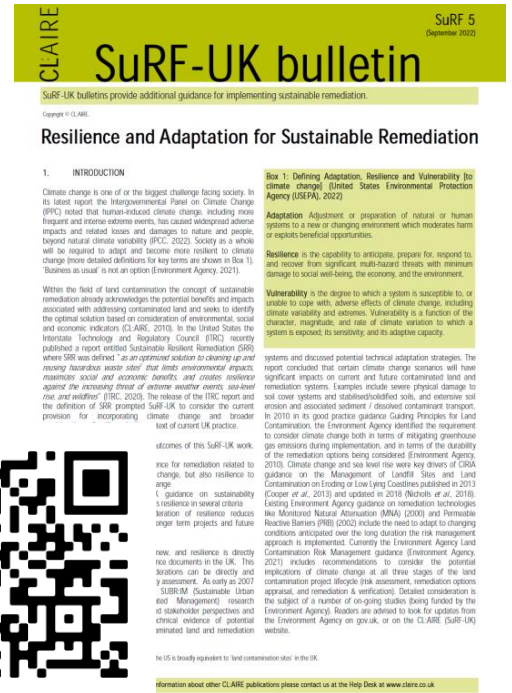
# Incorporating Resilience and Adaptation into the SuRF-UK Framework

Richard Gill, SuRF-UK Steering Group Member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SuRF 5
(September 2022)

SuRF-UK bulletin

SuRF-UK bulletins provide additional guidance for implementing sustainable remediation.

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Resilience and Adaptation for Sustainable Remediation

1. INTRODUCTION

Climate change is one of or the biggest challenge facing society. In its latest report the Intergovernmental Panel on Climate Change (IPPC) noted that human-induced climate change, including more frequent and intense extreme events, has caused widespread adverse impacts and related losses and damages to nature and people, beyond natural climate variability (IPCC, 2022). Society as a whole will be required to adapt and become more resilient to climate change (more detailed definitions for key terms are shown in Box 1). "Business as usual" is not an option (Environment Agency, 2021).

Within the field of land contamination the concept of sustainable remediation already acknowledges the potential benefits and impacts associated with addressing contaminated land and seeks to identify the optimal solution based on consideration of environmental, social and economic indicators (CL:AIRE, 2010). In the United States the Interstate Technology and Regulatory Council (ITRC) recently published a report entitled Sustainable Resilient Remediation (SRR) where SRR was defined "*as an optimized solution to cleaning up and reusing hazardous waste sites that limits environmental impacts, maximizes social and economic benefits, and creates resilience against the increasing threat of extreme weather events, sea-level rise, and wildfires*" (ITRC, 2020). The release of the ITRC report and the definition of SRR prompted SuRF-UK to consider the current provision for incorporating climate change and broader text of current UK practice.

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Box 1: Defining Adaptation, Resilience and Vulnerability [to climate change] (United States Environmental Protection Agency (USEPA), 2022)

**Adaptation** Adjustment or preparation of natural or human systems to a new or changing environment which moderates harm or exploits beneficial opportunities.

**Resilience** is the capability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to social well-being, the economy, and the environment.

**Vulnerability** is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

systems and discussed potential technical adaptation strategies. The report concluded that certain climate change scenarios will have significant impacts on current and future contaminated land and remediation systems. Examples include severe physical damage to soil cover systems and stabilised/solidified soils, and extensive soil erosion and associated sediment / dissolved contaminant transport. In 2010 in its good practice guidance Guiding Principles for Land Contamination, the Environment Agency identified the requirement to consider climate change both in terms of mitigating greenhouse gas emissions during implementation, and in terms of the durability of the remediation options being considered (Environment Agency, 2010). Climate change and sea level rise were key drivers of CIRIA guidance on the Management of Landfill Sites and Land Contamination on Eroding or Low Lying Coastlines published in 2013 (Cooper *et al*., 2013) and updated in 2018 (Nicholls *et al*., 2018). Existing Environment Agency guidance on remediation technologies like Monitored Natural Attenuation (MNA) (2000) and Permeable Reactive Barriers (PRB) (2002) include the need to adapt to changing conditions anticipated over the long duration the risk management approach is implemented. Currently the Environment Agency Land Contamination Risk Management guidance (Environment Agency, 2021) includes recommendations to consider the potential implications of climate change at all three stages of the land contamination project lifecycle (risk assessment, remediation options appraisal, and remediation & verification). Detailed consideration is the subject of a number of on-going studies (being funded by the Environment Agency). Readers are advised to look for updates from the Environment Agency on gov.uk, or on the CL:AIRE (SuRF-UK) website.

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# Sustainable & Resilient Remediation

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- Sustainable resilient remediation (SRR) is an optimized solution to cleaning up and reusing a hazardous waste site that limits negative environmental impacts, maximizes social and economic benefits, and creates resilience against increasing threat of extreme weather events, sea-level rise, and wildfires.

