

Climate Change Adaptation Second Round Report

July 2015



REPORTS



WALES & WEST
UTILITIES

Introduction	3
UK Gas Distribution Network Operators	4
Adaptation – First Round Reports	6
Understanding Climate Risk	8
Understanding Uncertainties	10
Addressing Barriers & Understanding Interdependencies.....	12
Monitoring & Evaluating	13
Opportunities & Benefits	15
Updated Risk Assessment – July 2015	16

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Introduction

The response is submitted on behalf of the Gas Transmission and Distribution Network Operators (GDNs) for Great Britain.

This group is comprised of:

- National Grid
- Northern Gas Networks
- Scotia Gas Networks
- Wales & West Utilities

These companies are all members of the Energy Networks Association (ENA), the industry body for the UK gas and electricity network companies. ENA facilitates the sharing of best practice and helps provide a coordinated approach to the climate change adaptation response by these companies, where that response is considered common to all network operators in Great Britain.

The representatives of the ENA Gas Environment Group have worked collaboratively to develop a comprehensive united industry response to the questions posed by the Climate Change Adaptation Reporting Power, Guidance for Repeat Reporters. The report reflects the common issues faced by the businesses in addressing the risks of climate change. Additional network specific information, where applicable, is included in *italics* within the body of the report.

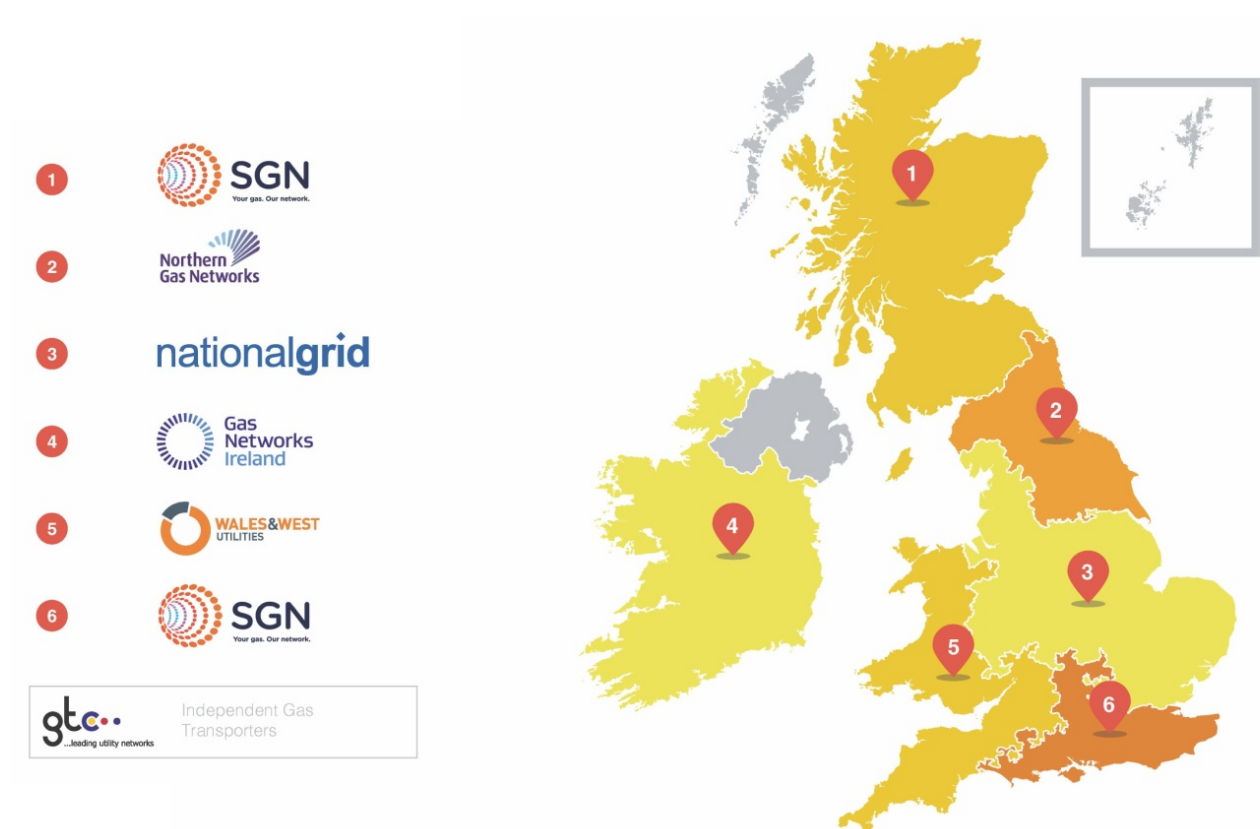
The companies control and maintain the critical national infrastructure that delivers vital services into homes and businesses throughout the UK. Gas is transported through Gas Transmission networks to regional Gas Distribution Networks that then deliver energy to customers on behalf of suppliers. Business operations include connecting new consumers, maintaining and replacing pipe work and associated assets, and dealing with gas emergencies along pipelines and within domestic, commercial and industrial properties.

