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PROJECT REPORT

INS309-02 Developing a Fitness Test on Resilience to Water Scarcity

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CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

WSP have been commissioned by the Office for Environmental Protection (OEP) to develop a methodology which assess the resilience of key water-using sectors and industries to water scarcity, and whether risks to the environment associated with sector operations are considered in resilience planning.

The overall objective of the work was to create a methodology which could be deployed by the OEP to understand the resilience of key economic sectors to water scarcity and drought, enabling the resilience of Environmental Improvement Plans in England and Northern Ireland to be scrutinised with regards to the water environment. This project report aims to summarise the approach to the methodology.

1.1 SCOPE OF WORK

A Landscape Review conducted at the commencement of the project (INS309-02 Developing a Fitness Test on Resilience to Water Scarcity) provided a broad background to the current landscape of water management planning across the key sectors. It also provided an overview of drought history and associated impacts to help frame the development of the assessment methodology in later tasks.

A qualitative scorecard has been developed to understand the resilience of four key economic sectors: agriculture, industry, power and development. The scorecard is comprised of a risk assessment using open access data, and a series of questions across the six aspects of resilience as outlined in the National Infrastructure Commission (NIC; now the National Infrastructure and Service Transformation Authority) approach to resilience[1]. The approach is further detailed in Section 2 and 3 of this report.

The scorecard has been developed with English data to provide an assessment of risk of water scarcity by region. It is intended that this risk assessment will support the OEP to understand potential regional specific risks or approaches to resilience. At the commencement of the project, and alongside the Landscape Review, a review of the appropriate data was undertaken for both England and Northern Ireland. Openly accessible water availability and abstraction data is more limited in Northern Ireland, and therefore it was decided by the project team and with the guidance of the OEP to forgo including this region in the risk assessment. The scorecard has been developed so that the principles can be applied to Northern Ireland, and can be answered by responders in this region, however regional specific risks will need to be researched in further detail, beyond the scope of this project.

1.2 INTENDED USE

In collaboration with the Office of Environmental Protection, the scorecard has been developed to serve as a data collection tool on the resilience of the four sectors. It is structured so that an

[1] https://nic.org.uk/app/uploads/Anticipate-React-Recover-28-May-2020.pdf

interviewer can speak to a sectoral industry body and collect information on (1) their member companies/organisations' resilience to drought, and (2) how the organisation itself may contribute to regional or national-level resilience. This could be used by the OEP to understand where public authorities need to or are already facilitating readiness to water scarcity. The scorecard has not been developed to be used as a maturity assessment, and results should be viewed as a snapshot in time. It is anticipated that the scorecard will be used in a semi-formal interview type setting, with an interviewer, who is familiar with water scarcity, interviewing the industry organisation and collaboratively filling in the scorecard on behalf of the OEP.

2 RISK ASSESSMENT

2.1 OBJECTIVE OF THE RISK ASSESSMENT

The risk assessment seeks to provide an overview of the potential hazard and vulnerability of the sectors to water scarcity over time. The use of open access datasets was prioritised in order for the methodology to be easily deployable by third parties in the future.

2.2 RISK ASSESSMENT METHODOLOGY

2.2.1 WATER RESOURCES AVAILABILITY AND RELIABILITY

The Environment Agency Water Resource Availability and Reliability[2] dataset was used to understand the current availability of water across England. The data is based on a nationally consistent method, and is mapped to Water Framework Directive Cycle 2 water body catchments. This data provides an overview of the reliability of water for consumptive abstraction, with the darkest blue showing consumptive abstraction is available at least 95% of the time and the lightest blue showing consumptive abstraction is available less than 30% of the time (Figure 2-1). This gives an indication of the exposure of abstractors within a region to current water availability.