- [srr (itrcweb.org)]

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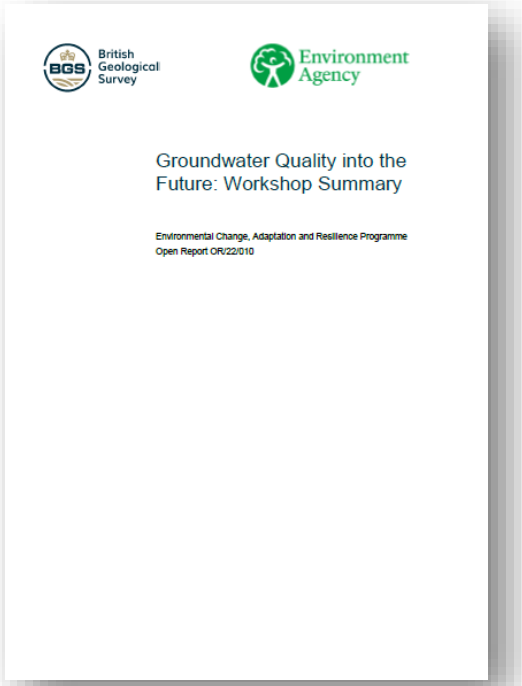
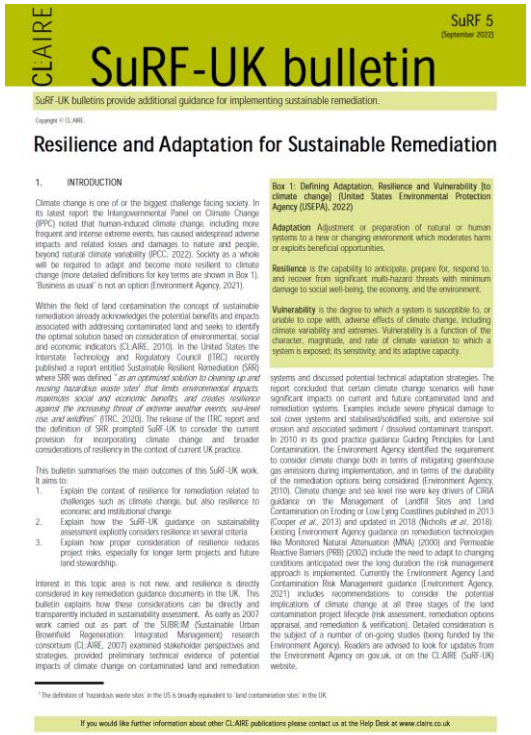


# SuRF-UK Bulletin

- Recently published bulletin, aims to:
  - Demonstrate how resilience can be incorporated into the existing framework
  - Expand the concept of resilience in CLM to financial and institutional changes
  - Explain how proper consideration of resilience reduces project risks



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Resilience and Adaptation for Sustainable Remediation

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This bulletin summarises the main outcomes of this SuRF-UK work. It aims to:

1. Explain the context of resilience for remediation related to challenges such as climate change, but also resilience to economic and institutional change
2. Explain how the SuRF-UK guidance on sustainability assessment explicitly considers resilience in several criteria
3. Explain how proper consideration of resilience reduces project risks, especially for longer term projects and future land stewardship.

Interest in this topic area is not new, and resilience is directly considered in key remediation guidance documents in the UK. This bulletin explains how these considerations can be directly and transparently included in sustainability assessment. As early as 2007 work carried out as part of the SUBR:IM (Sustainable Urban Brownfield Regeneration: Integrated Management) research consortium (CL:AIRE, 2007) examined stakeholder perspectives and strategies, provided preliminary technical evidence of potential impacts of climate change on contaminated land and remediation

**Box 1: Defining Adaptation, Resilience and Vulnerability [to climate change] (United States Environmental Protection Agency (USEPA), 2022)**

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[1] The definition of 'hazardous waste sites' in the US is broadly equivalent to 'land contamination sites' in the UK.

