WaterProof Northwest

A partnership project between:

MERSEY BASIN CAMPAIGN

MANCHESTER 1824
The University of Manchester

Sponsored by:

Environment Agency

United Utilities

WaterProof Northwest was sponsored by the Environment Agency and United Utilities and was managed by the Mersey Basin Campaign. The scenario development was contracted to the University of Manchester.

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The future is inherently uncertain. It is not possible to accurately predict how the environmental, economic and social forces that shape the growth and development of a region will evolve over time. Nevertheless, despite this uncertainty, decision makers across a range of sectors must develop and implement long term plans and strategies to influence issues such as the spatial development and economic competitiveness of a region. In the same way, water bodies in the Northwest - its rivers, streams, lakes and coastal waters - are impacted directly by an array of driving forces. Issues including levels of development activity, the extent of population growth, the priorities of political decision makers and the degree of climate change will all profoundly affect the state of the region's water environment. They will also influence the form and effectiveness of any plans and strategies designed to manage this fundamental environmental resource. It is crucial that organisations responsible for the management of the water environment are able to acknowledge, reflect on and engage with the key drivers of change influencing the region and its waters both in the short and long term. It is this wide reaching and challenging arena that provides the context for the WaterProof Northwest project.

"The future is inherently uncertain. It is not possible to accurately predict how the environmental, economic and social forces will shape the growth and development of a region will evolve over time"

An initial objective was to develop a series of water based scenarios with the potential to inform future decision making with regard to water management as a whole, the research then applied these scenarios with specific regard the future challenges and opportunities associated with meeting the goals of the Water Framework Directive (WFD) in Northwest England. Therefore, WaterProof Northwest is designed to illuminate relevant long term issues in the context of water management, provide a specific insight into the delivery of the WFD and to create scenarios with the potential to be applied within the water sector in the future.

The Water Framework Directive:

The WFD is Europe's most ambitious piece of water management legislation, streamlining previously separate water related legislation under one umbrella. The Directive outlines the basic principles of a comprehensive, holistic and sustainable approach to water management. Important objectives include:

- Preventing further deterioration of any surface (inland and coastal) and groundwater bodies.
- Encouraging the sustainable use and protection of water supplies.
- Protecting and enhancing the aquatic environment (habitats and species).
- Reducing point source and diffuse pollution to surface and groundwater bodies.
- Helping to mitigate the effects of flood and droughts.

The Directive provides a framework for developing procedures to help achieve these goals. This focuses on the development of River Basin Management Plans (RBMP) and programmes of measures to implement water management actions. A catchment approach to water management based around natural river basins is promoted. This acknowledges that administrative boundaries defining countries, regions and municipalities are not the most appropriate scale to manage water resource. The WFD encourages an ecosystem-based approach to water management recognising the significance of water for both humans and the natural environment.

The Environment Agency (the competent authority responsible for delivering the WFD in England and Wales) anticipates that achieving the goals of the WFD in the region will take almost two decades (see figure 1). The vision of the RBMP for the Northwest River Basin District confirms the long term nature of the Environment Agency's strategy to improve the region's water environment, stating that: "The vision is for all surface water bodies to achieve Good Ecological Status or Good Ecological Potential by 2027..." (Environment Agency, 2008).

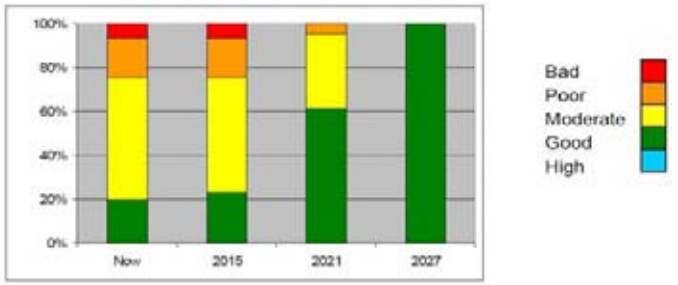

Figure 1: Good ecological status/potential in Northwest water bodies: targets for subsequent planning cycles (Source: Environment Agency, 2008)

Responding to the WFD in England's Northwest is clearly a long term challenge. In practice, there is considerable uncer-

tainty surrounding the future direction of key drivers, such as economic growth or technological change, which will impact on water quality and quantity issues in the region. Crucially, the scenarios method offers a mechanism for bringing these issues into the decision making process and highlighting those aspects which, although may have a key influence, may rest outside of the power of the Environment Agency. It is the development of scenarios that forms the heart of the WaterProof Northwest project. The scenarios described within this report provide an insight into how the Northwest's water environment could evolve over the coming decades through looking at different paths for, and interactions between, key drivers of change influencing the future of the region.

Introduction to the scenarios approach:

In January 2006 Stephen Ladyman, former Minister for Transport, said at the launch of Foresight's Intelligent Infrastructure Systems project:

"We can either stumble into the future and hope it turns out alright or we can try and shape it. To shape it, the first step is to work out what it might look like".

This statement highlights the key factor motivating WaterProof Northwest. The project aims to contribute a 'futures perspective' to WFD implementation, and to water management in the region more generally. To consider the future in this way requires innovative thinking on the kinds of paths that society may take and the key influences that may shape issues within the water environment. Scenarios are designed to aid this process of long term, future thinking.

A scenario is essentially an imagined sequence of future events. Scenarios are not predictions or forecasts, and levels of probability are not assigned to individual scenarios. Instead, they can be most effectively viewed as vehicles though which different possible futures can be visualised and their implications assessed. Scenarios are used across a wide range of sectors to aid decision making during the development of policies, strategies and projects. For example, Royal Dutch Shell pioneered the use of scenarios in a corporate setting. Since the 1970s, scenarios have been used by Shell as an input into strategy making and have helped them to anticipate changes in oil markets. Today, organisations from the public, private and third sectors utilise scenarios to aid planning and decision making.

"The process of developing and working with scenarios can help individuals and organisations to challenge their 'worldview' and perceptions of how the future may unfold"

In short, the advantages of using the scenarios include:

- The future is uncertain, yet decision makers must continue to develop forward plans in the face of uncertainty. Scenarios can assist this process through proposing alternative visions of the future, and the key forces driving change. Used in this way, scenarios can help to broaden consideration of the scope of possibilities influencing decisions.
- Scenarios are a valuable tool for examining the potential robustness of policies, strategies and projects under different possible futures. Scenarios present the opportunity to consider associated opportunities and challenges relating to their development and implementation, and may lead to changes strengthening forward plans.
- The process of developing and working with scenarios can help individuals and organisations to challenge their 'worldview' and perceptions of how the future may unfold. Viewed in this way, scenarios are a valuable learning and awareness raising tool.

Drivers of change:

Driver methodology overview:

The most challenging aspect of horizon scanning projects is not in recognising which factors drive change, but rather in selecting the few most relevant factors and mapping them onto a scenario framework. The first stage therefore was to establish a logical framework to identify relevant drivers, assess their potential impact and subsequently integrate them within the WaterProof scenario creation process. To aid simplicity we have used the same definition of drivers used by the Environment Agency (Environment Agency, 2006) within their existing scenario research, where a driver was defined as: "a key factor, force, trend or issue that could significantly influence the pressures on the environment in 2030". The methodological approach to driver identification and analysis is a three stage process, whereby a framework for analysis is created; a long list of potential drivers with the potential to affect water and the WFD in the Northwest is compiled; and this is whittled down into a short list of key drivers to inform the scenario creation.

Stage 1: Creation of driver identification and analysis framwork

In scenario based research drivers can include a variety of potential factors, such as climate change, population growth and environmental awareness. The scope of potential influences can be dauntingly broad however, and a strategy is required to help shape and inform choices. This phase of the research used a methodology influenced by the STEEP process, an acronym for categorising elements into Social, Technical, Economic, Environmental and Political classifications - an approach that has been commonly used within similar studies. These wide reaching forces for change are designed to provide a framework for organising relevant drivers within any scenario building exercise.

Stage 2: Selection of the “long list” of drivers

The Environment Agency 2030 scenarios have been used to guide the WaterProof project to maximise linkages with both existing strategies and the agency charged with implementing the WFD. Within this document an initial list of 51 drivers were identified, which were then honed down to 19 prioritised drivers considered to exert the most significant pressure on the UK environment up to 2030 (Environment Agency, 2006). Analysis of these drivers formed the first stage of the creation of the long list, where a desk top review of potential influences upon the WFD was conducted. In addition to the Environment Agency 2030 scenarios, which cover generic influences on the environment, a number of other relevant documents were studied to focus more specifically on water and the Northwest.

A meta-analysis of potential trends conducted for Defra's Horizon Scanning and Futures Programme identified 152 differing projects which discuss drivers in a comparable fashion and a total of 321 separate drivers were identified with the potential to impact on Defra's remit over the next 20 years (Talwar and Schultz, 2005). Whilst overly broad for a research project of the scope of WaterProof, the work does provide a starting baseline and database of key environmental drivers to be considered and developed further. More manageably, the Office of Science and Technology highlights 23 drivers, but these are both directly related to flood risk and utilise a different methodology for analysis (Evans et al, 2004). An alternative approach to driver identification was conducted within the Foresight Futures 2020 programme; here only three very broad drivers are identified: social values, governance structures and role of policy. These were further unpacked via consideration of eight, smaller, though still significant, economic and social trends, such as economic development, unemployment and equity (Department for Trade and Industry, 2002).

The broad scope and lack of clear agreement amongst existing horizon scanning research reinforces the view that to have maximum impact the WaterProof project should develop its own discrete set of key drivers with particular relevance to the region's water environment and the effective delivery of the WFD. Therefore to have maximum impact the drivers needed to be considered within the context of these goals.

The next phase of driver identification was also informed via two workshops, one with the project steering group and a second with regional stakeholders. In total, the workshops were attended by 27 people with knowledge of the WFD from a variety of key regional organisations. The workshop participants removed, added or merged selections to complete an agreed long list, which was presented within the STEEP framework. Table 2 details the long list of 50 wide reaching issues, which were then utilised as a baseline to help select the most significant drivers of change: the short list.

Stage 3: Selection of the “short list” of key drivers

The production of the long list provides both an important contextual input to the scenario creation exercise and also a manageable framework from which to highlight the most significant and relevant drivers to build the WaterProof scenarios around. The research considered the long list of drivers and, via two workshops and a series of interviews, selected a short list of key drivers with the most potential to impact upon the water environment of the Northwest. The workshop participants were split into three groups and asked to use the long list to identify what they would consider would be the five most relevant key drivers. In practice, some drivers were deemed to be overlapping and amalgamation was encouraged, with new headings created. In total 10 key drivers

were selected by the participants, with a description provided for each outlining the scope of the issue and giving an insight into the links with the water environment. The compilation of the short list was also supplemented by interview data from 15 key regional stakeholders.

The identification of both the wide WFD drivers (the long list) and those with more significant influences (the short list) is important for the construction of the storylines within the four WaterProof scenarios. Whilst all drivers will provide input, the selection of the most significant drivers will enable a more realistic and tailored set of scenarios to be developed which have key links with the WFD in the North-west. The following section provides an outline of each of the 10 key WaterProof drivers.

SOCIAL	TECHNOLOGICAL	ECONOMIC	ENVIRONMENTAL	POLITICAL
• Population & demography • Education • Affluence • Social conscience • Consumer behaviour • Communication • Crisis • Inequality / justice • Health and wellbeing • Lifestyle • Perception of risk	• Scientific knowledge • Appliance of science • Water efficiency & re-use • Working patterns • Source control • Smart metering • Information • Interactivity • Energy generation	• Gross Domestic Product • Public spending • Employment • Transport • Tourism • Structural change • Water costs • Infrastructure costs • Competition • Subsidies • Carbon management • Life cycle infrastructure • Energy pricing	• Climate change • Land use change & management • Agricultural practices • Environmental awareness • Recreation • Full cost pricing	• Globalisation • Regulation & legislation • Political will • Lobbying • Governance processes • Institutional structures • Partnerships • Leadership • Local planning • Market structures • Devolution of decision making

Table 1: The long list of WaterProof drivers in STEEP categories.

The Short List: Description of the 10 key WaterProof drivers

1. Social conscience & behaviour:

People can influence almost any aspect of water usage; and the attitude and behaviour of the general public is fundamental to achieving wider goals. This can be a direct influence such as adopting water efficiency measures, or indirectly by, for example, voting for a particular political party. The views of the public can be influenced by both carrot and stick approaches, which subsequently link to factors such as education and financial penalties. A crisis may also have the potential to significantly shift perceptions. The topic is further related to issues such as social conscience, education, lifestyle, well being, inequality, information, interactivity and working patterns – all of which can affect the relationship between people and their environment.