National Grid is the owner and operator of the national gas transmission system and four of the eight regional Gas Distribution Networks in Great Britain. The other Gas Distribution Network Operators are Southern Gas Networks (SGN), Scotland Gas Networks (SGN), Wales & West Utilities and Northern Gas Networks (NGN).

The primary duties of the companies are covered under the requirements of the Gas Act 1986 and Electricity Act 1989 to develop and maintain efficient, reliable, safe and secure networks and to facilitate competition. Further duties are included within secondary legislation Regulations.

All GDNs operate regulated monopoly businesses operating under licences issued by Ofgem. Allowed revenues for the industry are currently set by Ofgem every eight years under the RIIO (Revenue = Incentives + Innovation + Outputs) Price Control Review framework and these reviews govern the costs and income associated with operating regulated activities.

UK Gas Distribution Network Operators



Gas Distribution

Gas is delivered from the beach terminal through the high pressure National Transmission System (NTS), owned and operated by National Grid, to the GDNs. Gas is delivered into the Local Transmission System (LTS) of each network via offtakes from the NTS. Gas under high pressure in the LTS is moved around the distribution networks and subsequently reduced to Intermediate Pressure (IP), Medium Pressure (MP) or Low Pressure (LP) via Pressure Reducing Installations. Gas is then delivered to commercial and domestic customers via a network of polyethylene (PE) and metallic LP mains and services.

Each GDN's distribution network is comprised of pipelines operating at different pressure tiers. High Pressure (HP) pipelines operate between 70 and 7 Bar, Intermediate Pressure (IP) between 7 and 2 Bar, Medium Pressure (MP) between 2 Bar and 75 mbar and Low Pressure (LP) below 75 mbar. In addition, each company owns and operates storage infrastructure such as High Pressure vessels and Liquefied Petroleum gasholders.

Individual Companies

National Grid Gas

National Grid Gas (NGG) plc owns and operates the UK Gas Transmission system and the low pressure Gas Distribution in the heart of England distributing to approximately eleven million homes, office and schools via 7,700km of gas pipelines. NGG connects producers, processors, storage, transmission and distribution network operators as well as suppliers to industrial, commercial and domestic users.

Northern Gas Networks

Northern Gas Networks (NGN) is responsible for delivering gas to 2.7 million homes and businesses across northern England. The Company was formed when The North of England Gas Distribution Network was acquired from National Grid plc in June 2005. NGN's network consists of 37,000km of gas pipes and associated delivery and storage apparatus. NGN's area covers northern Cumbria, the North East and North, East and West Yorkshire with a population of more than 6 million people.

SGN

SGN is a privately owned Gas Distribution company, operating over 74,000km of gas mains and services in the south and South East regions of England and the whole of Scotland under the banner of SGN. It is the UK's second largest Gas Distribution Network company and is responsible for delivering gas to its 5.8 million customers safely, reliably and efficiently.

Wales & West Utilities

Wales & West Utilities was launched as an independent Gas Distribution business in June 2005 following the sale of the gas network for Wales and the South West of England. With more than 35,000km of mains, Wales & West Utilities transports gas to the homes and businesses of 2.5 million consumers across a geography covering 1/6th of the UK and serving a population of 7.4 million people.

Adaptation – First Round Reports

The Climate Change Act 2008 provides the framework for ensuring the UK's ability to adapt to climate change. Defra established an Adapting to Climate Change Programme and in November 2009 laid a strategy before Parliament for using the Adaptation Reporting Power under the Act. Responses were subsequently submitted by the companies to the First Round of Adaptation Reporting in 2010, which was designed to:

- Assess the current and predicted impact of climate change in relation to the companies' functions; and
- Outline the proposals and policies for adapting to climate change in the exercise of those functions and the timescales for introducing those proposals and policies.