# Climate Change: What's the latest?

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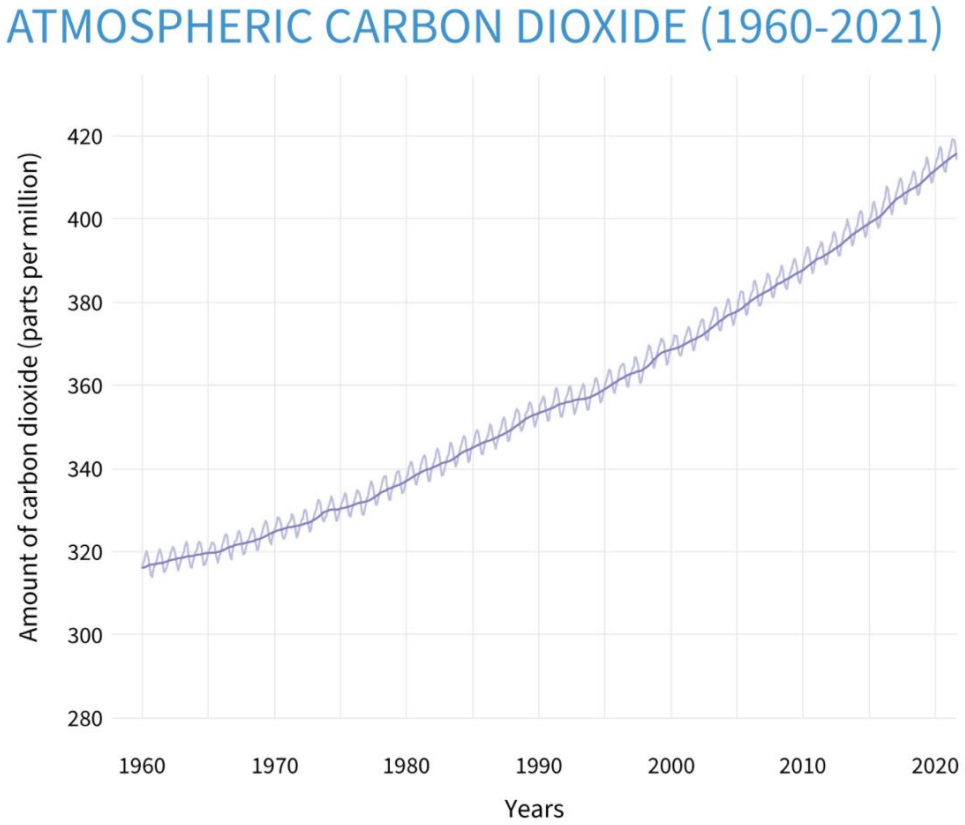
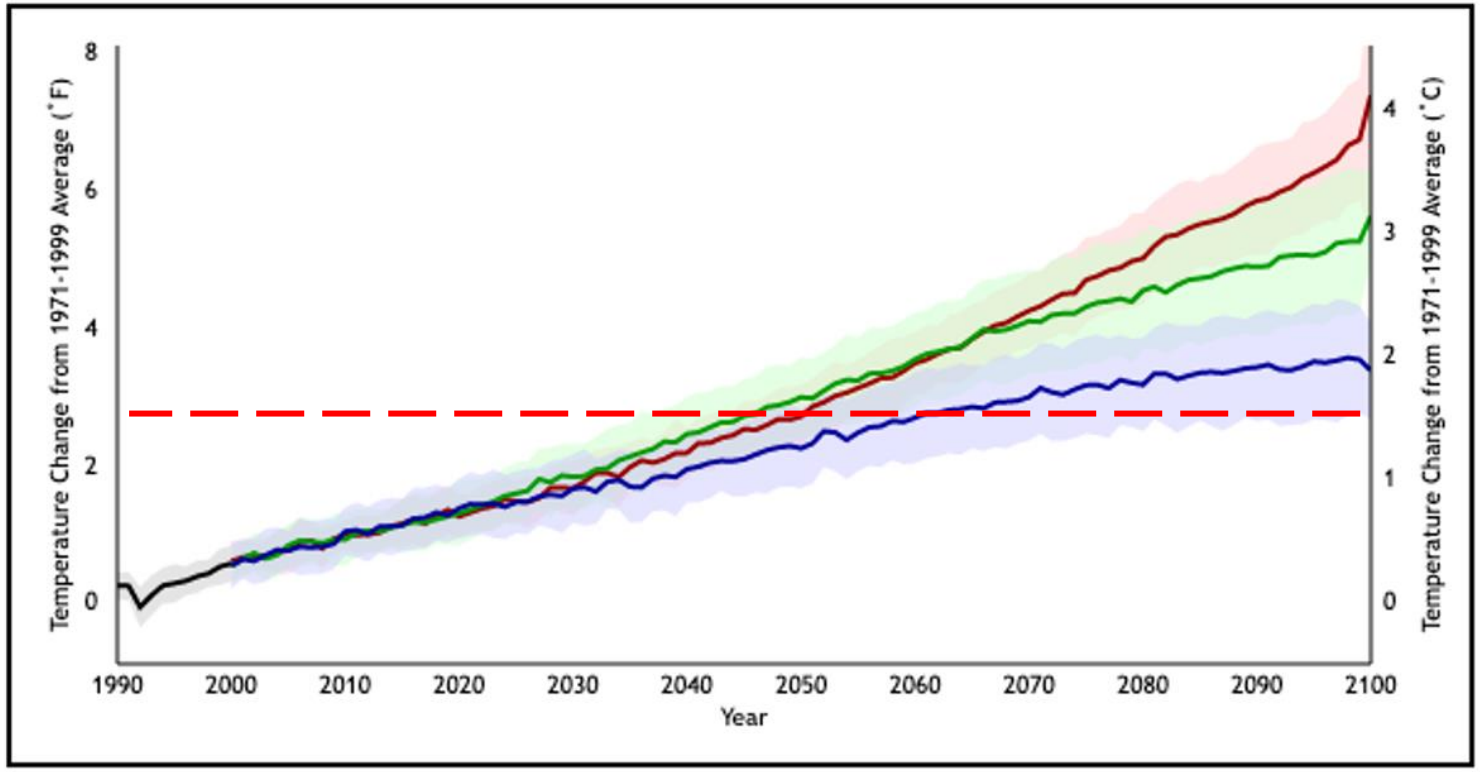