2. Leadership:

This may also be termed the 'Obama Effect', whereby a charismatic leader with a single vision and the power to follow it through can make great strides in influencing society. This includes all scales of leadership from the desire of a local champion to persuade changing practices to a city mayor with a clear environmental agenda. Leadership creates the potential for a bold, visionary, aspirational view that has a positive focus, and can challenge convention. The topic is connected with wider aspects such as lobbying, partnerships and political will. The village of Ashton Hayes provides an example of the success of leadership at a local level, as the village aims to become Britain's first carbon neutral locality, providing inspiration and good practice for elsewhere.

3. Climate change:

Climate change will bring considerable, wide ranging impacts and opportunities. It could also have huge influences on where and how we live. It is estimated that the effects will grow over time and could impact upon both the supply and demand for water. Within the Northwest, UKCIPs scenarios suggest that we can expect changing patterns of precipitation, with a tendency for more extreme events. Significantly, the changing precipitation patterns will also affect our capacity to cope, with for example flooding becoming more possible from both natural and more man made sources, such as the rising demands on drainage infrastructure. It also links with the powerful drivers of crisis and extreme climatic events and is therefore connected with topical issues such as risk, resilience and adaptation.

4. Appliance of science:

This driver is concerned with all aspects of innovative development and the application of technology. This includes measures such as water metering, and the reuse and recycling of the resource. The category also enables the effective monitoring of both the environment and people, and can therefore relate to pricing and social behaviour. It is therefore linked with aspects such as affordability, regulation and legislation. The driver also has a wider influence as it encompasses the availability of information, such as from the internet, and interactive dissemination, such as via Twitter, all of which have the possibility to change behaviour.

5. Land use change and management:

The function that land serves and the way that it is managed can have wide reaching affects on both the natural environment and how we behave. The SWMIs may be closely linked to this area as both point source and diffuse pollution are influenced by how we interact with land. It can also cause or alleviate flooding, or the consumption of water resources and covers both rural and urban areas. Wider linkages therefore include agricultural practices, urbanisation, transport, and energy generation. This topic is also related to intervention mechanisms such as local, regional and national planning.

6. Devolution of decision making:

The devolution of decision making widens the potential for local level leadership and innovation to occur. This is related to social conscience and is focused on people taking ownership for the decisions taken, both on a personal level and within their community. This could include, for example, localised water treatment and energy generation. The topic is therefore linked to widening local democracy and providing the facilities and tools to enable social conscience to be effective. The driver is most closely connected with leadership, and crucially, an enabling regulatory and legislative framework to provide stimulus and remove barriers to action.

7. Investment:

Investment is crucial to achieving the goals of the WFD. This can include, for example, significant capital expenditure on new sewers, new reservoirs or additional flood defences. On a smaller scale it could encompass universal water metering or the potential for SuDS use. Investment can therefore directly influence all aspects of the SWMIs, from pollution to flow and abstraction. The subject also has a less technical aspect, such as an investment in education in order to change the behaviour of actors and agencies.

8. Population and demography:

The Northwest is expected to experience both an increase in regional population and households over the first part of the 21st century. This will inevitably provide an upward trajectory on a whole host of related drivers and impacts. The additional people will need to live, work and travel and will therefore affect behavioural and consumption issues such as water and carbon usage, whilst the associated urbanisation will affect runoff and diffuse pollution. The increase may also affect exposure to risks due to floodplain occupation or sewer flooding, and is therefore connected with land use change and management.

9. Institutional and economic structures:

The way that we design and operate institutional and economic structures has a key influence on the behavioural of people, organisations and governments. For example, it determines how the water industry is organised, the availability of incentives/subsidies, and the level of competition. It can shape the relationship between key actors such as the government, regulator and the consumer, and can use economic instruments to achieve specific outcomes. Therefore the issue can directly affect the SWMIs and indirectly influence the water environment, by for example, the application of technology, full cost pricing, efficiency and the services people receive.

10. Regulation and legislation:

This is a practical selection reflecting the power that regulation and legislation can wield over the individual, organisation or wider governance agencies. This driver therefore operates on a number of levels, from Europe down to the action of local councils. The sphere of influence is wide, ranging from issues such as full cost pricing, smart metering, and the availability of subsidies, all of which can influence personal and industry behaviour. The topic can also potentially improve the quality of water resources by affecting the level of pollution or the volume of abstraction. To be effective however, it does need to be both effectively worded and implemented, and integrated with other related measures.

The WaterProof Northwest scenarios:

The WaterProof scenarios are based around the classic 'quadrant' approach used to organise recognised scenario sets such as those developed by the Environment Agency and the UK government's Foresight programme. Four contrasting scenarios have been created by combining two axes based around the drivers of change identified as being central to the future of the region and its water environment (figure 2). The two axes forming the basis of the WaterProof scenarios are the focus of governance systems and societal values. These are explained in greater detail below. Participatory workshops and interviews with relevant individuals provided information and insights to enrich the scenarios and the storylines that sit within them. The development of the scenarios was guided by a core project team involving staff from the University of Manchester, the Mersey Basin Campaign, the Environment Agency and United Utilities.

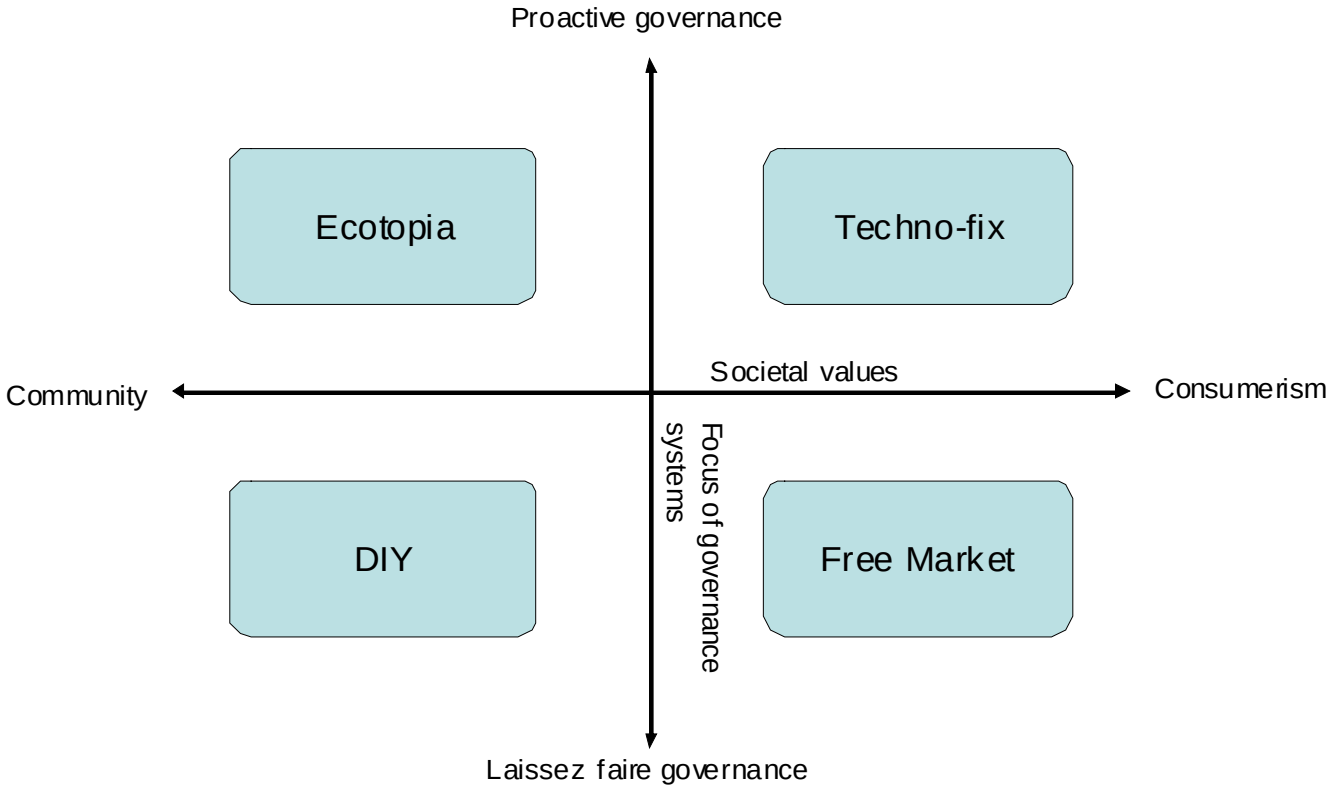

Figure 2: Basic structure of the WaterProof Northwest scenarios

Focus of governance:

Governance relates to the exercise of power and influence through government policy and decision making. The focus is on actions and decisions within the public sector (at national, regional and local scales), including relationships with the private sector and civil society. Due to the complexity of the water sector and the close relationship between society and the natural environment, governance arrangements are central to the future of water in the Northwest region. The governance axis captures drivers on the WaterProof 'short list' including institutional and economic structures, leadership, land use change and management, regulation and legislation and devolution of decision making.

Within the WaterProof scenarios, the extremes of the governance axis are proactive governance and laissez faire governance.

Laissez faire governance:

Laissez faire is a French phrase broadly meaning 'let it be.' Here the public sector exerts minimal control over the market in the belief that the private sector is the most appropriate and efficient way to deliver high rates of economic growth. Increasing levels of Gross Domestic Product is the principal goal of government and is viewed as the best way of solving economic and social problems. As a result, taxes are low, and there is little regulation of private sector activity. In addition there is little government intervention in other aspects of society, with many functions such as health care and education contracted out to the private sector.

Proactive governance:

The public sector takes an active role in attempting to shape the future, rejecting the market driven approach. An holistic long term view of the links between society, the economy and the environment is taken. The government leads by example in terms of sustainable management of the public sector estate and procurement processes. Intervention through taxation, regulation and legislation targeted at influencing actions and behaviour of the private sector and citizens is widespread. The aim is to develop policies to prevent environmental, economic and social problems from occurring rather than addressing them when they arise.

Societal values:

The values held by any society are a defining factor in the success or failure of a wide range of initiatives from education to environmental management. The values of society concerning the protection of the natural environment and its role in people's lives are crucial to the future management and use of water. The societal values axis captures drivers on the WaterProof 'short list' including social conscience and behaviour, appliance of science, leadership and investment (which in the water management sector is influenced significantly by the public's willingness to pay for environmental improvements). Further, responses to climate change are shaped by societal values and attitudes concerning the relationship between humans and the natural environment.

The WaterProof scenarios take the terms consumerism and community to reflect the extremes of the societal values axis.

Consumerism:

Consumption-driven values are dominant, with the acquisition of material goods and 'life-experiences' motivating behaviour. Little attention is give to the wider impacts associated with individual actions, and awareness of environmental problems is low. This is due to issues including an education system that lacks coverage of the links between humans and the natural environment, an uncooperative mass media, and the existence of government policies that focus on the promotion of wealth creation. Inequality in society is high with some sectors prospering whilst others suffer from social deprivation and economic hardship.

Community:

Society acts collectively towards the achievement of commonly held goals relating to protecting and enhancing environmental quality and encouraging social progress and equality. Awareness of these issues is high amongst society, with people's behaviour adapting accordingly. Less focus is placed on material gain and personal wealth with greater attention paid to wellbeing and quality of life. Government policies and programmes from the national to local scale support this approach, with the private sector also engaged in providing proactive solutions to issues such as improving environmental quality.

"The values of society concerning the protection of the natural environment and its role in people's lives are crucial to the future management and use of water"

Timescales and spatial scales:

The WaterProof Northwest scenarios take the period from the present day to 2030 as their time horizon. Several relevant regional initiatives link to this timescale, which lends a policy-relevance to the scenarios. These include the emerging Integrated Regional Strategy for the Northwest, which looks to 2030 and provides a policy framework for economic and spatial development. It is also significant that the RBMP for the Northwest River Basin District, the key policy document guiding the long term management of the region's water environment, has a central goal of achieving good ecological status/potential in all water bodies by 2027. It is acknowledged, however, that for some drivers of change (particularly climate change), longer time horizons are important to consider.

In terms of spatial scale, the focus is the Northwest River Basin District which is roughly analogous to the boundaries of the Northwest region (see figure 3). The scenarios are therefore intended to be valid for both the region and River Basin District. This will help to ensure that the scenarios are of use across a wide range of sectors and stakeholders in the region.

Figure 3: The Northwest River Basin District (Source: Environment Agency, 2008)

Interpreting the scenarios:

The following sections interpret each of the four scenarios and provide an illustrative storyline with regard to both the direction of society in general and a more specific focus on the water environment. These visions of the future have been developed in partnership with the project stakeholders to help increase wider understanding of the various pressures affecting water management in the Northwest.