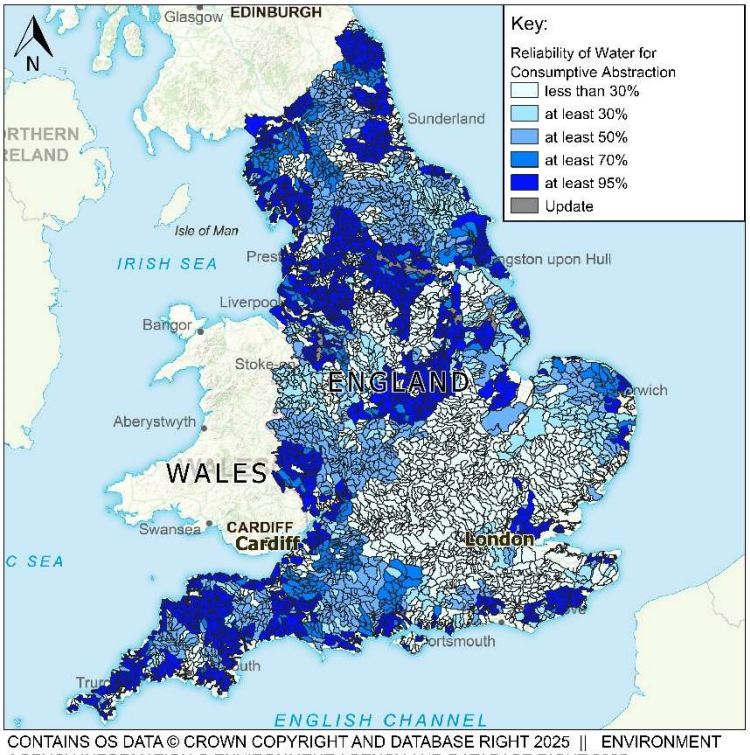

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Figure 2-1 - Reliability of Water for Consumptive Abstraction

[2] Environment Agency (2025) Water Resource Availability and Reliability https://environment.data.gov.uk/dataset/62514eb5-e9d5-4d96-8b73-a40c5b702d43

This dataset is for England only. A review of available data for the scope of this project for Northern Ireland has not realised any similar datasets.

2.2.2 WORLD RESOURCES INSTITUTE AQUEDUCT 4.0

The World Resources Institute (WRI) Aqueduct 4.0[3] Future Projections dataset was used to understand the potential future risk of water scarcity. The dataset is a global estimate of water stress, the ratio of projected demand to supply. Projections are centred on the milestone years 2030, 2050 and 2080 driven by general circulation models from the Coupled Model Intercomparison Project phase 6 (CIMP6). Socioeconomic variables are based on the Shared Socioeconomic Pathways database from the International Institute for Applied Systems Analysis. Three scenarios are available:

- “Optimistic” limiting the rise in global surface temperatures by 2100 to 1.3 – 2.4 compared to pre-industrial levels (1850-1900). Characterised by sustainable socioeconomic growth.
- “Business as Usual” with global surface temperatures rising by 2100 by 2.8 – 4.6 compared to pre-industrial levels (1850-1900). Characterised by regional competition and inequality.
- “Pessimistic” with temperature increases up to 3.3 - 5.7 by 2010. Characterised by fossil-fuelled development.

The Business and Usual scenario has been used to understand potential future risk of water scarcity regionally across the UK (Figure 2-2 and Figure 2-3).

[3] World Resources Institute (2023) https://www.wri.org/research/aqueduct-40-updated-decision-relevant-global-water-risk-indicators?auHash=74cRjEQPsH0NDpgT1NqIfNpqV-QpYNR4oiPo1HRhpGs