[Climate Change: Atmospheric Carbon Dioxide | NOAA Climate.gov]




[Climate Change: Global Temperature Projections | NOAA Climate.gov]

**Climate change and its impacts are here to stay**

# Climate Change Impacts on Contaminants & Remediation

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CBS NEWS

## 327 toxic Superfund sites in climate change, flooding bulls-eyes: AP

Across the nation, more than 800,000 homes are located near flood-prone toxic sites. Houses are at risk of contamination if intense flooding brings water into them, and many more people could be affected if the contamination seeps into the ground, finding its way into drinking water.


Search UK edition

The Guardian
For 200 years
News website of the year

## Toxic waste revealed as eroding coastlines expose old landfills

Floods and rising sea levels are washing hazardous waste from old rubbish tips into the sea at thousands of sites globally

# Climate Change Impacts and Contaminated Land Management

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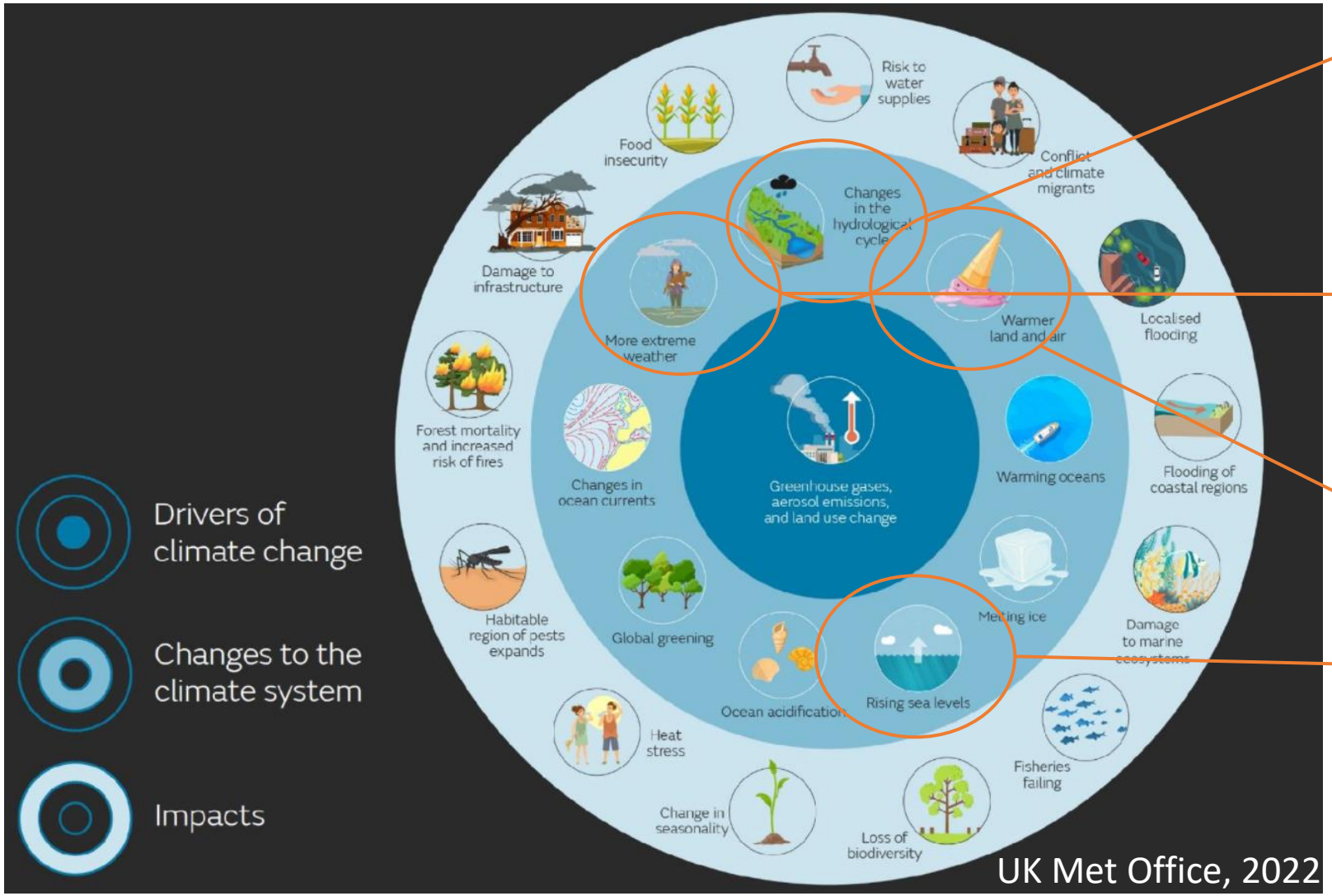
Maco et al. 2018




