the road where failure would have a serious local economic or social impact, or is a locally important lifeline route, ensuring access or continuity of supply of essential services during an unforeseen event. | A major route or section of the road whose failure would have a significant economic or social impact to more than one region, or is a regionally significant lifeline route, ensuring access or continuity of supply of essential services during an unforeseen event. |
| **Further criteria:** | - Low traffic volumes<br>- Low freight volumes<br>- No significant lifeline utilities or essential services, low socio impact. | - Feeds locally significant emergency services, hospitals, lifeline utilities etc | - Feeds regionally significant emergency services, hospitals, lifeline utilities etc |
| **Design and operation/maintenance requirements** | - Design/operate/maintain pavements to appropriate functional classification. No additional resilience requirements | Design/operate/maintain pavements to appropriate functional classification. Design/operate/maintain to moderate level for resilience: drainage, bridges, as well as readiness/response | Design and operate/ maintain to highest relevant standards for all elements of both operations and resilience |

# Understanding the Adaptation Strategies




Australian Aid, 2014

# PBC Response to Climate Impacts

| | | |
|---|---|---|
| **Seasonal and annual average rainfall** | • **Impact on soil moisture levels, affecting the structural integrity of roads, bridges and tunnels**<br>• **Impact of standing water on the road base ultimately leading to increased pavement deterioration**<br>• **Risk of floods from runoff, landslides, slope failures and damage to roads if changes occur in the precipitation pattern** | • **Focus O&M strategy on preventative measures and preservation treatments**<br>• **Elevate the road formation( including pavement structure) above estimated flood/inundation level for new road construction.**<br>• **Increase size and number of hydraulic structures**<br>• **Improve sub-surface drainage**<br>• **Enhance slope stability and erosion control ( including soil bioengineering applications ) to prevent sheet erosion, scour ,landslides, rock falls.** |
| **Higher maximum temperature and a higher number of consecutive hot days (heat waves)** | • Impact on pavement integrity, e.g. softening of asphalt layers, traffic-related rutting, embrittlement (cracking), migration of liquid asphalt , buckling and cracking of concrete slabs, retaining structures etc,<br>• Thawing of permafrost soils resulting in subsiding structures and roads<br>• Thermal expansion in bridge expansion joints and paved surfaces<br>• Impact on landscaping – vegetation/forest die-outs<br>• Temperature breaks soil cohesion with increased dust volume which causes adverse health impacts and traffic accidents | • Modify design assumptions and parameters for the use of bituminous binders and other materials.;<br>• Allow for more intensive maintenance and mitigation measures on the existing road network<br>• Allow for increased fire hazard in vegetation/forest management measures<br>• Apply appropriate dust palliative/control measures , including sealing of gravel and earth roads |

# PBC OPM & KPIs

| Component | Desired Outcome | O&M Measures (Current Specs in Sample Specification) |
|---|---|---|
| **Embankments** | Stable in all weather conditions<br>Only minor slips<br>Prevention of erosion | No more than one minor slip in 1000m ;<br>No gully erosion; ( minor rills may occur but need to be levelled and turfed within a given time) |
| **Bridge Structures** | To be fully operational to design standards<br>Structural<br>Hydraulic | No debris<br>Limit defects as per condition KPIs |
| **Bridge abutments/scour protection** | Free of debris<br>Free of cementation build-up<br>Stable abutments and river training works( riprap, gabions, walls) | Free of debris<br>Free of cementation build-up |
| **Sub pavements - cut-off drains** | Sufficiently draining subsurface moisture<br>Open flow | Sufficiently draining subsurface moisture<br>Open flow |
| **Slopes (Fill)** | Erosion free<br>Stable –no slips<br>Prevent undercutting/toe cutting | Erosion free<br>Stable –no slips<br>Prevent undercutting |
| **Corridor Vegetation Control** | Rainfall - free water flow<br>Droughts – prevent a fire hazard<br>High winds – prevent lying debris, toppling trees | Grass cutting from safety and free draining perspective use current PBC specifications)<br>Use drought resistance plants where appropriate –prevent overgrowing (fire hazards), Trees to be well-cleared road roadway. |

# Example of Performance Measure for Bridges

| | Earthquake severity | | |
|---|---|---|---|
| | Minor earthquake (as 5.1.2(b)) Return period factor = $R_u/4$ | Design level earthquake (as 5.1.2(a)) Return period factor = $R_u$ (ULS event) | Major earthquake (as 5.1.2(c)) Return period factor = $1.5R_u$ |
| Post-earthquake function - immediate | No disruption to traffic | Usable by emergency traffic | Usable by emergency traffic after temporary repair |
| Post-earthquake function – after reinstatement | Minimal reinstatement necessary to cater for all design-level actions | Feasible to reinstate to cater for all design-level actions, including repeat design-level earthquake* | Capable of permanent repair, but possibly with reduced load capacity |
| Acceptable damage | Damage minor | Damage possible; temporary repair may be required | Damage may be extensive; collapse prevented |

**Notes**

* The performance requirements that shall apply in the event of a repeat design level earthquake event shall be those that apply to a major earthquake event.