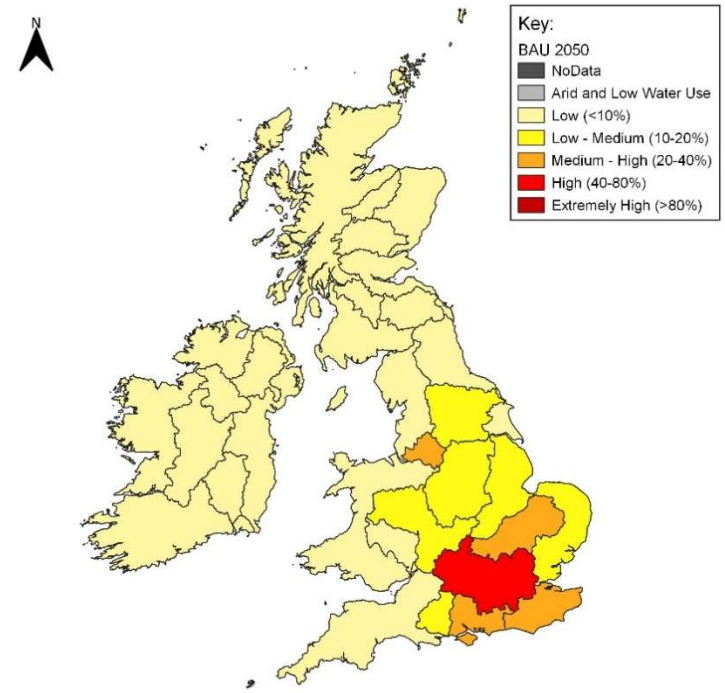

Figure 2-2 - Business as Usual 2050

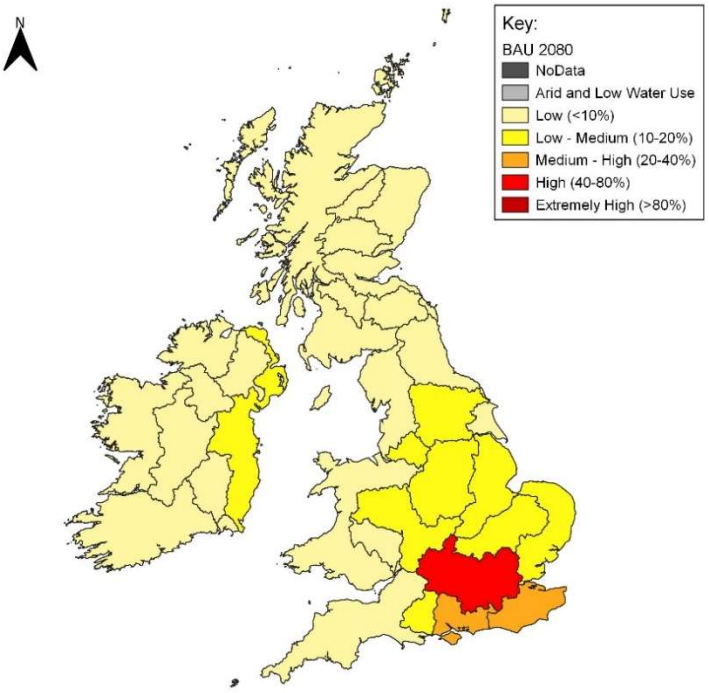

Figure 2-3 - Business as Usual 2080

2.2.3 ABSTRACTION STATISTICS

The Environment Agency Abstraction Statistics[4] were used to understand the distribution of abstraction licences for the key economic sectors. The dataset provides details of licenced abstractions measured in megalitres per day (ML/day) per year from 2000 to 2018 across England. The dataset does not include abstractions up to 20m^3/day as they are not required to be licenced under the Water Act 2003. The project looked at the abstractions from all surface and groundwater data, as these key sources are the most vulnerable to climate change. Tidal sources have therefore been excluded.

Consumptiveness is the amount of water which is abstracted and not returned to the natural environment. It is expressed as a ratio between 0 and 1. Consumptiveness is licence specific, and is a data field included in the National Framework 2 modelling currently being undertaken by the Environment Agency. Public water supply will have the greatest consumptiveness factor, owing to the fact it is mostly used for consumptive purposes. Power generation is likely to have the lowest consumptiveness factors, as water is generally used for cooling and returned to the natural environment.