*Example:*

- Wetter: flooding, storms, more runoff

CBS NEWS **327 toxic Superfund sites in climate change, flooding bulls-eyes: AP**

*Example:*

- Scour (e.g. wind/wave damage)

*Example:*

- Decreased dissolved oxygen/ anoxic

*Example:*

- Erosion

**Toxic waste revealed as eroding coastlines expose old landfills**

Floods and rising sea levels are washing hazardous waste from old rubbish tips into the sea at thousands of sites globally

Search UK edition The Guardian For 200 years News website of the year

# Climate Change Impacts and Contaminated Land Management

| Remediation approach (examples) | Technique | Climate change impact for remediation activity |
|---|---|---|
| **Soil Treatment** | Bioremediation | Degradation activity may change, unexpected intermediaries |
| | Landfarming/landspreading | Inundation of site by sea level rise or flooding |

Maco et al. 2018

# Resilience and Contaminated Land Management

- Sustainable and risk-based management of contaminated land includes being mindful of how the risks change over time
- **Adaptation**, the action to prepare and adjust to new conditions, thereby reducing the harm or taking advantage of new opportunities

**Resilience is applicable to other impacts…**

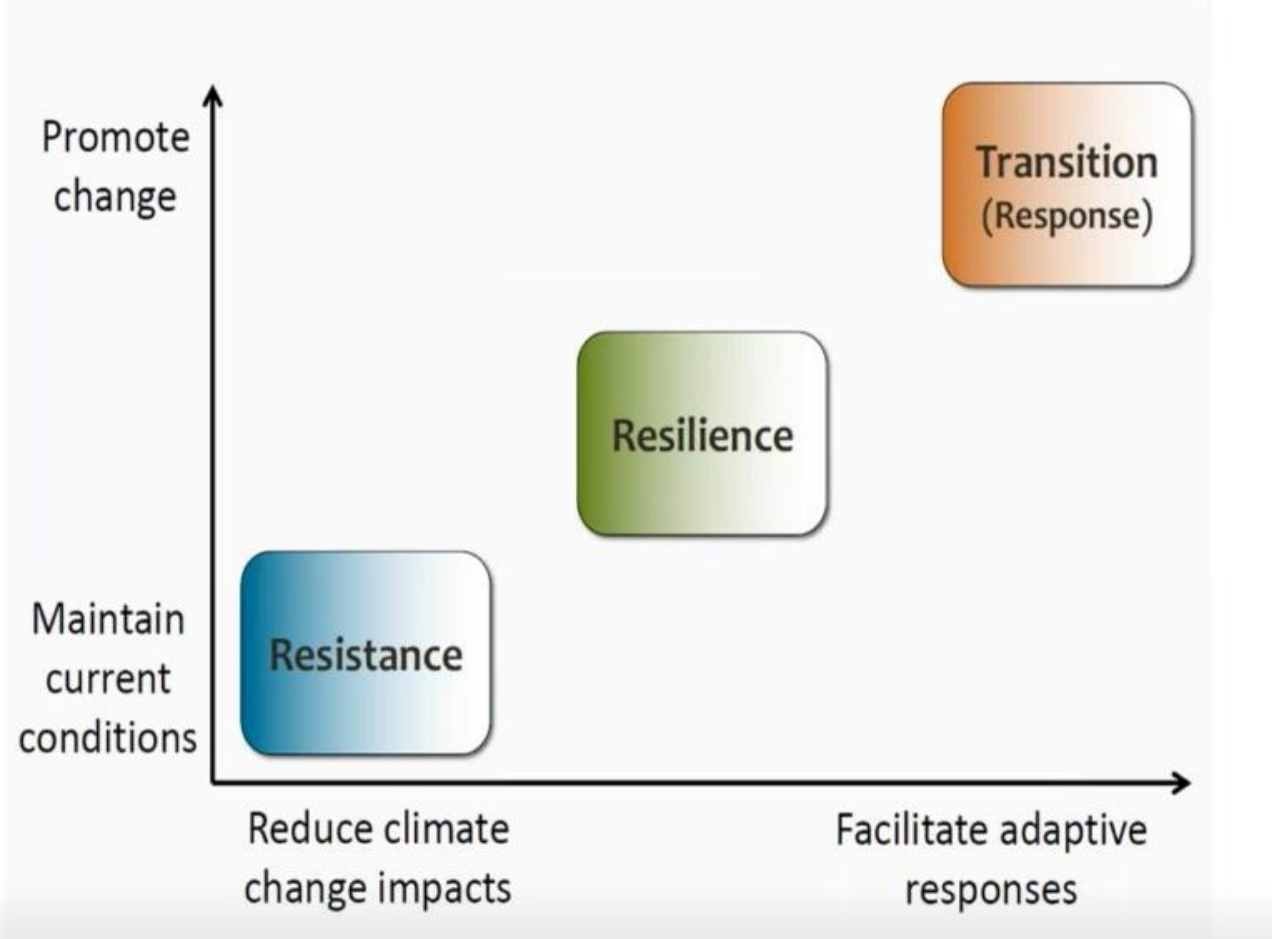
*Financial*

- Provisions are required for long running projects
- Changes in land ownership, liability management or macro economic conditions over time