The Reports therefore represented individual company assessments of existing assets and business processes and identified areas where the environment is capable of impacting the ability to meet its business objective.

This formed part of the process of ensuring the businesses adapt to the expected climate changes including hotter and drier summers, warmer and wetter winters, coastal, river bed and bank erosion and increasingly extreme weather events such as flooding. The main categories of weather events and environmental risks were identified as follows:

- Flooding and heavy rain fall (including saturated ground conditions);
- Snow and ice;
- Increases in temperature, heat waves and drought conditions;
- Coastal erosion from sea level rise;
- River erosion; and
- Storm events and high winds.

Using information drawn from UKCP09 and working alongside the Meteorological Office Hadley Research Centre, the Environment Agency and the Scottish Environmental Protection Agency, the key risks and opportunities facing the businesses were identified. High emissions projections to 2050 were used to determine worst case scenarios and for correlation against the lifetimes of existing assets. Account was taken of the expected increase in number, frequency and intensity of weather events.

The risk methodology and categorisation identified a number of potentially vulnerable areas and the mitigation measures that were either in place or needed to be developed further. Decisions on the appropriate controls are dependent on the accuracy of the supporting information and data and whether a quantitative or qualitative assessment has been made.

The Reports highlighted that network assets and processes may be vulnerable to certain aspects of climate change. However, the national and regional infrastructure has a significant degree of resilience to these impacts and none of the identified risks were considered to be high. The management of these risks is now embedded within companies' overall risk management processes to ensure that any appropriate actions are recorded and completed. Responsibility and ownership of these action plans ensures their timely delivery and climate change adaptation is also subject to the same level of ongoing review and evaluation as other business risks.

Revenue is determined by Ofgem price control mechanisms (currently RII0-GD1 – Revenue = Incentives + Innovation + Outputs) and dictates the expenditure by the businesses, including the level of adaptation investment. Any increase in adaptation related costs will be required over longer medium to long term timescales however.

The inherent resilience of the networks is largely due to the majority of Gas Distribution assets being located underground, with greater resilience built into the Gas Transmission network compared to the distribution network. Those assets most at risk to the weather and climate parameters, highlighted above, are those found above ground; typically large Pressure Reducing Installations (PRIs), critical sites such as data centres, and pipelines in close proximity to watercourses. Impacts are usually localised to the asset and the process it supports and are unlikely to lead to a loss of supply or result in a risk to the system as a whole.

In addition prolonged periods of extreme weather could have a significant impact on the ability of the workforce to access and carry out their roles, particularly field-based engineers. They could also impact on the ability to conduct 'business as usual' activities as a result of the reliance on appropriate adaptation of other major infrastructures, such as telecommunications and transport. Impacts on the operation of supply chain businesses and the continued availability of equipment also needs to be considered. The environmental impact of companies' assets could be affected by the mobilisation and migration of land contaminants from flooding and ground saturation.

These interdependencies can be mitigated through the implementation of maintenance and inspection regimes, the development of flood defence measures, the availability of necessary equipment, up to date contingency measures and ensuring Business Continuity Management Plans are in place.

Understanding Climate Risk

How has your understanding of climate risks, impacts and their effects on your sector/organisation and stakeholders advanced since your first round report?

There has been no significant change in the understanding of climate change risks since the first round of Adaptation Reports were submitted in 2010/11. This understanding was based on the UKCP09 data published under the Climate Impacts Programme (UKCIP) that forecast the risks under various scenarios to the end of this century.

Similarly Environment Agency flood maps that were available and referenced at the time have not been developed any further and so the perceived risk remains the same. However, all the gas networks operators (GDNs) have experienced severe weather events in last few years which have provided ongoing learning and further insight into, and confidence in, the resilience of the gas networks infrastructure.

Actual flooding events occurring within the years subsequent to the original report have also demonstrated the network's ability to withstand incidents of this nature without impacting on security of supply.

What climate change evidence or research have you used to better understand the implications for organisational functions?

The Companies are still reliant on UKCP09 as the primary source of information and data and which remains the only such reference available. Updates from the Climate Ready service or other updated research data would therefore be welcomed.