2.2.4 REGIONS

Each dataset considers different areas which have been standardised into 7 regions and 16 sub-regions derived from the abstraction data and the WRI aqueduct data respectively (Figure 2-4). This is to enable the analysis of the data by region. Responders can select the region they are in or have the greatest presence in, to provide understanding of the potential risk of water scarcity now and over time. Interviewers can also use the risk assessment to tailor the scorecard, for example through the weighting of questions or asking regional specific questions, to further understand local risks.

[4] Environment Agency (2019) ENV15 - Water abstraction tables for England https://www.gov.uk/government/statistical-data-sets/env15-water-abstraction-tables

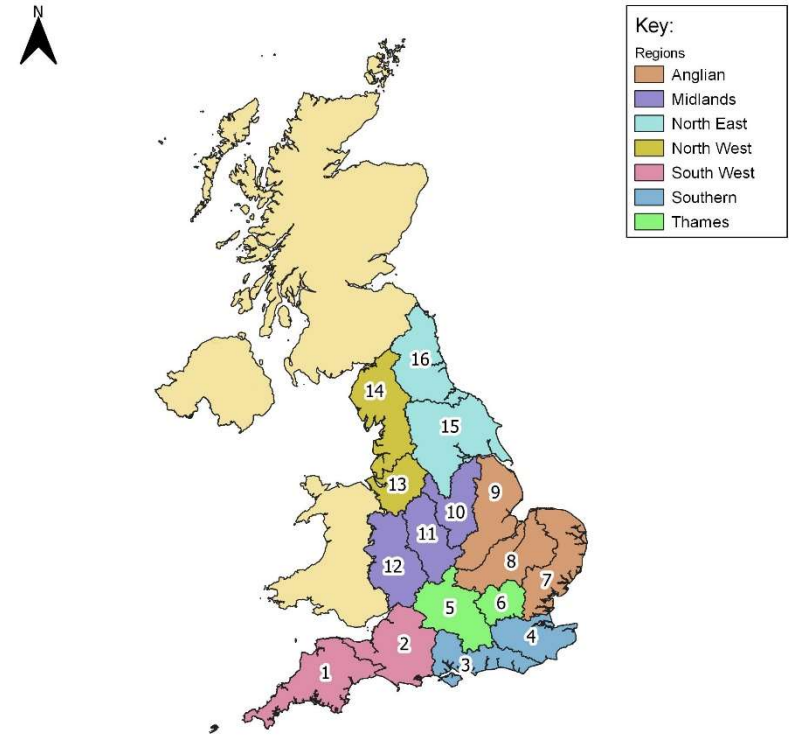

Figure 2-4 - Adjusted Regions Used in the Scorecard

The Water Resources Availability and Reliability dataset consists of 4,436 regions across England. These were aggregated into the 16 regions by averaging across each region. When aggregating this dataset, the areas of the 4,436 regions were considered. Across the 4,436 regions each of the categories for the reliability of water for consumptive abstraction were assigned a value (Table 2-1), this value was then multiplied by its area. For these an average was taken across each of the 16 sub-regions which was then divided by the total area for that region, creating an overall reliability value for each of the 16 sub-regions.

Table 2-1 – Water reliability data and assigned categories for data processing

Reliability of water for consumptive abstraction ('resavail') category	Assigned value
Less than 30%	1
At least 30%	2
At least 50%	3
At least 70%	4
At least 95%	5

Abstraction data is given by the 7 regions, annually from 2000 to 2018 by sector. The annual data was averaged by sector and by region to give an indication of abstraction.

2.3 LIMITATIONS

The World Resources Institute Aqueduct Future Projections uses a global circulation model. A UK specific hydrological and climatological projection model, such as eFLaG[5] may better represent the risk of water stress to the UK over time. The eFLaG data is openly available, however was not used in this project due to its granularity. The eFLaG model outputs are provided at a catchment scale. As the intended deployment of the scorecard will be to industry associations, the catchment focus is less important as industry association members may be located across multiple catchments. Further, the dataset focusses on drought characteristics and low flow time series across the modelled time series, which doesn't alone provide indication of the potential chronic water stress to any one sector making it less relevant to achieve the objectives of the risk assessment.