"The collaborative process of developing the scenarios and applying them to the implementation of the WFD has been designed to raise awareness of the complex range of pressures on the Directive and their potential consequences"

It is worth noting that although the drivers within each alternative future remain the same, their impacts may be subtly different dependent upon how they relate to either the focus of governance systems or societal values. For example, consideration of key issues such as science, investment and regulation will occur in all scenarios, but their influence will not remain constant; in one outlook these measures may be strong, whilst in another they could be weak. In practice there is a significant divergence between the scenarios and thus the differing futures relating to the management of water. The collaborative process of developing the scenarios and applying them to the implementation of the WFD has been designed to raise awareness of the complex range of pressures on the Directive and their potential consequences. The storylines are therefore designed to inform long term planning and have the potential to help increase the resilience of strategic policies and plans.

Ecotopia

Scenario Summary:

Education and awareness raising efforts via government programmes, with the help of a cooperative and vibrant media and a proactive populace, stimulate a major shift in society's relationship with the natural environment. As it becomes apparent that high environmental impact lifestyles are increasingly expensive, people's behaviour shifts to become less resource intensive. Seasonal and locally produced food is favoured and there is a reduction in meat consumption. There is also greater appreciation of the natural environment as a recreational resource amongst the population, increasing support for its protection and enhancement. Politicians and business leaders respond to, and in some cases help to drive forward, this societal shift.

A global deal to move quickly towards a low carbon economy stimulates rapid action as nation states compete to seize a 'first mover advantage' for their economies. Governments develop new legislation, regulation and taxation arrangements to meet this challenge, looking holistically across all sectors of society. Public and private sector capital is increasingly made available for renewable energy schemes, and other sustainable infrastructure investments including public transport and water supply and treatment. This is driven forward by an EU Carbon Directive. Societal pressure on policy makers increases the scope of the response. The region's landscape gradually evolves with livestock farming changing, smaller and more rural settlements reinvigorated, and renewable energy generation becoming prominent.

Scenario Storyline:

The early years (2010-2017)

Societal behaviour change comes quickly. Evidence grows of climate change impacts on a global scale, and of associated human suffering and inequality. Citizens in the Northwest start to accept that individual actions can have global repercussions. Public direct action and demonstrations on climate change issues become widespread. These are driven by rising energy costs and increased awareness of climate change impacts, and lead to the blockading of oil refineries and airport sit-ins. Social norms and acceptable behaviours in relation to the use of natural resources change with people increasingly chastised and financially penalised for energy-hungry lifestyles. Changes to the school curriculum stimulate children to act in more sustainable ways, which proves to be a powerful force for change.

There is sporadic development of 'ecotopian' settlements in towns like Garstang which has a history as a 'fair trade town'. The Transition Towns movement also gathers momentum, with participants joining with local councils to produce joint strategies based around reducing dependence on oil and facing up to the implications of climate change. These communities become beacons demonstrating to the wider public what is possible when communities work together towards more sustainable patterns of living and working. New technology is embraced where it has a benign impact. Working practices change with greater use of videoconferencing, and improvements in broadband technology allow more people to work from home. The region's universities begin to specialise in research into sustainable living bringing creativity and innovation into the sector.

Subsidies and tax incentives evolve to reward and encourage 'sustainable' behaviour. People accept that carbon intensive activities and industries are going to be penalised in the transition to a low carbon future. This reflects a broader change in taxation policy which moves away from taxing income towards taxing behaviour and lifestyles. Much of this legislative change is driven by central government in order to provide a framework for more sustainable activities and industries. However, regional and local governments are given considerable freedom to develop policy and strategy targeted to local circumstances and needs. Northwest authorities respond, re-evaluating their budgets and spending more on activities including recreation, local environmental quality and

recycling. Also public sector procurement changes stimulate local markets and sustainable industries.

Mid-term changes (2017-2025)

A global climate change agreement, swiftly followed by an EU Carbon Directive and carbon pricing, increases the pace of political and economic reorganisation. It becomes clear that the low carbon economy is now a reality. This monumental change in the relationship between humans and the natural environment is driven by factors including recognition of the need to address climate change and looking for new ways of producing and consuming energy in the face of dwindling fossil fuels supplies. There is also an increasing acceptance of the costs associated with unsustainable lifestyles both in terms of higher prices (linked to carbon taxes) and the costs of responding to the aftermath of flood events, heat waves and droughts for example. Despite efforts on a global scale to reduce greenhouse gas emissions, climate change and extreme weather events continue. Adaptation to climate change impacts is a key priority for the region's policy makers. Particular emphasis is placed on flooding and security of water supply which are seen as the key threats to the environment, economy and society of the region.

Securing renewable local sources of energy generation is a high political priority. Initially this is motivated by a desire to improve the region's energy security in the face of increasing energy prices and threats to economic growth. Also, there is a desire to find a more sustainable stimulus for the economy following the deep recession which began in 2009. Public and private sector investment flows into technologies including offshore wind and geothermal energy. This is driven by fiscal incentives for renewable energy including changes in the use of taxation, grants and subsidies. The region's waterways become an important source of renewable energy, sparking the early stages of a blue energy revolution which becomes a particular feature of the region's energy mix. Starting at a small scale, technologies including Archimedes screw turbines become common across Northwest rivers and streams. Longer term plans for larger scale initiatives focus on tidal power.

> ***"Education and awareness raising efforts via goverment programmes, with the help of a co-operative and vibrant media and a proactive populace, stimulate a major shift in society's relationship with the natural environment"***

The long view (2025-2030)

As time passes, clear changes in the landscape of the region become evident. Sensitive biomass cropping for energy production takes place where appropriate and environmentally sustainable. However, the biggest changes relate to farming and food production. As the carbon costs of food imports affect food pricing, there is a re-engagement with region's agricultural sector and an increase in production to fill the demand for more local produce. Productive arable land is prized and protected, and in some cases brought back into use where previously neglected. With diets becoming less dominated by meat products, for reasons including its high price and carbon footprint, livestock farming declines. Increasing cost of fertilisers (which are energy and oil intensive) reduces their usage with associated environmental benefits.

Urban landscapes also continue to evolve. Ongoing programmes to increase green infrastructure in densely populated urban areas (planting street trees, increasing green roof cover, improving access to urban rivers etc) change their character. Benefits include improved capacity to adapt to climate change impacts, enhancing urban biodiversity and encouraging health benefits amongst the population. In rural areas, demand for housing increase as people seek greater access to the countryside. This is supported by fully integrated public transport schemes which connect urban centres to outlying rural settlements, and flexible working arrangements facilitated by improved communications technology.

Although many of the changes are seen on a small scale down to the level of individual buildings, certain high profile schemes offer highly visible evidence of change. Over a decade of planning and infrastructure development comes to fruition with the opening of tidal barrages on the Mersey and Dee Estuaries and the Solway Firth. Collectively they provide 5% of the UK's electricity needs. Micro-hydro schemes in the Pennines and parts of the Yorkshire Dales provide a more localised contribution to energy supplies. This puts the Northwest at the centre of the country's renewable energy map, with the scale of offshore wind generation capacity also rising significantly. Critical mass in renewable generation makes this source of energy increasingly competitive in comparison to fossil fuel based sources.

New development is subject to much tighter regulations on the planning and design of buildings. There is less available land for development, which along with a high taxation economy proves a downward pressure on growth and job creation. As the affordability of housing decreases, more social accommodation is provided but the young in particular find it difficult to get on the housing ladder. It is clear that although there are significant benefits to the natural environment, some aspects of society are suffering as a result of this interventionist approach and trade offs are becoming more apparent. Decision makers are left to consider how to deliver positive environmental change alongside broader visions for a sustainable society.

DRIVER	KEY CHARACTERISTICS
Social conscience and behaviour	Society exhibits high environmental awareness and willingness to change behaviour towards more environmentally sustainable practices. Green living becomes the social norm with activities such as failure to recycle and driving 'gas guzzlers' increasingly shunned by the majority. Social equity is also a key concern. Changes stem in part from the school curriculum, but also government education and action programmes.
Population and demography	The region experiences steady population growth. There is also some in-migration due to perceived 'quality of life' benefits, centring on access to high quality landscapes for recreation. Rural areas prosper. This brings with it additional housing and infrastructure, which is mostly environmentally friendly due to strong regulation and legislation.
Climate change	With the push towards a low carbon economy, emissions reduction becomes a core societal goal. However, due to inertia in the climate system relating to past emissions of greenhouse gases, significant climate change impacts are experienced. Effective adaptation measures reduce severity of impacts, but not to the extent that the impacts of all extreme events are absorbed. Flooding remains a real threat.
Appliance of science	New technology is embraced where its impact is environmentally benign. The price of carbon is a key driver of technological development. This impacts all areas of society. Water efficiency, storage and capture are common in new and existing developments (through retrofit). Technology also affects people's behaviour and working practices (e.g. real time smart energy metering and videoconferencing).
Land use change and management	Sustainable land management in urban and rural areas is promoted. Growth in new development and infrastructure is steady. Retrofit of existing buildings is widespread. Particular changes are seen in the agricultural sector with local food production supported for environmental and social reasons. Also legislation leads to a shift towards less intensive low carbon agricultural practices.
Investment	Public and private sector investment in environmentally sustainable infrastructure (energy, water, transport etc) is high. This is driven by public demand, legislative requirements and market potential. 'Soft' ecosystem focused responses are often favoured. Investments are promoted which have a low carbon footprint and offer additional benefits (e.g. biodiversity protection and recreation).
Institutional and economic structures	Institutions and organisational structures are reorganised to be more holistic and reflective of environmental processes and the functioning of ecosystems. Integration of decision making spatially and within/between sectors takes place. Further, the market is recognised as an important means of promoting environmental goals, through the use of fiscal measures and public sector pump-priming.
Leadership	There is a strong political drive, from the national to local level, for environmental sustainability and low carbon economy action. Strong leadership extends beyond the political arena with civil 'champions' within local communities also acting to rally support for changes in behaviour. Indeed, it is public support for environmental change that legitimises political action.
Regulation and legislation	Strong legislative backing for environmental sustainability influences action within the public and private sector, and at the level of individual citizens. Links between carbon and water are recognised as fundamental to energy use, with associated legislation enacted. Protection is also given to landscapes and ecosystems in recognition of their wide benefits.
Devolution of decision making	Top down imposed central government actions are uncommon, with regional and local decision makers given the opportunity to develop policy and strategies that suit their particular location. This approach recognises that catchment based approaches to water management, for example, are more in tune with the water cycle and the bio-physical processes relating to it.

Table 2: Description of the 10 key WaterProof drivers under the Ecotopia scenario.

Ecotopia and the Water Environment:

Despite efforts on a global scale to reduce greenhouse gas emissions, climate change and extreme weather events continue. Awareness of flooding and drought has been raised by a number of significant short term impacts, which although mainly affecting other parts of the UK, acted as a 'hydro-canary' for the Northwest. A series of dry winters and a change in precipitation towards short, sharp events have helped create water shortages in the East, South and South East. Surface water flooding in Sheffield and the Midlands has helped to focus political will on the need to reinvest in ageing drainage networks.

As the recession fades the natural environment of the region is recognised as a key driver for growth with rivers and coasts an important element of the tourism offer, since foreign travel is less affordable due to the high costs of flying. European legislation also helps drive this agenda with a huge increase in knowledge stimulated by the demands of the Flood Directive and the Water Framework Directive and fears of fines for non-compliance. Further, the need to reduce carbon emissions extends to the supply and treatment of water, with universal metering and greater use of ecosystem services for improving water quality. Technology develops in these areas.

These factors increase pressure on the government and regulators to provide a substantial increase in funding for both water companies and environment agencies during the second decade of the 21st century. The combined goals of the water and environmental sectors increase partnership working and the sharing of information. Good regional networks develop between key stakeholders - the Environment Agency, United Utilities and local authorities plus a vibrant university sector – who all combine to drive knowledge and best practice. For example, land owned by these agencies is now made to work much harder, with a move towards the multifunctional use of land and ecosystems services to help mitigate runoff and diffuse pollution. Flooding does still occur, but on a smaller scale, and as knowledge regarding the sources and pathways of water improves, the damage is limited as warning systems and local resilience networks help to manage the events and their aftermath.

In response to forecasts from scientists and policy makers about future pressures on basic services, sustained investment enables a substantial increase in water supply, with new reservoirs and infrastructure constructed. The change is facilitated by a streamlining of decision making for significant projects, greatly speeding up the process. The investment is typified by an emerging flagship national water grid project, connecting the region's water resources with neighbouring areas. This development both provides more water for areas of the country less able to generate their own supplies, and a source of revenue to Scotland, Wales and parts of the North. The investment in infrastructure alongside more regional and local storage helps to regulate abstraction volumes, which are kept at levels beneficial to the environment.

In addition to demand side measures, the region also engages with the supply of water. Although rising numbers of households increases overall demand, this is offset by a targeted gradual reduction of individual water consumption from an average of 150 litres per person per day, to around 110 litres by 2030 – a level deemed to be sustainable allowing both growth and reasonable personal usage. The change is driven by a threefold approach: provision of universal metering and a rise in the price of water; technological developments, such as more efficient washing machines and greywater reuse; and an increase in the capture and storage of the resource within individual households for a variety of uses. The rise in costs of water does have implications however, with some groups unable to pay bills.