Wales & West Utilities has shared information regarding the development of a pilot project with Landmark Information Group Ltd (Landmark) to map the physical impacts of climate change.

The Wales & West Utilities and Landmark pilot study was conducted over a small area in mid-Wales, linked to EU Water Framework Directive Catchments, which contains a broad range of Gas Distribution assets. The project was initiated to close the gap between UKCP09 forecasts and actual physical impacts in order to inform reporting authorities and wider users to be able to make justified investment decisions to adapt to climate change.

Has your understanding of thresholds of climate impacts advanced to better pinpoint organisational vulnerability? If so, how?

UKCP09 provides climate information for the UK up to the end of the century. The projections show three different scenarios representing high, medium and low greenhouse gas levels. Information is provided on observed climate data, future climate projections and future marine and coastal projections. These scenarios are still being used and remain the best existing available information.

How have you developed your quantified assessment and analysis of risk likelihood and impacts?

The original round of Adaptation reporting provided Gas Distribution with increased confidence in the level of resilience in our asset infrastructure and this allowed the companies to focus on remaining areas of risk. The existing risk assessments have been reviewed and confirmed as being still fit for purpose and the current risk ratings remain the same based on the available data.

There are limited changes to the Wales & West Utilities' updated risk assessment with regards to overall risk categories. Those with minor changes in risk relate largely to slight alterations to likelihood scoring (mainly revised down rather than up). These revisions are predominantly due to experiences to-date, existing controls and that notable changes in climate between 2015 and 2020 are unlikely. Some small changes have also been made to normalise likelihood scoring across the varying pressure tiers of above-ground gas regulating equipment with regards to flood risks.

The pilot study with Landmark developed a mapping tool as a small-scale proof of concept to analyse and query asset data against floodplain growth, increasing flood depth and escalating rates of river bed and bank erosion. The availability of an asset management tool of this kind will be a significant shift in the assessment of likelihood and impact. Presentation of the findings of the pilot study have been well received by Defra, DECC, Met Office and HM Treasury (Infrastructure UK).

Understanding Uncertainties

What uncertainties remain in monitoring and evaluating climate risks to your sector's/organisation's functions?

There is a need for cross sector planning scenarios to ensure that sectors with interdependencies have used similar assumptions when reporting; this was not fulfilled in the first round of reporting. This is important to address the wide variety of views regarding the extent and impact of climate change on national infrastructure.

The overall level of uncertainty for gas networks is low as the sector has a high level of inherent resilience due to the level of safety awareness and regulatory overview.

Monitoring, evaluating and adapting to risks of all types, including climate change, are an integral part of business as usual.

What new uncertainties have come to light?

No new uncertainties in Gas Distribution have emerged since the original Adaptation report. The businesses continue to monitor three key areas of flooding, ground subsidence and coastal and river erosion.

Further information on flooding risks is available from both internal and external sources; however this is limited. Further analysis is still required to understand the impact associated with subsidence/land slips and the extent to which climate change will cause ground movement. Asset replacement programmes continue to reduce this risk by removing brittle metallic mains from the network. River and coastal erosion continue to be monitored at identified locations and investment strategies are introduced where required.

What further implications do uncertainties have on action your sector/organisation has taken or plans to take?

Any emerging uncertainties will be captured within the risk management approach adopted by the companies and addressed within business work plans.

This process needs to ensure that any asset investment made is necessary, timely and appropriate. All of the companies are regulated monopoly businesses and as such capital and operating expenditure is subject to economic regulation by Ofgem. This is achieved via a periodic price control process known as RIIO (Revenue = Incentives + Innovation + Outputs). The current price control runs from 2013 to 2021 and, unless there are exceptional or unforeseen circumstances, then the levels of approved revenue needed to accommodate the planned asset infrastructure investment and maintenance for this period, including any work required to adapt to climate change, have now been determined.

At present the current UKCP09 data does not support further asset investment beyond that already planned. The existing revenues will allow for some reactive investment but the available forecast projection data does not adequately support significant adaptation investment at this time. However, the Landmark pilot project indicates the potential to generate meaningful asset impact data. This could be used to support further infrastructure investment across multiple industries such as utilities, transport, telecommunications, insurance bodies and construction.