Source NZTA

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# Resilience into PBC Principles

1. **Resilience is affordable** -> target low hanging fruit
2. The **PBC could become a vehicle for significant resilient gains** by altering its structure slightly. For example, opportunities to modify these contracts which incentivize disaster response activities will greatly enhance the effectiveness of response activities following major disasters
3. Points to Remember:
   a) **Investment decisions** must balance an array of investment criteria (network objectives) with affordability and long-term sustainability of the strategy
   b) **Risk transfer** needs careful considerations -> risk should be carried by party who has most control of managing the risk
   c) Blanket **risk transfer** could be costly
   d) Clear and sensible **KPI and OPM vital** – "*you will get what you ask for*"
   e) This about the **"blind spots"** and how to deal with them in collaboration

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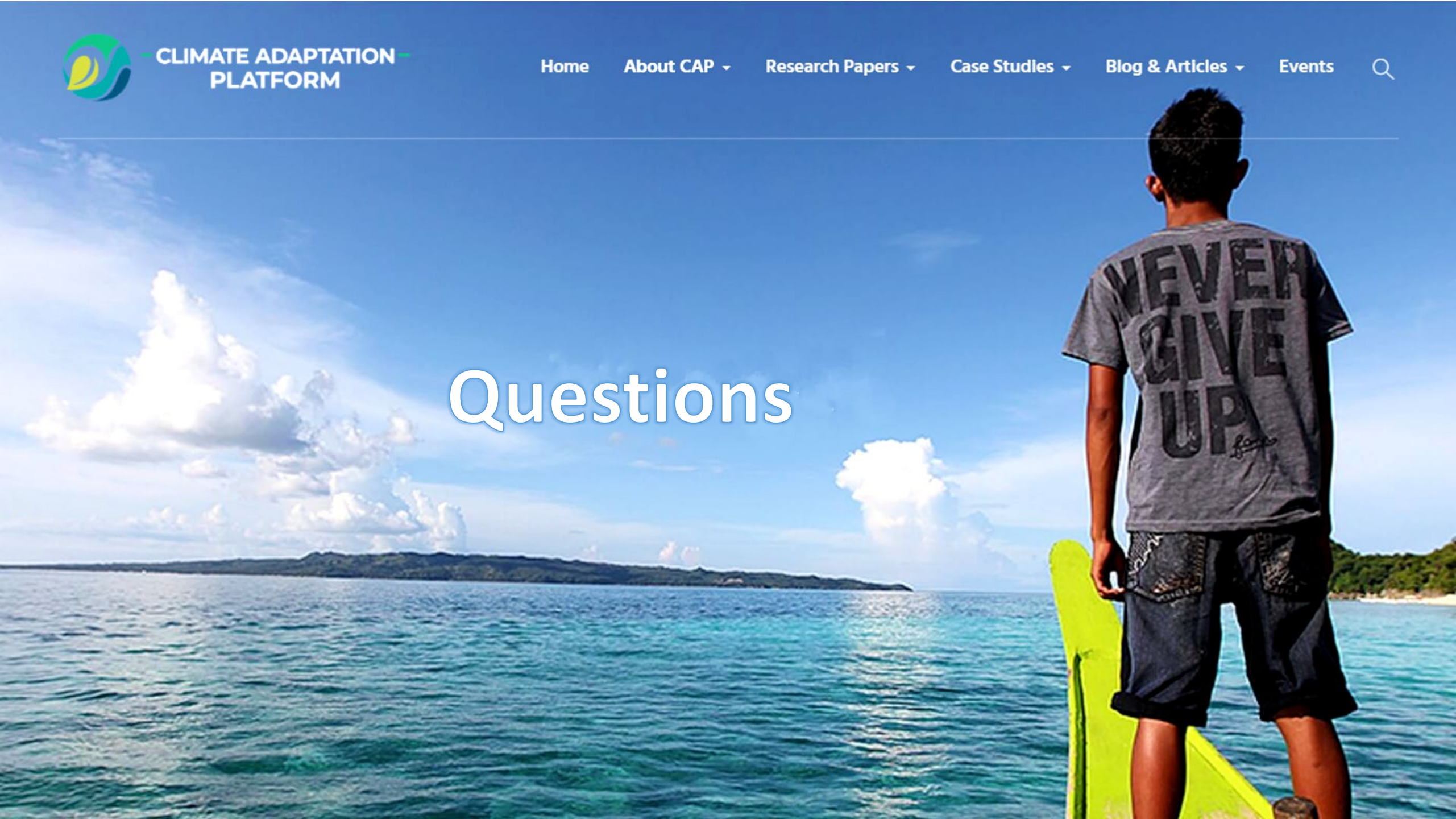
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