Behavioural change within households receives a significant boost with the gradual introduction of the 'grey tap' into homes. The low carbon agenda challenged water quality norms and, considering the high energy requirements, it was acknowledged that there is no need to provide all domestic water to drinking standards. The grey tap provides a lesser standard of water for garden watering and the operation of some household appliances. As the water is cheaper, households readily accepted this change and begin to revalue water use in general. In addition, food labelling now contains a water footprint element, helping educate consumers.

"The low carbon agenda challenged water quality norms and, considering the high energy requirements, it was acknowledged that there is no need to provide all domestic water to drinking standards"

Although the region's population increases, diffuse pollution becomes less of a factor as management practices adapt to address this issue. Investment in the sewerage infrastructure helps, as does better interception and capture of runoff via the use of SUDS. Within the farming sector, a shifting of the Common Agricultural Policy towards more sustainable and non-polluting practices becomes a key demonstration of joined up thinking as it is recognised that this policy should be redesigned to help achieve the goals of Water Framework Directive. Point source pollution also steadily reduces. Investment in technology and infrastructure is the key driver, but increased public awareness of the environment and higher fines provide a further deterrent.

Coastal areas receive an income boost from tourism. Even though some areas have been modified, such as the broad array of offshore wind farms off the Lancashire coast and the tidal barrages, these are seen as a symbol of regeneration after decades of decline, supplying local jobs and a stimulus for further investment. The growing importance of small scale hydro-power provides a further economic driver for rural areas, the importance of which assists in the need to retain a consistent level of water flow, helping riverside habitats to flourish. Managed coastal realignment and functioning floodplain protection facilitates the creation of green spaces and habitats.

Techno-fix

Scenario Summary:

Society remains largely driven by the desire for instant gratification and material consumption. There is some awareness of issues such as climate change, largely as a result of the increasing frequency of extreme events and proactive government responses. When it comes to environmental problems, people generally believe that technology will provide the solutions and that changing behaviour is not necessary. Although outdoor recreation is a common pastime, activities have often been reduced to commodities with people paying for entry into intensively managed parks or landscape sites. Collective community-scale activities are rare, and society suffers from problems linked to inequality and exclusion.

In contrast to the general public, politicians influenced by mounting scientific evidence highlighting the severity of climate impacts and other pressing environmental problems start to take action. However, there is reluctance amongst politicians to apply demand management responses (such as universal water metering and carbon taxation) as people do not readily accept the need to change behaviour. This leads to a reliance on 'techno-fixes'. Regulation and legislation focuses on the private sector, with some businesses becoming increasingly engaged in environmental issues. However, the scale of new development, coupled with lack of public support for environmental debates, places significant pressure on land and natural resources.

Scenario Storyline:

The early years (2010-2017)

Society is characterised by an acceleration of consumption-driven trends including increased use of private cars, growth in 'exotic' tourism, and coveting of high-tech consumer goods. The mass media stands out as a strong influence on people's aspirations and behaviour. There is little effective reporting of the intensifying environmental and social problems, although some social media and blogging websites appear to fill the information gap. Knowledge of broader environmental and social issues is limited, and people are reluctant to restrain consumption.

Within government there is a growing recognition, informed by the scientific community, that current patterns of growth and development are unsustainable. Rising inequality and natural resource issues are perceived as economically inefficient and inhibiting future prosperity. However, the government's ability to tackle issues such as over-consumption of natural resources is weakened by lack of public engagement. There is a perception of a choice between improving standards of living and addressing environmental concerns. The public focuses on issues including education, crime and health care, which remain top priorities for the public sector purse. Politicians do not have a mandate to address challenges such as climate change via policies aimed at reducing demand or encouraging behaviour change.

The delivery of environmental improvements focuses on the private sector and the management of the public sector estate in a sustainable way. Action is also related to enhancing the availability of capital for businesses to invest in technology, and promoting research and development. Spatial planning is used as a powerful tool to regulate the design and location of new development, and where possible to protect natural systems and the functions they provide to society. There is a reliance on established institutions, with the support of the government, to manage natural resources. These include local authorities, the Environment Agency, utilities companies and non-governmental interest groups. These organisations are given greater authority and responsibility, with legislation and regulation developed to support this approach.

There is a growth in the use and capacity of technology across a wide range of sectors. This is stimulated by strong economic

growth and the availability of capital to invest, the increasing processing power of computers and the falling prices of electronic equipment as markets in China and India mature. Technological developments are related in part to the need to reduce fossil fuel energy use in the move towards a low carbon economy, and the recognition by business that saving energy boosts profits. Legislation mandating environmental improvement in sectors including farming, waste disposal and house building helps to encourage technological progress.

Mid-term changes (2017-2025)

Not all technological change and innovation relates to 'hard' and 'shiny' products and infrastructure. For example, nanotechnology for water treatment becomes a major growth industry and begins to be successfully applied. The private sector plays an important role in developing 'soft-tech' solutions to environmental problems following an ecosystem based approach. These include small scale interventions such as reed bed water treatment to improve water quality. Geo-engineering strategies take place on a much bigger scale. These include the development of carbon sinks by producing biochar (a form of charcoal that locks carbon into soils whilst also increasing the agricultural productivity) and seeding the oceans with iron to stimulate algae growth and the absorption of carbon dioxide.

At the regional scale, the Atlantic Gateway initiative becomes a key focus for growth in high-tech industries centred on the development and regeneration of land along the River Mersey and the Manchester Ship Canal. With the decline of petro-chemical and heavy manufacturing industries across the Northwest, Atlantic Gateway provides an important platform for economic growth and employment. The initiative is given an early boost with the completion of Port Salford, a multi-modal freight terminal that helps to encourage companies to the area. Further incentives are provided such as lower business rates and creating enterprise zones to help facilitate rapid business start-ups. Alongside private sector development, the Gateway is also a site for significant housing development, recreation and energy production.

"When it comes to environmental problems, people generally believe that technology will provide the solutions and that changing behaviour is not necessary"

People are also generally living longer due to medical advances. Some areas of ageing populations, such as Cumbria, find it difficult to cope without extra investment. Strong growth in the Northwest is accompanied by in-migration and population expansion. This places huge pressure on critical infrastructure with traffic congestion increasing and some social infrastructure (schools, hospitals etc) struggling to cope with increasing demand. Due to the healthy economy, investment does flow into infrastructure upgrades, although some developments prove to be inadequate to deal with the changing climate.

The long view (2025-2030)

The reliance on technological fixes to address climate change has failed to prevent gradual warming, and the UK and Northwest begin to experience some of the predicted impacts. Although international mitigation targets have been set these lack strength. The emphasis is on new mechanisms to limit carbon, such as Carbon Trading schemes, allied to an investment in green technologies. These measures have slowed the rise of emissions, yet the onus gradually shifts from mitigation to adaptation as impacts intensify.

Although economic growth is strong, there is a clear division between the 'haves and have nots'. The segregation of rich and poor communities leads to periods of social unrest. Gated developments, often equipped with the latest energy generation and efficiency technologies, become more common. Those who are able to pay continue to use energy (and other natural resources) wastefully. In contrast, poorer communities are increasingly unable to access the latest technologies to help reduce bills and pay proportionally higher costs for energy. Investment in nuclear generation begins to alleviate the 'energy crunch'.

Agriculture generates some of the most visible changes to the landscape of Northwest England. High levels of growth and consumption increase demand for food products. There is a rise in intensification and monoculture. Farmers also increasingly engage in biomass production for use in energy generation and biochar production. The farming industry is carefully regulated by the government. This leads to changes such as greater use of organic fertilisers and expansion of riparian protection zones. The few larger farms that dominate parts of Lancashire and Cheshire prove easier for the government to manage and monitor than the greater number of smaller farms which they replaced.

As time passes, climate change, high levels of consumption, intensification of agriculture and development pressure all take their toll on the natural environment. Although resource efficiency technologies and the growth in renewable generation limits the extent of negative impacts to a degree, natural resource constraints and damage to ecosystems become more common and increasingly harmful. This is despite the efforts of the government, with the support of established institutions, to play a strong regulatory role. Their efforts to reduce the environmental impacts of consumption and development are constrained by the pace of economic growth and the reluctance of the public to change behaviour.

DRIVER	KEY CHARACTERISTICS
Social conscience and behaviour	There is limited willingness to take action to address environmental and social issues, which are becoming increasingly difficult to ignore. There is an increasing divide between the 'haves and have nots', and despite advances in technology and energy efficiency, the environment continues to be damaged. However, this is not enough to change the behaviour of the consumption focused society.
Population and demography	Population growth is strong, supported by in-migration into the region by migrants seeking to benefit from the buoyant economy. People are also living longer due to medical advances. The impacts of rising population are evident on critical infrastructure, which becomes stretched. The impacts of these changes are managed where possible through regulation and legislation, such as using the planning system.
Climate change	Climate change mitigation and adaptation become central to public sector decision making. This is driven by increasing recognition of the science, and also of the potential contribution of the low carbon economy to growth and employment. Despite the response of the public and private sector, lack of citizen engagement and unwillingness to reduce their 'standard of living' limits the government's mandate for delivering change. Flooding and heat stress intensify as a result.
Appliance of science	The role of science in policy making is strengthened, with a closer relationship forged between the two communities. There is rapid growth of investment and research in science and technology. This is made possible by strong levels of economic growth and the requirement to enable this to continue. Northwest England becomes a hub for 'green' technology development, centred on the Atlantic Gateway. The region also becomes a focus for nuclear generation and offshore wind power.
Land use change and management	The regions landscape sees some notable changes, many of which relate to agriculture. Intensification and monoculture are key drivers of change within farming, leading to a smaller number of large farms dominating the landscape. These are heavily regulated to manage their environmental impact. Renewable energy becomes more prominent on land and in water, with biomass production a particular growth industry. Urban areas expand to accommodate a growing population.
Investment	There is sustained investment by the private sector in technological change such as smart electricity grids and digital infrastructure. Much of this activity is focused on low carbon technology, nuclear, energy efficiency, and critical infrastructure. Initially this is stimulated by public sector funding and legislative changes.
Institutional and economic structures	There is recognition that a lack of integration between different sectors (e.g. transport, housing, infrastructure provision) is inefficient and a key cause of environmental problems. There is a move towards more joined-up thinking and decision making, both spatially and sectorally. This is encouraged by government through legislation and regulation.
Leadership	There is political support for engaging in the climate change debate, and for developing strategies to address environmental limits to growth and development. The government takes the private sector with them on this issue, with some businesses themselves becoming champions for a low carbon future. Community engagement is limited however.
Regulation and legislation	Regulation and legislation is principally targeted at the private sector. Attempts at influencing citizen behaviour are based on efficiency measures rather than reducing demand. Policies include incentives for businesses developing sustainable technology, strong spatial planning legislation, and use of the public sector estate and procurement.
Devolution of decision making	Overarching central government policies are implemented flexibly at local and regional level. Regional governance is supported, allowing the Northwest to take forward initiatives such as Atlantic Gateway. Essentially, the focus of policy is to devolve responsibility for activities to the most appropriate level of government.

Table 3: Description of the 10 key WaterProof drivers under the Techno-fix scenario

Techno-fix and the Water Environment:

The need to invest in critical water supply and waste water treatment becomes increasingly apparent as climate change impacts intensify and population expands. Some of the resource comes from the public purse, although private sector investment is also needed to make any significant progress. The growth in population also places a requirement for new hard infrastructure for water supply and waste water treatment, with measures designed to reduce demand becoming voluntary and targeted at the private sector rather than households. Water companies are also subject to relatively strong environmental regulations, meaning that they now operate in an increasingly highly regulated arena.

A series of droughts and flood events in the region does present challenges but in many cases these are subsequently addressed by the provision of new infrastructure or the tightening of land use controls. These responses are reactive, in effect technological sticking plaster. Many underlying trends driving risk are not addressed, such as the population growth and necessary infrastructure investment. There is a resultant negative effect on diffuse pollution with many of the region's waterways struggling to improve their early advances in water quality despite restrictive point source pollution regulation.

The agricultural sector makes some advances towards more sustainable practices driven in part by changes to the Common Agricultural Policy. A combination of better management practices and effective regulation and legislation means that diffuse pollution from this source is reduced. But, the growth in population and road transport across the region offsets these gains particularly in watercourses near to large urban centres.

The growth in population also places pressure on the consistent supply of water throughout the year, with summer droughts becoming more commonplace. The failure to effectively address demand side approaches to water supply means that although there is investment in the capture and distribution of water this is continually under pressure to perform, particularly in times of low precipitation. The more affluent sections of society utilise new technological developments to store rainwater to enable their lifestyles to continue uninterrupted. The poorer are less fortunate. The need to manage more wastewater from the growing population also places the treatment of wastewater under stress. As the Northwest is characterised by small rivers crossing densely populated areas, there is limited scope to dilute extra wastewater and there are calls for both a higher level of treatment to hit water quality targets and for the network to be expanded.