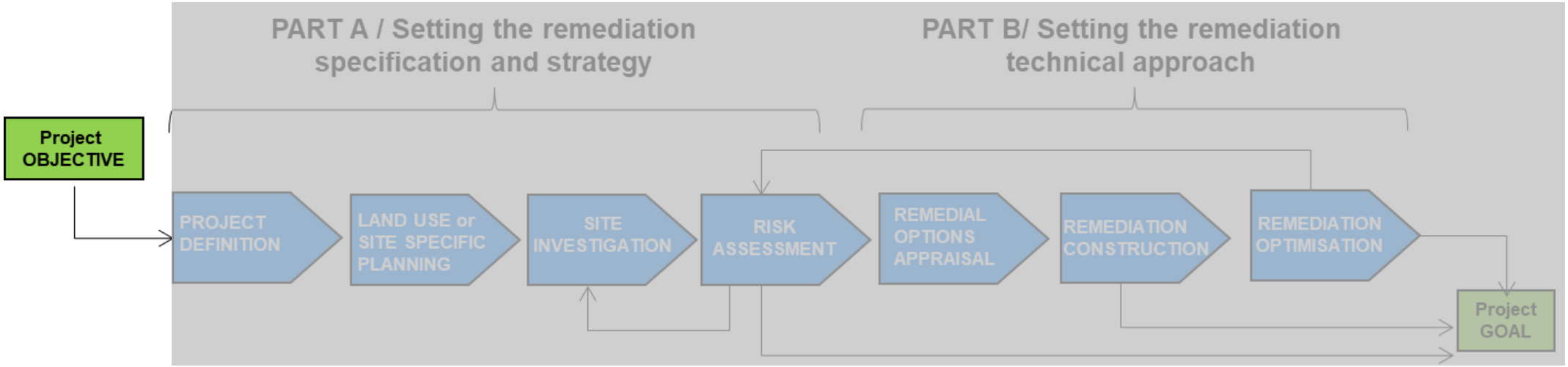
*Institutional*

- Changes in government priorities, policies or changes in stakeholder perspectives could influence institutional controls

**Spectrum of Adaptation Options (After SuRF, 2021)**

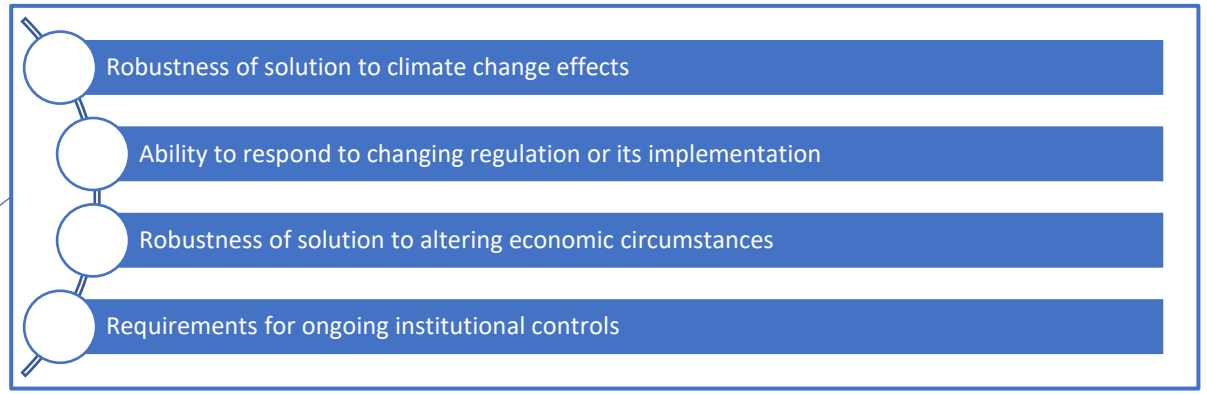


# Incorporating resilience into the SuRF-UK Framework




- Incorporating sustainability indicators

| Environment | Social | Economic |
|---|---|---|
| Emissions to Air | Human health & safety | Direct economic costs & benefits |
| Soil and ground conditions | Ethics & equity | Indirect economic costs & benefits |
| Groundwater & surface water | Neighbourhoods & locality | Employment & employment capital |
| Ecology | Communities & community involvement | Induced economic costs & benefits |
| Natural resources & waste | Uncertainty & evidence | Project lifespan & flexibility |