To provide ease for deployment, the Water Resource Availability and Reliability dataset has been scaled up to the regional level. This has resulted in the granularity of the dataset being lost, however due to the intended deployment method a regional assessment is appropriate.

[5] UK Centre for Ecology and Hydrology (2022) https://www.ceh.ac.uk/our-science/projects/eflag-enhanced-future-flows-and-groundwater

3 QUALITATIVE SCORECARD

3.1 QUALITATIVE SCORECARD METHODOLOGY

A scorecard has been created for each economic sector (agriculture, industry, power and development) with both sector-specific and cross-cutting questions. The scorecard includes both questions about member organisations (of the industry association) and of the industry organisation completing the scorecard. The member organisation questions are categorised across the six NIC (now National Infrastructure and Service Transformation Authority) aspects of resilience, into four sections:

- Anticipating and Preparing - Actions taken to prepare for acute shocks and stresses, such as forecasting or checking the conditions of assets.
- Resisting and Absorbing - Actions taken to help an entity withstand or endure acute shocks and chronic stresses, preventing or lessening any impacts.
- Recovering Quickly - Actions that help an entity quickly restore business or service following a shock.
- Adapting and Transforming - Actions that modify or transform an overall system to enable continuous operation in the face of long-term changes or stresses.

Each question has an answer ranging from 0 – 3, which represents least resilient actions (0) to most resilient actions (3). Answers are specific rather than a scale, to enable the data users to understand where there are gaps in resilience actions. Responders can add further text detail for each question to support the answers they have provided.

Each question is weighted within its section, e.g. the question weightings under ‘Anticipating and Preparing’ total 100%. This provides a resilience score against each section, so that data users can understand where the greatest weaknesses in resilience actions are. Interviewers who are deploying the scorecard, could amend the weightings within each sector if necessary, if there are questions within the section more interesting or necessary to understand in current policy context.

Both the questions and answers were developed using the Landscape Review at the commencement of the project to contextualise the current likely approaches to water scarcity, and targeted literature review where necessary. All sources are included in the scorecard. The scorecard has been tested by a group of WSP Subject Matter Experts (SMEs) covering each sector and broader resilience and water quality. The scorecard has also been tested by the OEP’s College of Experts (CoE) who have extensive experience in water resource management.

The scorecard should be deployed alongside a pre-information pack, a template of which is included in Appendix A. It is anticipated that due to the nature of deployment to industry associations, providing pre-information for the associations to consider prior to completion of the scorecard may result in the answers provided being more meaningful. It will also provide the user some context for resilience and water scarcity.

3.2 LIMITATIONS

Due to the intended deployment of the scorecard, the questions have been developed to broadly cover a wide group of organisations across different sizes and sub-sectors. As a result, the data

gathered from an industry association may not provide insights into specific areas for resilience and will be limited on their knowledge of their member organisations.

4 FUTURE DEVELOPMENT, RECOMMENDATIONS AND NEXT STEPS

The risk assessment methodology has been developed using readily available, open access datasets to enable third party deployment. Data covers England, with open access data being less available in Northern Ireland and therefore in this phase has been excluded. This could be updated with any data which provides information on abstraction and water stress risk both now and into the future. This includes data such as the National Framework 2 dataset (Environment Agency) which holds actual and recent abstraction data and how much water is needed to maintain environmental flows. eFLaG could be used to better understand future water scarcity risk, particularly the potential impact of acute droughts. The eFLaG portal[6] is an interactive tool to explore the dataset, including drought event characteristics such as duration, maximum deficit, and total deficit, and transient low flow at varying Q values. This data may provide interviewers interesting catchment specific parameters to explore further with the responders.