"The failure to effectively address demand side approaches to water supply means that although there is investment in the capture and distribution of water this is continually under pressure to perform, particularly in times of low precipitation"

Surface water flooding becomes a serious issue for the Northwest, particularly in high population and high density urban areas. The growth agenda has placed stress on the drainage infrastructure, and although on the whole the network has been upgraded this is not the case in all areas. In many areas it is simply too expensive to upgrade in a highly competitive time for resource allocation. The impacts of floods and droughts are very unevenly distributed in the region. Adaptation decisions are taken on a national basis, with larger populations and sites of wealth creation in the South and East having an advantage in securing improvements. Moreover, certain sections of society become more adept at influencing resource allocation and placing pressure on decision makers.

Citizens also take steps to insulate themselves from water based threats. There is a rise in sales of domestic water efficiency measures and water storage, particularly for gardening and greywater reuse. These developments serve to protect some people from the general rise in water costs, but means that there is little incentive to change behaviour to reduce consumption. From a flooding perspective, homes and businesses become more resilient with design and resilience features becoming integrated within planning policy.

A general trend is to greater inequality. The benefits of the high growth and high consumption approach are concentred within narrow sections of society, with the same groups also best able to access technology designed to minimise their exposure to related costs. Conversely those with less disposable income to purchase technology and with less ability to influence decision making increasingly experience the majority of the effects of constrictions in water supply, water quality and flooding.

D.I.Y.

Scenario Summary:

Environmental and social awareness increases significantly within society. This is stimulated by factors including more experiences of projected climate change impacts domestically, and reporting of events overseas within some sections of the media. The links between anthropogenic climate change and more extreme natural events gradually become more established and accepted. However, due to the lack of a proactive government response to emerging environmental threats and the impacts of economic depression, some communities take action themselves in the face of a changing climate and faltering critical infrastructure. Responses are generally patchy and piecemeal, their effectiveness dependent on factors including geography and availability of resources locally.

Government response to the economic depression which started in 2009, and the subsequent recovery from this period of sustained low growth, is constrained by a lack of resources for investment and an unswerving free market approach to policy making. Regulation of industry is lax due to a desire not to limit potential wealth creation and to maximise spending power. Public sector engagement in environmental debates is limited, with the private sector and local communities generally being relied upon to provide leadership in this area.

Scenario Storyline:

The early years (2010-2017):

The recession which began in 2009 intensifies into long economic depression affecting many parts of the globe. Due to the prominence of the financial sector and over-reliance on consumer driven products and services, the UK is hit particularly hard. The country experiences a 'lost decade' of growth and investment, with interspersed periods of relative stagnation and occasional growth. The Northwest region sees significant economic decline. Falling industrial activity over preceding decades, and a corresponding increase in service sector employment, leaves the region particularly prone to the economic downturn. Like many other regions that had seen strong growth in services, the Northwest's employment base is badly shaken.

The impacts of the economic downturn are widespread, affecting society and the natural environment. With fewer resources available to the public sector, front line services are cut and social inequalities widen. Cuts are imposed by central government on local authority budgets for the delivery of services. Greater emphasis is placed on the role of the private sector to deliver change. Also, through reducing capacity for local authority spending, the government effectively puts a greater onus on communities to engage in action at the local level. Living standards, as measured by factors including employment opportunities, quality of public services and income levels, rise for some but fall for many. The recession also creates environmental problems which stem from issues including lax environmental regulation and enforcement.

The depression begins to trigger a shift in the public's perceptions of issues relating to the role of the State in providing services, with a drive towards more community based intervention. Equally, there is a transition from a focus on 'standards of living' to 'quality-of-life'. Material products and consumption-driven lifestyles are less highly prized, with greater emphasis placed on community activities and outdoor recreation. Environmental attitudes also change. People are less able to take foreign holidays, and spend more time closer to home for holidays and recreation. This brings people more into contact with their local environments, leading to louder calls for their protection and enhancement.

Mid-term changes (2017-2025)

The duration and depth of the economic depression also changes the political landscape of the UK. Policies to increase levels of economic growth become the central concern of the government's agenda. Growth is promoted as the most appropriate way to address the clear social and environmental problems that have emerged as a result of the downturn. Legislation in place that is seen to provide any significant barrier to economic development and the 'bottom line' is either repealed or not enforced. This leads to more point source pollution incidents, loss of biodiversity, and increasing greenhouse gas emissions for example. Spatial planning frameworks are progressively weakened as Government attempts to limit restrictions on business.

The private sector is impacted by the negative pressures of the depression and uncertain equity markets. Where public sector money does become available, this is used to prop up 'traditional' industries. Some growth is seen in industries providing solutions to local environmental constraints, such as small scale micro-hydro and water efficiency technologies. This is encouraged by public demand, and the gradual emergence of settlements mobilising local responses to environmental and economic problems.

As time passes, people become increasingly wary of returning to a state where economic concerns and wealth creation are prioritised over broader social and environmental wellbeing. Also, the public respond to mounting scientific evidence, sometimes backed up by their own personal experiences, that the local and global environment is at threat from unrestrained economic growth and climate change. However, politicians and the private sector are generally slow to pick up on this shift in attitudes, and hold onto a free market consumption-driven approach to policy making and organisational behaviour. Efforts to provide incentives to encourage more sustainable behaviour (e.g. local energy generation) are limited and are not enough to capture the opportunity for real change.

"Due to the lack of proactive government response to emerging environmental threats and the impacts of the economic depression, some communities take action themselves in the face of a changing climate and faltering critical infrastructure"

The long view (2025-2030)

Over the longer term, some communities begin to act independently in the face of climate change impacts and critical infrastructure constraints that emerge as a result of public and private sector under investment. Local responses to environmental problems become commonplace. For example, there is a revitalisation of smaller town centres, a growth in the recycling and second hand markets and some small steps into promoting 'local currencies'. Some small towns and villages supplement their own energy supplies through investing in wind energy technology. The sale of surplus energy sometimes returns a profit for the community, which is often reinvested into schemes such as small scale community biomass and basic flood management schemes. In effect, what is seen is a transition towards community preparation and localisation. Within some communities quality of life begins to increase and social bonds strengthen. Other communities, where people are not able to respond collectively, decline.

People do not see real evidence of any concerted central government action to respond to the economic downturn and associated problems. However, at the local level, more politically engaged and active citizens increase pressure on their elected representatives to become more transparent and accountable. The appetite for change leads to pockets of action where smaller parties challenge the status quo. Popular local leaders promoting progressive messages find themselves increasingly successful. As time passes, mainstream political parties respond to calls for more sustainable patterns of growth, with more power devolved to the local level. However, a legacy of public debt remains, limiting ability to meaningfully invest in a sustainable recovery.

Although the political and economic order begins to change, the scale of the transformation needed to adapt the economy and society is huge. This comes at a time when the increasing frequency of extreme weather events, linked to a changing climate, reduces the capacity of governments to develop a coordinated response to these threats. Progress is generally patchy and localised with success dependant on issues such as local leadership and the availability of skills and resources. Urban to rural migration is strong within this scenario and smaller towns and villages working collectively tend to be more prosperous. Communities in Cheshire and Lancashire attract people, predominantly at the expense of larger settlements, which in some cases see further declines in social cohesion. This leads to more development, although this is not always supported by additional infrastructure such as schools, health centres and public transport provision.

In the early years, domestic food production is encouraged as a response to the economic downturn and rising food prices, leading to an intensification of industrial scale farming. This trend gradually reverses due to pressure from the public and changes in government policy. Farmers and their products are more highly valued, with much of their produce consumed locally. The quality of local landscapes and environments improves as a result. Renewable electricity generation becomes more common, with biomass cropping and small scale wind and hydro power changing the character of landscapes in some areas. Another driver of positive landscape change is the reinvigoration of domestic tourism. People seek out high quality landscapes for recreation, leading to the protection and enhancement of upland areas such as the Forest of Bowland and seaside areas including the Fylde Coast. In the face of considerable climatic, economic and political barriers, the strength of public desire for positive change slowly delivers progress for the Northwest region.

DRIVER	KEY CHARACTERISTICS
Social conscience and behaviour	Public engagement in, and awareness of, environmental issues grows significantly. Society becomes more community focused and less concerned for accumulating material wealth. There is strong desire for high quality local environments. Demands for change targeted at the government and private sector increase, but are generally not met.
Population and demography	There is a net growth in the population of rural towns at the expense of dense urban settlements, which see declines and a general increase in social problems. However, rising property prices in certain rural areas (in contrast to falling prices in some urban areas) brings its own range of social problems.
Climate change	As time passes, climate change impacts become more frequent and intense both at local and global scales. Floods, droughts and heat waves become more common across the region. The public sector mitigation and adaptation response is limited. Adaptation responses therefore, by necessity, tend to be local and piecemeal and are sometimes ineffective.
Appliance of science	The economic recession and the squeeze on capital markets limits the amount of financial capital available to invest in new technology and R&D. There are some exceptions, for example micro-hydro and small scale wind generation where demand is stimulated by the increasing use of local scale energy generation technologies.
Land use change and management	The 'localisation' agenda begins to affect the landscape of the region. There is a high demand for local food, and much more food is sourced from small scale local farms. Micro energy generation becomes a more common feature of the landscape, as does local scale biomass cropping. There is also a re-invigoration of some rural towns and communities.
Investment	Investment levels are low, both in the public and private sector. The depression puts a brake on large scale private sector initiatives, and public sector funding is not available to pick up the slack. There is a lack of investment in critical infrastructure, for example water supply and waste water treatment and energy generation and transmission networks. Their efficiency and performance begins to suffer as a result.
Institutional and economic structures	In the public sector, departmental structures are fragmented. Lack of policy integration limits the response to complex issues (such as climate change) to piecemeal and short term actions. The private sector is given a stronger role in the delivery of policy agendas across a wide range of issues. Legislation and policy is designed to encourage competition between firms in order to reduce costs to the minimum.
Leadership	The political response to environmental problems is constrained by traditional models of economic growth and wealth creation. Despite the public's support for proactive environmental and social change, political leaders champion the cause of business and industry. The reliance on the private sector to deliver change, which does not always materialise, stimulates local action. Leadership on environmental and social issues comes from 'grass-roots' levels and community networks.
Regulation and legislation	Most new regulation and legislation that does emerge in this 'light-touch' environment is targeted at stimulating economic growth. Key priorities are lowering levels of taxation and limiting barriers to free market economic growth. There is very little 'green' legislation, with issues such as climate change marginalised. Enforcement of existing environmental legislation is at best patchy and often non-existent.
Devolution of decision making	Faith in 'big' government is weakened by poor economic performance and the protracted depression. With central government slimming back their responsibilities for delivery in a range of areas, the remit of regional and local authorities grows. However, this comes at a time of budget cuts and rising public concern over the quality of local services.

Table 4: Description of the 10 key WaterProof drivers under the DIY scenario

DIY and the Water Environment:

The inability to agree binding and effective global targets for greenhouse gas emissions has resulted in an increase in temperatures and the effects of climate change are starting to hit the Northwest. The dominant government position in this period is one of a smaller central government with a reduced overall tax burden, which is designed to stimulate growth by maximising consumer spending power. There is also increased government and regulatory pressure upon the water sector to reduce costs and concentrate on basic service provision.

However, the scaling back of both the role of the state and the environmental responsibilities of the private sector impedes the ability to adapt to climate change impacts. Although flooding and scarcity events occur more regularly, they are not experienced equally, with some areas of the region suffering multiple debilitating episodes, whilst others escape largely unscathed. Those that can afford to do so move away from the areas at most risk as insurance becomes more expensive and punitive. Resources to manage flooding are concentrated in other parts of the UK, particularly the South East. This drives some further migration to this region at the expense of areas in the Northwest subject to high flood risk.

In terms of flood risk, there is devolution of responsibility from centralised intervention towards communities and households. As the ability to effectively manage risks and events become more costly for the government, local authorities, water companies, and people are given more information about their own exposure and expected to invest in limiting their personal vulnerability. For example, maps of areas at risk from all sources of flooding are hosted online. This enables people to choose where they wish to live, and provides advice concerning how they may best adapt to their local risks.

The decrease in income from customer bills for the water sector was offset by a watering down of sustainability and environmental goals. The government has joined forces with likeminded countries across Europe to either delay or reduce the aims of the WFD which are seen as an unreasonable bar on growth and investment in these troubling economic times. Similar perspectives lead to a reduction in the power of the planning system to demand environmental mitigation, with private sector freedom and individual responsibility becoming a dominant theme.