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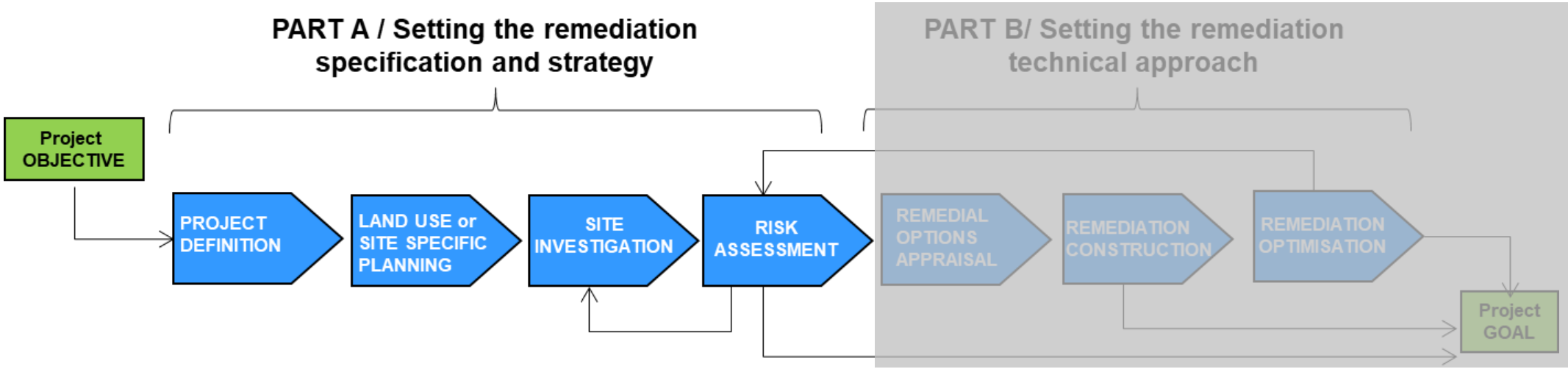
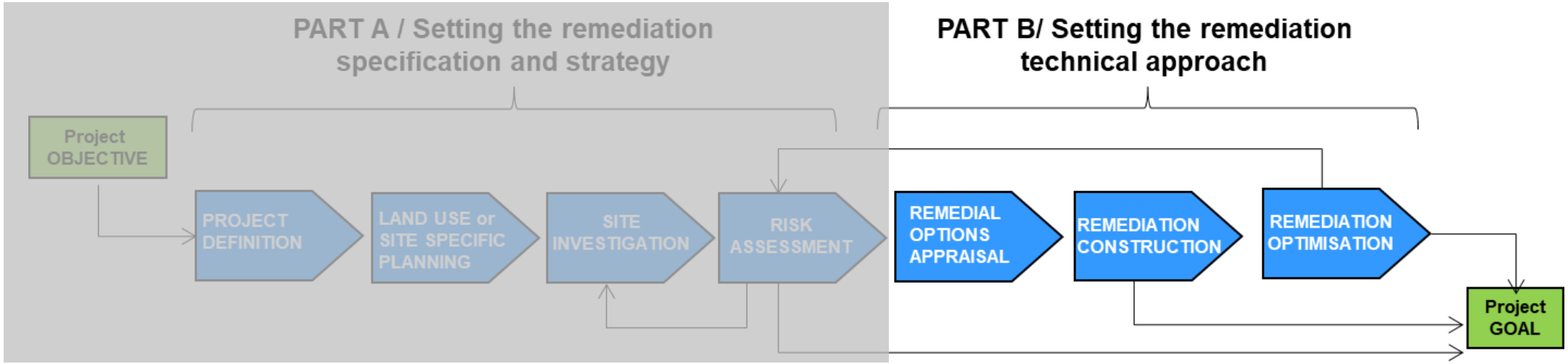



**Examples of more detailed analyses that could be completed during Part A:**

- Consider resiliency in future site use
- Sensitivity of CSM to resiliency
- Climate Change Vulnerability Assessments
  - Example of the approach set out in the ITRC SRR document
  - Using country specific resources
- Account for resiliency in risk assessment
  - Example of the SoBRA report published Aug 2022