The risk assessment could also be further developed to enable the user to use specific postcode data to understand their risk of water scarcity. This would allow greater granularity of the risk to be included in the assessment, but would be redundant if the method of deployment remains to regional or national industry associations. If future requirements necessitate a regional focus, the scorecard weightings could be linked to the risk assessment weighting. For example, if in a region with a greater risk of water scarcity over time, the answers could be weighted to indicate that a greater level of resilience actions is required to mitigate risk over time.

A list of initially identified industry associations, created in collaboration with the WSP SMEs and OEP CoEs is included in Appendix B. This is not intended to be an exhaustive list, but aims to provide an indication of the associations which would be interesting to test resilience with.

Power is the largest abstractor of all sectors[2]. The Landscape Review highlighted that the power sector through the Joint Environmental Programme (JEP)[7] is taking a more proactive and strategic approach to water resource management and are highlighting key questions for the power sector to consider when thinking about water use now and into the future. It may be interesting for the OEP to test the scorecard with JEP or other power industry associations to understand how this research has informed business practices. It may also be interesting to test the resilience of the sector in terms of sub-sector, for example with the potential increase in hydrogen power in line with the Government's Net Zero ambitions[8]

Alternatively, the Landscape Review indicated that the impact of previous drought events have resulted in the greatest impact to the agriculture sector. Therefore, it may be interesting for the OEP

[6] UK Centre for Ecology and Hydrology (
[7] Joint Environmental Programme (JEP) (2025) https://www.thejep.org/
[8] Department for Energy Security and Net Zero (2024) UK Hydrogen Strategy. https://www.gov.uk/government/publications/uk-hydrogen-strategy/uk-hydrogen-strategy-accessible-html-version#chapter-1-the-case-for-low-carbon-hydrogen

to test whether previous events have impacted the agriculture sector's approach to water resilience, and where there are potential gaps in enabling factors.

Appendix A

PRE-INFORMATION TEMPLATE PACKAGE

INTRODUCTION

The interviewer should be clear about the reason for deploying the scorecard, the objective for the work and the intended use of the data obtained. The interviewer should collect the required information in the 'Instructions' tab of the scorecard, shown below.

Question 4 is to enable the data to be analysed according the regional risk outlined below. This template has been developed with knowledge of English datasets, however is transferable to Northern Ireland.

STEP 1: Organisation Information
1. Organisation Name:
2. Sector:
3. Is there a specific sub-sector that the organisation would fall under (i.e., chemical manufacturing, horticulture, etc.)?
4. Which region in England are most of the organisation's members based?
5. What is the typical size of the organisation's member companies (e.g., by employees, revenue, or operational scale)?

REGIONAL RISK

The interviewer should include, where appropriate, a regional map(s) showing the current water availability and give indication of how this might change over time. The following datasets may be used:

- *Environment Agency Water Resource Availability and Reliability[9] for indication of current water stress (Open Government Licence)*
- *Environment Agency National Framework 2 modelling for indication of current and future potential water availability including abstraction information and understanding of environmental destinations (not currently open access (2025))*
- *The World Resources Institute (WRI) Aqueduct 4.0[10] Future Projections dataset for indication of future water stress (Creative Commons licence)*

[9] Environment Agency (2025) Water Resource Availability and Reliability https://environment.data.gov.uk/dataset/62514eb5-e9d5-4d96-8b73-a40c5b702d43

[10] World Resources Institute (2023) https://www.wri.org/research/aqueduct-40-updated-decision-relevant-global-water-risk-indicators?auHash=74cRjEQPsH0NDpgT1NqIfNpqV-QpYNR4oiPo1HRhpGs

- *eFLaG[11] for indication of future water stress (Open Government Licence) for indication of UK specific future water stress. Interviewers would need to select the relevant hydrological models.*

This data is mostly only relevant for England, however similar datasets for Northern Ireland could also be included if available.