"Although flooding and scarcity events occur more regularly, they are not experienced equally, with some areas of the region suffering multiple debilitating episodes, whilst other areas remain largely unscathed. Those that can afford to do so move away from areas at most risk as insurance becomes more expensive and punitive"

Overall, the policy of reducing the financial settlements for the water sector results in a lack of investment in infrastructure. From a supply side, the downward pressure on bills does not assist in hitting targets relating to household consumption, and although water is cheap the supply is interspersed with periodic bans or constraints in supply affecting households and industry. The use of meters is low, and until the gradual rise in scarcity events towards the latter end of the scenario consumer attitudes towards the resource remain largely unchanged. The need to tap into emergency supplies from the Lake District is criticised by environmental campaigners.

The wastewater function of the water sector also experiences problems from under investment. Climate change, the rise in households and associated urbanisation increases the pressure on drainage systems and many different areas across the region begin to suffer from surface water flooding. The relatively small level of resources available to combat this trend means that improvements are targeted according to the most economic benefit and therefore some areas become subject to frequent, small scale surface water flood events debilitating a number of local communities.

There is an increase in point source pollution due to a slight rise in population combined with a scaling back of environmental quality targets. There is also an increase in diffuse pollution, which proves a persistent downward pressure on water quality up to 2030. This is initially driven by the rise in large scale agricultural practices, which is offset slightly as the trend towards more sustainable and local produce is realised. The lack of large scale investment in sustainable drainage and green infrastructure also helps to maintain the now long standing problems of diffuse pollution.

Environmental problems raise people's perception of the value of water and heighten the relationship between citizens and the natural environment. Although water related problems do hit the UK, the shift in responsibility away from the state and the private sector towards local authorities and communities helps drive the DIY agenda, with people starting to take increased responsibility for improving the resilience of their home and community. People begin to use the additional information on risks to better effect, and features such as localised water storage become more common in less densely habited areas and buildings are retrofitted to lessen their vulnerability to flooding. To part address this change a series of financial incentives are offered to enable an increase in the water resistance of buildings and a greater installation of water efficiency and storage features. This step also facilitates private sector growth in providing community and household level resilience measures and gives a stimulus to the DIY generation.

Free Market

Scenario Summary:

A consumption-led population characterised by a lack of community spirit and a low awareness of wider environmental and social issues are dominant features of society. Governments design policies to encourage economic growth with a much lower tax burden on society and a scaling back of the state and its ability to intervene. Citizens are generally not willing to restrict consumption of resources to encourage environmental benefits. A society rife with inequality is created, with a system of winners and losers generated in respect of economic and material wealth.

The key focus of governments at all scales is on increasing Gross Domestic Product (GDP). The environment is regarded as a 'free good' to be utilised for this aim and the government does not develop proactive solutions to manage droughts and floods, which increase in their frequency and intensity. Their capacity to respond to a changing climate is lowered by a lack of necessary policy structures, limited public support, and the power of industry lobby groups. The onus is shifted to the private sector who place an emphasis on 'hard-engineering' and a greater role for insurance companies. Regional governance disappears and local governments are increasingly constrained given falling budgets and limited autonomy from central government.

Scenario Storyline:

The early years (2010-2017)

Public interest in and awareness of environmental issues is low. Consumer lifestyles continue apace. There is limited value attached to the natural environment as a recreation resource, with people distancing themselves from nature in favour of more tangible and virtual experiences and products. This mindset amongst the public is encouraged by a lack of education and an uncritical media supporting the government's policy focus on economic growth. The education system is gradually restructured to help the state and private sector meet targets on growth and investment, with a slash in research budgets for sectors including renewable energy and sustainable transport.

Following the economic recession of 2009-2010, the government focuses all its attention on increasing GDP growth rates, job creation and inward investment. Numerous pro-growth policy changes are instituted, centred on a private sector friendly taxation and regulation regime. This does deliver significant increases in economic growth, although the benefits are principally captured by a small minority of high earners. Most people fail to see any real improvement in living standards or long term job prospects. Social inequality is prevalent across a wide range of indicators from income levels to quality of education.

There is some public sector economic stimulus, which although limited by the post-recession public debt burden, is largely targeted at supporting existing patterns of growth and development. Funding is placed into road building and improvement, fossil fuel extraction (particularly coal), and homebuilding to meet housing growth aspirations. Some sectors therefore benefit from the investment packages. In terms of homebuilding, the focus is on rapid new-build with little attention to retrofitting to improve the quality of existing properties. Spending cuts to fund the stimulus impact directly on environmental regulators, who are unable to maintain existing services. There is no meaningful commitment to the climate change debate, or to wider environmental issues, from policy makers, businesses or the general public.

Mid-term changes (2017-2025)

Aside from an intensification of the trends emerging in the early years, this mid-term period is characterised by the impacts and repercussions of two major climatic events in the same year – a drought followed by a flood. Although a climate signal showing a trend towards progressively drier summers was clear, decision makers did not accept that Northwest England could be at risk of drought and failed to act to secure water supplies. Successive governments, worried about the extra consumer costs associated with massive investment in new reservoirs and distribution network, avoided investment. This was despite the fact that the region is mostly reliant on surface water resources, and is therefore vulnerable to changes in weather and climate. The water service provider, unable to raise bills due to a cap imposed by the regulator in order to stimulate consumer spending, could not invest in improving storage facilities. Three dry summers with rainfall significantly below average culminate in a major drought in the summer of 2022. West Cumbrian supplies, central to the provision of water to the south of the region, saw major declines and capacity constraints.

Impact of the drought crosses many sectors as the supply of water is restricted to society and industry. Water rationing becomes widespread for both domestic and industrial users, and lower water pressure pose a problem for some industries and services. Water metering is discussed, but it is optional and there is slow progress on reducing demand. The drought also magnifies broader social conflicts and divisions. Inequitable distribution, which was based around ability to pay for additional supplies, causes frictions between communities and sectors. As a result, within this period of drought some sectors and individuals manage to prosper whilst many others find life increasingly difficult.

The drought is followed by an exceptionally wet winter. A legacy of development in areas prone to flood risk, coupled with increasing urban sprawl and housing in growth point areas, conspire to make flooding events more frequent and damaging. An intense Atlantic storm brings extreme levels of rainfall, which over a period of three days is deposited onto already saturated ground. Flooding, which has already occurred sporadically across the region over the winter months, is widespread across many urban and rural areas. Flash flooding in urban river systems is accompanied by surface water and sewer flooding as capacity issues magnify. Broad scale impacts include loss of electricity and water supplies, transport disruption, and loss of agricultural crops.

The events of 2022 become a defining moment for the region. It is clear that economic growth aspirations held by the region's policy makers cannot be sustained in the face of these kinds of impacts and their disruption to the economy and society. Cities and regions better prepared for a future affected by significant climate change start to attract more private sector investment at the expense of other areas. In the Northwest, there is a slow down and gradual reversal of inward investment as climatic constraints strengthens.

"There is increasing division between different sections of society. For example, insurance cover is removed from flood prone areas creating 'flood ghettos' inhabited by vulnerable populations"

The long view (2025-2030)

Calls for action are not able to generate necessary changes to systems of governance and political priorities to help secure more sustainable patterns of growth and development. Integrated institutional structures are not in place to manage the problem effectively, and no coherent policy framework exists to deliver change. Government departments are hampered by a lack of funding and short term, target driven thinking. Also powerful industry lobby groups, who exert a strong influence over government policy, resist change, whilst the necessary skills and resources are not available to meet the scale of the challenge.

Northwest England begins to experience significant climate change immigration. In other regions such as the South East, disruption caused by climate change is much worse (although the events of 2022 demonstrated that the Northwest is not immune) and climate change migrants from the UK and beyond move into cities including Manchester and Liverpool. The immigration impacts on the region's natural resources. It also puts pressure on infrastructure and causes social problems, particularly in rural locations whose elderly population are unable to attract sufficient funding or support. There is also confrontation and mistrust between citizens, regulators and service providers.

There is increasing division between different sections of society. For example, insurance cover is removed from flood prone areas creating 'flood ghettos' inhabited by vulnerable populations. At the same time structural flood defences are developed to protect affluent and economically prosperous areas. This is considered on a national basis, with the South East particularly favoured. The impacts of droughts also tend to fall on those communities least able to cope with the effects. Government regulators and water service providers focus on the use of price as an instrument to respond to water supply constraints, with infrastructure upgrades generally dismissed. This has its largest impact on those who are least able to pay, and does not tackle the broader causes of the problem. Ultimately, it becomes clear that the focus on economic growth and consumer-driven society has ill-equipped the region for the future that it is beginning to experience.

DRIVER	KEY CHARACTERISTICS
Social conscience and behaviour	Popular culture is very materialistic with the corporate mass media dominating the news and entertainment. Society is highly individualistic with weak community values and structures. Inequality is rife, and there are stark divisions between the 'haves and have-nots.' The public shows little concern for and engagement in environmental issues. The consumption culture continues unchallenged and unabated.
Population and demography	The region's population grows, partly as a result of an influx of climate change migrants. Trends towards increases in single person households continue, and consequently there are high levels of housing demand and associated development. Its location is often inappropriate, for example on floodplains and in areas where critical infrastructure is inadequate.
Climate change	Attempts to gain global consensus around plans to address the causes and impacts of climate change fail. With rising greenhouse gas emissions, climate change impacts accelerate driven by positive feedback loops in the climate system. Limited and piecemeal adaptation responses are not sufficient to deal with the impacts of floods and periodic droughts, which steadily increase in frequency and intensity.
Appliance of science	Technological development is rapid, but is targeted principally at the consumer sector and industrial production. There is little innovation linked to environmental sustainability due to a lack of policy support and perceived limited direct economic value. For example, in the energy sector effort is placed on extracting remaining supplies of oil and natural gas stifling investment in renewable technologies.
Land use change and management	Gradual changes in the landscape are apparent reflecting intensification of farming, expansion of inappropriately sited housing, and the spread of consumption-oriented developments. This is supported by spatial planning regulations which are principally designed to facilitate and remove restrictions to development. The impacts of climate change begin to appear, such as the results of moorland peat and heather fires.
Investment	In a low tax, low utility bills environment, investment in critical infrastructure is not always forthcoming. Where investment does take place, it is targeted at traditional 'hard' infrastructure such as roads and electricity generation/supply, and also emerging technologies such as next-generation broadband. Little investment goes into environmental technologies or infrastructure.
Institutional and economic structures	A silo mentality dominates organisational behaviour in the public sector with different government departments working in isolation towards narrow short term economic growth objectives. The power of lobby groups tied to established industries (e.g. nuclear power, road building) is such that government subsidies continue to flow in their direction.
Leadership	The vast majority of the electorate is focused on material enhancement, and politicians respond with a policy agenda that has GDP growth at its heart. Indeed, civic and business leaders promote economic growth as the primary goal of public policy. Calls for restraint, such as for environmental reasons, are generally disregarded and ignored.
Regulation and legislation	Government regulation and legislation is largely 'light touch' and private sector friendly. Taxes are kept low to stimulate consumer spending. Existing environmental legislation seen as a potential break on economic growth is often repealed. Where it does remain, the enforcement of legislation designed with environmental or social goals in mind is under-resourced and generally ineffective.
Devolution of decision making	Central government plays the dominant role in setting policy making frameworks, and there is little scope for action at the regional and local level. Maximising the country's levels of economic growth is seen as the core function of government, with limited local power to step outside this remit. There is little stakeholder engagement at any level of government, with policies developed behind closed doors.

Table 5: Description of the 10 key WaterProof drivers under the Free Market scenario

Free Market and the Water Environment:

The fear of a double dip recession at the end of the first decade of the 21st century has led to a focus on encouraging private sector growth and increasing consumer spending power. The impacts on the water sector are a succession of small settlements from the regulator and overall funding in the sector is reduced due to concerns about the costs of bills to consumers. After strong complaints from the water and sewerage companies it is accepted that it will be increasingly difficult to operate at a profit and achieve all regulatory demands whilst maintaining this downward pressure on income. In response there is a gradual scaling back of the regulatory burden and the role of the private sector water companies to hit wider goals on water quality, sustainability and efficiency. This results in minimal upgrading of aging infrastructure, with priority given only to those parts of the network most severely in need. This argument spreads to the European arena, and there is significant lobbying to reduce the water quality targets in Water Framework Directive.

The increase in households and urbanisation across the region combines with an intensification of precipitation events linked to climate change to create more surface water and pluvial flood events, with small scale events becoming commonplace. There is a rising trend of personal resilience, with a greater role for private sector insurance. Insurance against surface water flooding becomes harder to attain however, due to rising costs of claims and the inability to accurately predict urban risks. There is also a shift in the provision of flood defence from being the role of the state towards shared responsibilities between the government and homeowners. To cater for this transition, the availability of information on flood risk rises. Consequently, flood prone homes become harder to sell and there is intense lobbying for extra flood defence spending within the Environment Agency at the expensive of environmental quality goals.