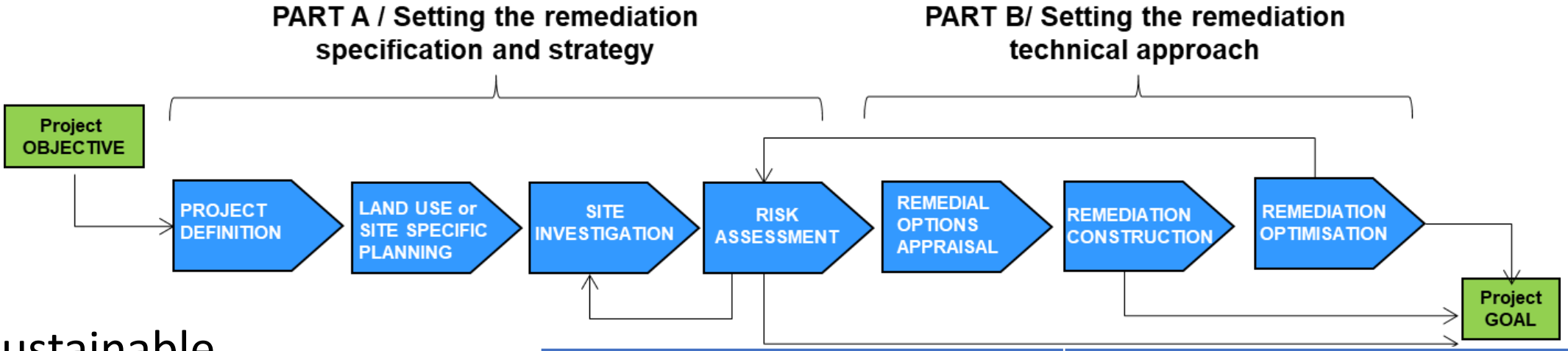
# Incorporating resilience into the SuRF-UK Framework




**Examples of more detailed analyses that could be completed during Part B:**

- Consider resilience of remediation options in sustainability assessment
- Assess the longevity of the solution
- Opportunities for using land stewardship approach
  - Example of NICOLE approach

# Incorporating resilience into the SuRF-UK Framework




- Sustainable management Practices
  - Relevant across whole project lifecycle
  - Use the latest guidance
  - Examples could be…

| SMP | SMP Benefit |
|---|---|
| **Plan site layout with regard to minimising the physical remediation required** | • The potential impacts from climate change could also be incorporated into the site plan to ensure remediation is more robust |
| **Request that the functional performance specifications of products are supplied** | • Ensuring that the operational limits of materials and equipment can operate in the event of extreme weather events or other climate change impacts |
| **Set sustainability criteria in the specification to motivate suppliers to provide more sustainable products and services** | • Drives a culture of sustainability across the supply chain. |

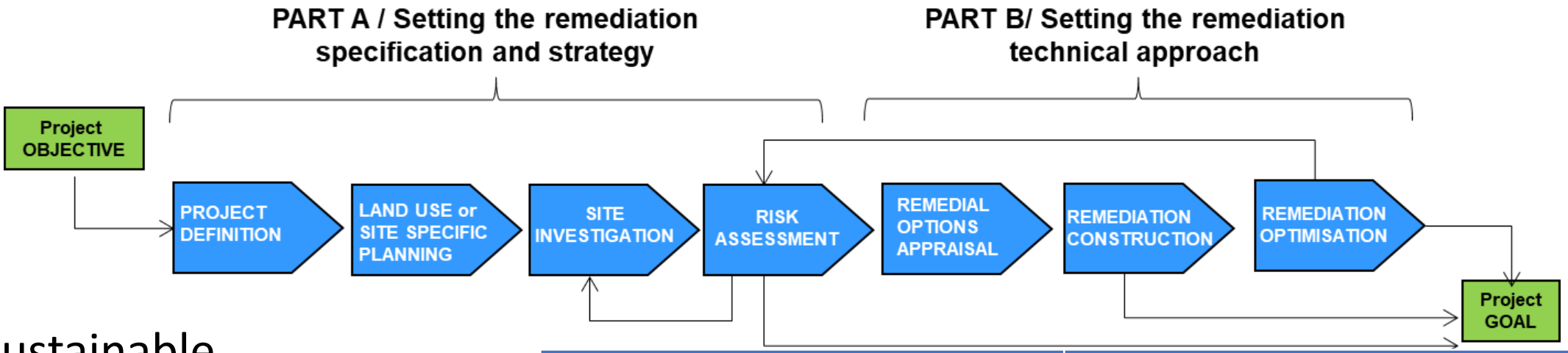
# Conclusions

- Range of risks that CLM practitioners need to navigate
- Climate change and financial and institutional changes can introduce risks to projects
- The SuRF-UK Framework allows evaluation of resilience to be built into projects
- Furthermore, the framework allows for the adoption of SMPs that can be implemented throughout the project lifecycle

# Resources

- CL:AIRE (in prep), SuRF-UK Bulletin: Resilience and Adaptation
- NICOLE (2020), Land Stewardship
- ITRC, (2020), Sustainable and Resilient Remediation
- Environment Agency, (in prep) Review of the climate change impacts on contaminated land management (CIRIA document)
- Environment Agency, (in prep) Incorporating climate change impacts into contaminated land risk assessments (nuclear industry focus) (WSP)
- SoBRA, (in prep) Incorporating climated change impacts into controlled waters risk assessments

# Incorporating resilience into the SuRF-UK Framework

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