SECTOR VULNERABILITY

The interviewer should give context to the potential vulnerability of the sector to water scarcity. This could include a narrative of the indication of impacts of water scarcity and the distribution of abstractions within the region. Interviewers could also include reference to land use policies such as relevant local plans, or the upcoming Land Use Framework to understand potential future competition for water resources.

Water scarcity may impact sectors in some of the following ways:

Power

- *Vulnerability of energy generation due to water resources for cooling becoming unavailable*
- *Reduced output where there are higher costs of raw materials e.g. for bioenergy crops or hydrogen generation*

Agriculture

- *Reductions in agricultural productivity (yield), particularly of rainfed crops and crops relying on abstracted water for irrigation.*
- *Reduced crop quality due to soil moisture deficits.*
- *Projected changes in crop suitability to other crops more suited to drier conditions.*
- *Changes to milk volumes due to shortages in livestock feed.*
- *Risks to livestock welfare and health.*

Industry

The industry sector is broad. Reported impacts would be more meaningful if they were sub-sector specific.

- *Reduced output where there are higher costs of water or ingredients, or disruptions to raw materials supply*
- *Disruptions to onward supply chain*

[11] UK Centre for Ecology and Hydrology (2022) https://www.ceh.ac.uk/our-science/projects/eflag-enhanced-future-flows-and-groundwater

RESILIENCE

In the pre-information package, the interviewer should describe how 'resilience to water scarcity' is defined within the context of the scorecard. It is important to acknowledge that individuals may interpret resilience differently based on their background, experience, or sector.

The information package should explain that the scorecard is based on the National Infrastructure Commission's (NIC, now National Infrastructure and Service Transformation Authority) definition of resilience. According to the report, resilient infrastructure can maintain essential services during acute shocks and has the capacity to adapt and evolve in response to long-term, chronic stresses. In this project, this definition is applied specifically to assess how well the agriculture, industry, power, and development sectors in England can continue to function under conditions of water scarcity, and how effectively they can adapt or transform to meet future challenges. They are assessed under four categories:

- *Anticipating and Preparing - Actions taken to prepare for acute shocks and stresses, such as forecasting or checking the conditions of assets.*
- *Resisting and Absorbing - Actions taken to help an entity withstand or endure acute shocks and chronic stresses, preventing or lessening any impacts.*
- *Recovering Quickly - Actions that help an entity quickly restore business or service following a shock.*
- *Adapting and Transforming - Actions that modify or transform an overall system to enable continuous operation in the face of long-term changes or stresses.*

Appendix B

INITIAL LIST OF INDUSTRY ASSOCIATIONS

Sector	Industry Association
Agriculture	Agriculture and Horticulture Development Boards
Agriculture	Broadland Agricultural Water Abstractors Group
Agriculture	British Trout Association
Agriculture	Country and Landowners Association
Agriculture	East Suffolk Water Abstractors Group
Agriculture	National Farmers Union
Agriculture	Farm Advisory Service
Agriculture	Horticultural Trades Association
Agriculture	Leaf Linking Environment & Farming
Agriculture	Producer Organisations
Agriculture	UK Irrigation Association (Water for Food Group)
Agriculture	Internal Drainage Boards
Industry	Aerospace Wales Forum
Industry	Association of British Pharmaceutical Industry
Industry	Chemical Industry Association
Industry	Confederation of Paper Industries
Industry	Data Centre Alliance
Industry	British Chemicals Association
Industry	British Glass
Industry	Food and Drink Federation
Industry	Ceramics UK
Industry	Mineral Products Association
Industry	Institute of Grocery Distributors

Industry	Manufacturing Northern Ireland
Industry	Mining Association of United Kingdom
Industry	Paper Industry Technical Association
Industry	Scotland Food and Drink
Industry	UK Fashion and Textiles Association
Industry	UK Steel
Power	Energy UK
Power	Joint Environmental Programme (JEP)
Power	HydrogenUK
Power	RWE Generation UK
Power	Uniper

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