Together with a rise in population and a squeeze on both environmental regulation and the responsibilities of water companies there is a general deterioration on water quality across the region. There are still fines for point source pollution episodes, but these are becoming less of a deterrent as the level has been frozen for a number of years as it is seen to be an unfair environmental tax on competitiveness. Diffuse pollution becomes a more serious pressure on the environment as measures to tackle this become more voluntary. For example, there is a move towards a lesser regulated farming sector in order to enable more intensive agricultural production. At the same time the increase in road transport, from both economic growth and the burgeoning population, brings more diffuse pollution from urban areas.

In addition to the continued upward pressure on water use from the growing population there is a rising trend of usage per household. The general perception of the public in the Northwest that there are seemingly abundant water resources and an overall excess of precipitation creates a culture of complacency within the population. There is limited investment in water metering and there is little progress in influencing behavioural change. The relatively low cost of water, the scaling back of water efficiency goals for water companies and the rise in water intensive goods, such as power showers and dishwashers, all fuel overall consumption. But this position gradually becomes more exposed as the lack of investment in new infrastructure is highlighted and there are regular summer hosepipe bans. Although water companies would be willing to invest in new infrastructure they are faced with an uncooperative economic regulator and a customer base largely unwilling to change their approach to water comsumption.

Abstraction levels increase to help cater for demand, resulting in habitat loss and destruction and low flow conditions in rivers and watercourses. As a lack of investment on infrastructure creating more flash flooding. Accompanied by increased water temperatures as a result of climate change, this impacts negatively on aquatic biodiversity through, for example, intensifying pollutants, encouraging algal blooms, and altering fish spawning behaviour.

To provide a spur for investment the powers of the planning system to intervene in proposals are scaled back as developers are given more freedom. Although this helps drive investment, it results in a rise in the number of properties at risk from flooding, and the risk of surface water flooding elsewhere. Moreover the removal of the regional tier of government to streamline the costs of the planning system starts to hit strategic decision making and water management continues to grapple with long established policy and institutional silos. There is also a reduction in environmental education and knowledge transfer as funding streams for environmental orientated research are axed to move towards research with a more tangible economic gain. This development results in a skills shortfall, with public and private sector professionals receiving little quality training.

"Although water companies would be willing to invest in new infrastructure they are faced with an uncooperative economic regulator and a customer base largely unwilling to change their approach to water consumption"

Conclusions and recommendations:

Key observations and implications:

Through the development of a set of scenarios, the WaterProof Northwest project has highlighted a range of issues of relevance to the future of water and water management in the region. These issues have clear implications for meeting the goals of the WFD. The process of developing and working with the scenarios has also generated valuable learning relating to bringing a futures perspective into decision making within the water environment. The WaterProof scenarios build on and complement existing scenario sets such as the Environment Agency's 2030 scenarios, which relate to environmental issues at the UK scale. The WaterProof scenarios differ in that their focus is on Northwest England and issues related to water specifically. Although the key outputs of the project relate to this region, the lessons are transferable to other areas of the UK, and to other developed nations experiencing uncertain drivers of change on the water environment. The scenarios should therefore have an application beyond the scope of this project.

The development of these scenarios required innovative thinking regarding the identification and consideration of the multiplicity of factors that could affect the relationship between society and water up to 2030. It should be noted that the scenarios are not designed to create the illusion of certainty, rather to inform strategic decision making and raise awareness of future contexts. The wide ranging trends and drivers with the power to influence effective water management in the Northwest are potentially huge, and therefore the first stage of this aspect of the project necessitated the consideration of these key influences. Subsequently these drivers were utilised within water specific scenarios. There follows a summary of key observations and implications stemming from the WaterProof scenarios. These relate to the scenario creation process, implications for water, the WFD and the Environment Agency.

Scenarios and the scenario development process:

The WaterProof scenarios offer four contrasting visions of how the region and its water environment might evolve to 2030. The process of developing the WaterProof scenarios was participatory, involving workshops, interviews and regular meetings between the core project team and a steering group. The output of the project, the scenarios and the analysis of their implications for water, integrate the information gathered by this participatory approach. Bringing different stakeholders together and involving them in discussions about the future of water in the region was an important element of the project. In practice, it should be acknowledged that the value of scenarios concerns both the process through which they are developed and the end product; the scenarios themselves.

The involvement of stakeholders is a central element of planning for and implementing responses to meeting the goals of the WFD. Indeed, the legislation specifically addresses this issue, and provides a framework for bringing relevant stakeholders more closely into the management of water resources. The WFD encourages organisations such as the Environment Agency to actively involve stakeholders at key stages in the WFD process, including the preparation of RBMPs. The WaterProof Scenarios provide a potentially valuable tool to actively involve stakeholders in this way. This is significant because due to the wide ranging scope and implications of the Directive, it will not be delivered effectively in isolation from the organisations and individuals with an interest in or influence over the future of the region's water environment. The scenarios provide an adaptable framework for working with stakeholders to contribute to visioning and planning for the WFD and water management more broadly. Developing the scenarios and working with them to consider the future of water in Northwest England has helped to stimulate creative thinking around these issues amongst participants involved in the process. The value of this output to a broad scale, long term initiative such as meeting the goals of the WFD should not be underestimated. Applying the scenarios in other situations could help to capture this benefit amongst more stakeholder groups, and may act as a catalyst for policy involvement, analysis and development.

Water and the Water Framework Directive in the Northwest:

The WFD is fundamentally concerned with providing a planning framework to ensure that sufficient water resources are available to meet the needs of society, and also to allow ecosystems, habitats and species to flourish. Also implicit within the WFD is the perspective that economic advancement can be facilitated through environmental improvement. It is crucial for the future growth and development of regions such as the Northwest that effective strategies are developed to implement the aims of the Directive. However, the WaterProof scenarios demonstrate that over the long term, there are a range of challenges and opportunities which will influence the achievement of this goal. There follows a discussion of significant observations arising from the analysis of the scenarios in the context of achieving the goals of the WFD in Northwest England. Rather than looking at these issues on a scenario by scenario basis, the following observations look

across the four WaterProof scenarios to highlight overarching themes.

The state of the economy:

The type and direction of economic growth and development will play a central role in the effectiveness of responses to implement the WFD, and in terms of the quality of the water environment more generally. However, through applying the WaterProof scenarios to the issues of water management and the WFD, we can see that it may be simplistic to assume that the biggest threat to achieving the goals of the WFD is growth. Whilst an increase in population and industrial activity does place a downward pressure on many of the significant issues influencing water quality in the Northwest, the scenarios indicate that in the early years it is the exact opposite that may pose the most substantial obstacle. A sustained period of slow or stagnant growth may place such a threat on the nation's finances that the scaling back of governance to become more business friendly is a real possibility. This could encompass cuts in public and private sector funding to stimulate customer spending and moves to lessen the influence of regulation and spatial planning on development activities; all key managerial tools to helping achieve the goals of the WFD. In fact, the principles of the WFD itself could be at threat under such a scenario, at least in terms of the enforcement of its requirements.

Closely linked to economic growth and stability is the issue of investment in water-related infrastructure. At present, the delivery of the WFD is influenced to a large extent by the capital investment programmes of the utilities companies responsible for supplying and treating water. Spending by water companies is one of the key sources of funding for programmes to address water quality and quantity issues. Looking beyond the state of the economy to distinct yet interlinked issues, the availability of capital for water companies to invest relates to aspects including public willingness to pay for environmental improvements and the relationship between water companies and their regulating authorities. Factors such as these are subject to significant change, the nature of which cannot be accurately predicted. However, where the need to maximise consumer spending power is seen as a priority, there will be political pressure on regulators to limit bills. Similar broad drivers of change may also influence the ability of organisations such as the Environment Agency to maintain investment programmes addressing water quality and quantity issues. Further improvements in this area will require long term significant investment, and in an era of economic uncertainty, it is not entirely clear as to where this funding will come from.

Climate change:

Climate change has a clear role to play across the scenarios, and can be expected to influence the water environment in a variety of different ways. The UKCIP09 scenarios suggest that according to current projections, significant changes to the region's climate are not anticipated until the period around the 2040s. Extreme weather events, such as heat waves and intense storms and rainfall will nevertheless be likely over the coming decades and could intensify, bringing significant water management challenges linked to floods and water shortages. Although the direct impacts of climate change on variables including temperature and precipitation are important, these could be less significant in the Northwest over the period to 2030 than secondary impacts related to a changing climate. These issues would perhaps present a greater threat and in some cases an opportunity to the WFD than direct climate change impacts. The move to a low carbon economy, climate change induced migration and food security issues are particularly relevant, and are discussed in greater detail below.

Under certain scenarios, the response to climate change will begin before the direct impacts take effect. The term 'low carbon economy' is often used to encapsulate the changes that will accompany moves towards less carbon intensive systems and organisational structures. Driven by leadership, legislation, technology and behaviour change, the low carbon economy would have huge implications for the management of water resources. There are a variety of mechanisms through which carbon reductions associated with the supply and treatment of water could be achieved, and depending on the nature of these approaches, the landscape and water environment of Northwest England could change significantly. For example, the differences between a technology or an ecosystem focused approach to carbon reduction would be fundamental and, as the scenarios suggest, would be likely to mirror broader drivers within society.

Although the Northwest may not be subjected to significant climate change over the next two decades (although the threat of extreme weather events is nevertheless significant) other areas of the UK, particularly the Southeast in respect of water resources, may begin to see climate change impacts over this timescale. On a global scale, the impacts of climate change on issues such as water supply and agricultural productivity are already being experienced and are set to intensify. Migration driven by climate change and associated impacts on peoples livelihoods could bring more people into the Northwest, with implications for water resources and related infrastructure.

Agriculture dominates many of the rural landscapes of the Northwest. It is possible that climate change (particularly

extreme weather events) and its impact on water resources could begin to impact on farming practices. More frequent winter flooding may also impact negatively on some arable production. However, it is the impact of climate change in other parts of the world, and the effect that this may have on global food markets, that could have a larger impact on farming in the Northwest. Britain may have to become increasingly reliant on domestic agriculture in order to maintain food security. This could become a key priority for government, overriding many others. The associated impacts on the landscape of the region, and water quality and quantity issues, would be significant. The nature of these impacts would depend on broader drivers of change including public environmental attitudes, legislation and regulation, and technology.

Governance and regulation:

The WFD is essentially a framework developed to manage the water environment. The strength of this planning framework will be affected by the nature of governance arrangements supporting the Directive and environmental management more broadly. Governance, and associated issues such as political leadership, the balance between central government control and local autonomy, and the extent to which environmental legislation is enforced, will have significant implications for the implementation of the WFD, and even for the future of the Directive itself. The scenarios suggest that one of the largest impediments to progress on the WFD's goals may actually be a trend towards laissez-faire governance. Under these scenarios the WFD is at threat of being attacked, weakened and under resourced. Conversely, where governance is more proactive and recognises the links between the water environment and fundamental agendas including health, wellbeing and economic competitiveness, the position of the Directive would be strengthened.

Addressing the issue of governance also helps to question the potentially much more troubling perception of a choice between growth and the WFD. In theory, growth and water quality measures can co-exist. Indeed growth can feasibly be driven by water quality improvements, for example, in scenarios where there is a boom in domestic tourism or heightened awareness of the environment as a resource. The WFD has the potential to support this approach as at its core the Directive can be seen as a long term tool to increase the economic competitiveness of European member states through environmental improvement. However, this does rely upon effective and proactive governance, from environmental regulation to spatial planning. Here an integrated and holistic governance approach is essential, linking water company investment programmes with river basin management planning processes for example. Education, awareness raising and the role of media will also influence views on this potentially pivotal issue. The key concern remains that without a supportive framework of governance and regulation, the WFD has limited potential to be effective beyond an administrative exercise.

Social issues:

The attitude of society to the natural environment plays an important role in each of the WaterProof scenarios. This is due to the impact this has across a number of the key drivers of change connected to the future of water. For example, political leadership and systems of legislation and regulation are underpinned, or in some cases undermined, by the degree of public support for environmental improvement. Politicians may feel unwilling to promote the development of legislation to manage demand for water without a supportive populace willing to accept changes to the way they pay for and consume water resources. Similarly, willingness to pay for environmental improvements will affect the price that water companies can charge for their product, and therefore the resources available to invest in infrastructure upgrades. It is unclear as to how society will evolve in this respect. For example, issues such as whether the traditional and emerging forms of media will become a stronger force for promoting 'sustainable' behaviour and the natural environment, or to what extent the education system improves 'environmental literacy', will have a real bearing over the coming decades on society's approach to the water environment.

There are also potential social impacts associated with meeting the goals of the WFD which should be recognised. A concerted approach to improving the water environment implies that resources are prioritised that may have otherwise been used for other purposes. There may be unexpected negative consequences associated with an active response to the water management. For example, tighter restrictions on the availability of development land or the requirement to conduct a higher standard of building practices could restrict investment and the supply of homes. Whilst higher consumer bills to enable increased investment in infrastructure may disproportionately hit some of the poorer sections of society. It is here that the links to the level of environmental awareness in society are crucial, and stakeholders such as the Environment Agency must work hard at decoupling the perception of a simple choice between economic growth and meeting the WFD's goals. It would also be important to highlight the links between a better quality water environment and agendas such as the economic competitiveness of regions, tourism and health.

Implications for the Environment Agency:

The WaterProof Northwest scenarios have been used to think creatively about the potential risks and opportunities to the region's water environment under different possible future circumstances. This analysis raises important issues associated with meeting the goals of the WFD in the region, which have implications for the response of the Environment Agency and could usefully contribute to their long term water resource planning. It is important to emphasise that the scenarios have generated ideas and debate, highlighting opportunities and threats, rather than absolute conclusions. It is in this light that the WaterProof scenarios should be seen, as a vehicle for encouraging a long term perspective on effective approaches to water management in the region.

Perhaps the key message emerging from this research is the recognition that the achievement of the core goals of the WFD - relating to the quality and quantity of water - will be heavily influenced by drivers of change beyond the control of the Agency. So although the Environment Agency has been identified as being responsible for the Directive, in practice their success in achieving key objectives may be determined by wider external forces. For example, the prevailing political attitude to the extent of governance, the speed of the recovery from recession, levels of public environmental awareness or the pace and acceptability of technological change may all play central roles. Whilst the Agency is well placed to address the specific goals of the WFD, it is a passive recipient of many of those broader societal drivers which can have a forcing effect on water issues.

The scenarios also suggest that a lot of the power to affect the implementation of the WFD may rest above the regional scale. Whilst actors and agencies in the Northwest clearly play a role, central and European government policies and international agreements (for example, as might happen with carbon) may have a key effect. Therefore, in order to help the Northwest hit water targets, there may have to be a greater role for stakeholders within the region to extend their awareness and influence to a national and even international scale. For example, this may include an increased effort to proactively engage with major national and international agencies, which may mean greater collaborative working beyond our boundaries. Partnership working is clearly also relevant at the local scale, across spatial boundaries and between sectors. The scenarios provide a strong steer that due to the wide ranging scope of the drivers, and the range of sectors impacted by and influencing water, partnerships will be central to the WFD response. The nature of future circumstances such as governance arrangements and levels of investment in water related infrastructure may also help to dictate the form and function of the partnerships.

The WFD is a broad, progressive piece of legislation relating to many aspects of the water environment, and has been described as Europe's first 'sustainable development' Directive. Indeed, the WFD will be the key planning framework around which water quality and quantity issues are managed within Europe for the foreseeable future. Therefore, when considering the implications of the WaterProof scenarios for the WFD, there is much of relevance to the water environment more generally. Further, the outcomes of the project relating the WFD are also relevant to other fields of environmental management over which the Environment Agency has an influence, such as climate change mitigation and adaptation (to flooding for example) and biodiversity conservation. These are influenced by similar broad drivers of change.

A common approach when determining long term strategies is to gather more data in an attempt to reduce uncertainties. However, the sheer complexity of the influences on the water environment revealed within the WaterProof scenarios suggests that, far from providing a simplistic level of clarification, a more detailed outlook of the wide ranging drivers of change provides a view of a Directive whose long term success may rest worryingly beyond the scope of the Agency charged with its delivery. In effect, rather than reducing uncertainty, the project may have provided a more ambiguous but realistic view of a piece of legislation embedded within a region and society subject to strong external forces.

So how should the Environment Agency respond? Scenario exercises are designed to identify and consider future risks and opportunities with the aim of increasing the resilience of future plans and policies. In the context of the WFD, the project as a whole, both in terms of its methodology and findings provide a consistent view: it is a partnership approach encompassing a wide variety of stakeholders operating within and beyond the region that forms the core of a response. Maintaining sufficient organisational flexibility is also crucial in a rapidly changing region impacted on as it is by a range of multifaceted drivers of change. As the WFD is focused on natural river catchments, this may require national agencies to give the Environment Agency at the regional level the freedom to respond to the Directive through the development of locally relevant strategies and responses. As our awareness of the complexity of environmental problems improves so should our methods for addressing them.

"Perhaps the key message emerging from this research is the recognition that the achievement of the core goals of the WFD - relating to the quality and quantity of water -will be heavily influenced by drivers of change beyond the control of the Agency"

Appendix i: Using the scenarios in practice:

The WaterProof scenarios have been designed to be used in practice. Although, the scenarios have been applied to better understand how to achieve the long term goals of the WFD in the Northwest of England, the broad consideration of the drivers of change with the potential to impact on water ensures that their relevance may have wider applicability. As the scenarios are a stand-alone output, they can potentially be applied in other water orientated contexts and by different stakeholders beyond the project, the region and the UK.

The section below provides a brief introduction to how the WaterProof scenarios can be used to aid future planning and decision making. It is hoped that this will enable the scenarios to perform a useful function beyond the end of the project.

The value of using the scenarios:

Prior to using the scenarios, it is important to be aware of and communicate the value of the process to participants employing the scenarios in a practical decision making setting. In this respect, the WaterProof scenarios perform two important functions.

Educational resource:

Working with scenarios has an important educational role to play, helping to illuminate potential future challenges and opportunities associated with an action. Further, using scenarios in practice can act as a catalyst for the participation of stakeholders in a workshop setting, bringing a broader range of individuals into the decision making process.

Decision aiding tool:

Scenarios are not intended to take decisions, but to aid decision making. They provide an insight into different possible futures and the impact of significant drivers of change on their activities. Used in this way, scenarios have the potential to stimulate the development of more robust decisions in the face of uncertainty about the future. For example, using scenarios can help as an 'early warning device' highlighting issues on the horizon that organisations could usefully address through additional research, action or strategy development. Or they can help identify key issues with the potential to influence the success of a plan or project both operating within, or beyond, an organisation.

When can the scenarios be used?:

The WaterProof scenarios provide a framework around which a futures exercise can be organised, and effectively provide the basis for a long term impact assessment relevant to water. There are several broad situations where stakeholders with an interest in and influence over the water environment could find using scenarios useful. These include:

- Where an organisation considers it necessary to introduce a strategic and future-orientated perspective into their operations, for example when creating a new vision or mission statement.
- When an organisation or a sector is undergoing change either as a result of internal restructuring or the impact of external forces such as political or economic change.
- During the development of forward plans, particularly those that will have long term consequences, in order to assess the implications of different policy options under several contrasting future contexts. This can help to determine the strengths and weaknesses of various options.
- To increase the resilience of a proposed action (for example a specific project or development) in light of different possible future circumstances. Scenarios offer an opportunity to help "future proof" the action being assessed.

A process for using the scenarios:

There are several key stages that should be employed when utilising the WaterProof scenarios during a workshop exercise. Ideally, a full day should be allocated in order to make the most of the process. A facilitator who has knowledge of the scenarios and the use of this approach in practice should be identified.

It will not always be necessary to use all four scenarios during a workshop exercise. If time is limited, two contrasting scenarios could be chosen and worked with. The two scenario pairs that are recommended for a scaled-down scenario exercise are Ecotopia/Free Market and DIY/Techno-fix. Either of these pairs provides two contrasting scenarios for use within a workshop. It is not advisable to use the individual scenarios in isolation as it is the process of exploring contrasting futures that provides the basis of scenario thinking.

Key stages in using the scenarios in practice include:

Define the scope of the exercise: Agree on the issue or action that the scenarios will be used to interrogate. Where possible this should be framed as a water-related question with a futures dimension. For example, how might demand for water in Greater Manchester change over the coming decades,

how might water quality change in Northwest England over the next 20 years, or what issues should an organisation consider when updating its forward plans for managing water resources?

Invite stakeholders: Working with scenarios is participatory in nature, and is an effective way of drawing individuals and organisations into a collaborative planning process. Where possible a range of stakeholders relevant to the issue being assessed should be invited. Appropriate participants will depend on factors including the sector involved and the degree to which the object of the exercise is strategic or operational in nature. It could be useful to send a summary of the workshop aim and the scenarios in advance.

Get to know the scenarios: Firstly, a selection should be made of which scenarios will be used. Options include all four scenarios or one of the scenario pairs highlighted above. The WaterProof scenarios themselves should be accepted by the group as a series of viable possible futures, rather than specific predictions. The resources available in a workshop setting should be dedicated to considering the implications of the scenarios for the particular issue being addressed. The participants should be given sufficient time to study the scenarios and familiarise themselves with their content. Participants could be encouraged to engage with the scenarios through exercises such as developing imaginary newspaper headlines to highlight the key features of each scenario.

Analysis of the scenarios: Once the participants have familiarised themselves with the scenarios, the next step is to confirm that the issue or question around which the scenario exercise will be based is correctly framed. Once this has been agreed upon and confirmed, the heart of the workshop concerns analysing the implications of the scenarios for the issue, forward plan or action being assessed. The specific nature of this stage in the process will depend on factors such as the target of the scenarios exercise, the individuals involved, and the time available. However, the main objective is to provide a structured approach to consider the research question in the context of the WaterProof scenarios. The scenarios can be taken individually or in pairs, with their implications analysed and recorded.

Outcomes and action: The final stage of the process concerns interpreting the outcomes of the scenario analysis process. The aim is to develop broad recommendations to inform the development of the forward plan, action or issue being assessed. Outcomes may include a list of strategic priorities for decision makers to consider in updating a forward plan, or the strengths and weaknesses of identified policy options under the different scenarios. Associated actions relating to following up on related issues, for example through further research or changes to policy or strategy, could be usefully recorded. A key aim may also be to consider those factors that may influence the success of a project, but rest outside of the organisation. A common finding is therefore a more precise understanding of partnerships to be developed and specific aims to be pursued with wider stakeholders.

Caveats relating to the scenario process:

Certain caveats must be acknowledged and communicated to participants when working with the WaterProof scenarios. These include:

- Scenarios should not be used to guide short term decisions. They are tools to inform long term planning and decision making, or the implications of actions likely to have long term consequences (in the case of WaterProof with reference to water in Northwest England).
- Using scenarios is generally a qualitative method involving subjective judgements. They are not designed to produce clear guidance on the direction of decisions, but rather to raise broad issues for decision makers to acknowledge. Outcomes should therefore not be used as formal evidence and should be treated with caution to avoid mis-interpretation by groups who may not fully understand the nature of the scenario process.
- Participants must be prepared to invest time in reflecting on the output of the scenario process in order to inform decision making. This may require additional research to look in greater detail at issues raised during the scenarios process. Further, scenarios should be seen as one of a range of inputs applied to support and strengthen ongoing planning and decision making process, and should not be applied in isolation.

This section has provided a brief introduction to the utility of and processes involved in working with the WaterProof scenarios. For those who would like to learn more about the use of scenarios in practice, the Environment Agency has produced guidance to aid working with the Environment Agency's 2030 scenarios (Environment Agency, 2006a). The document provides useful information concerning how to effectively use the WaterProof scenarios in practice.

"Scenarios have the potential to stimulate the development of more robust decisions in the face of uncertainty about the future"

Appendix ii: List of stakeholder participants:

Roundtable participants:

Peter Batey, Mersey Basin Campaign

Jeremy Carter, University of Manchester

Freya Cheshire, Mersey Basin Campaign

Lesley Cryer, Mersey Basin Campaign

Matt Ellis, Environment Agency

Pauline Foster, United Utilities

Clive Gaskell, Environment Agency

John Handley, University of Manchester

David Hardman, United Utilities

Will Horsfall, Salford City Council

Andrew Hunt, Trafford Metropolitan Borough Council

Walter Menzies, Mersey Basin Campaign

Brian Morrow, United Utilities

Fiona Moss, Salford City Council

Krishnan Narayanan, United Utilities

Derek Norman, REPAC

Caroline Riley, Mersey Basin Campaign

Andrew Short, Manchester City Council

Anna Steele, Environment Agency

Richard Tracey, NWDA

Mark Turner, Foundation

Jan Tyson, United Utilities

Steve Whipp, United Utilities

Iain White, University of Manchester

Janine White, United Utilities

Stakeholder interview participants:

Mark Atherton, NWDA

Tony Conway, United Utilities

Paul Farrand, Trafford Metropolitan Borough Council

Clive Gaskell, Environment Agency

Jo Harrison, United Utilities

Keith Hendry, APEM Ltd

Will Horsfall, Salford City Council

Andrew Hunt, Trafford Metropolitan Borough Council

Walter Menzies, Mersey Basin Campaign

Fiona Moss, Salford City Council

John Sanders, United Utilities

Andrew Short, Manchester City Council

Graeme Sims, United Utilities

Iain Taylor, Peel Holdings

Adrian Williams, APEM Ltd

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