Climate change risk will continue to be monitored as part of the companies' approach to risk management and information will be shared with the sector via ENA.

Wales & West Utilities submitted a detailed asset management plan to adapt to climate change, based upon UKCP09 forecasts, as part of our business plan submission to Ofgem in 2011. There was some recognition in our allowances for adaptation to climate change. Mapping data which displays a projected impact would support the development of a much stronger case for allowed revenue in future.

What progress have you made to address information gaps?

Along with other sectors the gas network industry remains reliant on national climate change data, projection scenarios and research published by the Government. Consequently these need to be periodically revised and updated. Access to a tool, such as the Landmark climate change physical impact mapping, would be of great benefit in justifying and delivering robust adaptation measures across the whole of the UK.

In the meantime the ongoing monitoring of network operations, particularly in periods of severe weather, together with sharing of experience across the sector via the ENA, has improved the confidence levels in the resilience of the networks to future climate change impacts. This in turn provides an indication of any appropriate mitigating actions that may be required.

The Wales & West Utilities and Landmark pilot study was delivered to provide the user with the option of viewing current impacts with future impacts for high, medium and low emissions and 90%, 50% and 10% probabilities. The capability of a user to make these choices will enable a comparison to be made regarding the level of impact and cost of adaptation for a range of scenarios.

What are the strategic business and methodological assumptions that underpin your analysis of impacts and risks?

Company business strategies are driven by both asset life cycles and the regulatory framework within which the sector operates.

Assets are installed with an expectation of over 40 years of reliable service based on equipment integrity, level of operational use and suitable maintenance regimes. Based on these parameters, and the standards to which such equipment is initially designed, constructed and installed, assets are deemed to be climate resilient during this service lifetime.

The levels of asset investment that are determined in the intervening price control periods assist in the assessment and response to the impact of climate change adaptation. The assumptions that are made as part of this process remain based on the available long term climate data forecasts.

Addressing Barriers & Understanding Interdependencies

Where you've identified interdependencies, how have these assisted or hindered actions to address climate risk?

The First Round Reports highlighted key interdependencies with other sectors that were not previously required to report via the mandatory process or did not provide a comprehensive level of reporting. Details of fundamental interdependencies with transport, telecommunications and the local authority sectors in particular have resulted in some areas which retain higher risk profiles than necessary and which would have benefited from being designated as Reporting Authorities from the outset.

Within the gas sector, high levels of cooperation exist between all the network operators to manage emergency situations including major incident simulations. This, together with joint working via the ENA, helps to create an environment of cooperation to address climate risk.

What were the main barriers to implementing adaptation actions and why?

The currency and robustness of the existing data set is a potential barrier to an effective adaptation response. It is unclear if the projected climate forecasts within UKCP09, which dictate the required investment now, are sufficiently accurate and robust to inform the required business decisions. Please refer to the previous comments on the Landmark pilot project.

There is also a need for stronger links between the forecasts and the actual projected impact at the local, regional and national environment level i.e. the level of rainfall, frequency of severe events, change in wind levels, the degree, extent and depth of flooding, increased rates of erosion and the exacerbation of land movement etc that will impact on all sectors.

It remains difficult to accurately predict the level of funding needed by the regulated businesses for long term adaptation measures due to the current periodic price control investment cycle. A detailed process of assessment led to Ofgem determining the allowed level of revenue and investment for the companies only covering the period from 2013 – 2021, including any expenditure required for adaptation.

Have new barriers been identified? Are these being addressed? If so, how?

Any interdependencies with other sectors that are identified, and which impact on the operation of the gas networks, will be included within the company risk and business action plans going forward.

Further research and analysis into climate change impacts would certainly allow risks to be better understood.

Monitoring & Evaluating

How effectively has consideration of climate change risks been embedded within your sector or organisation?

There is an increasing level of awareness within the companies and its employees on climate change risks and the requirements for both mitigation and adaptation response. This is aided by the sharing of information and best practice via ENA, the industry body for the sector. ENA represents both the gas and electricity network companies providing opportunities for further liaison and learning opportunities as all energy sector companies are designated as Reporting Authorities and share some common issues.

The gas network businesses already demonstrate comprehensive existing management of their assets and resilience to existing and future climate impacts. Increasingly this is seen as a business as usual aspect of risk management. This work is further supported by the sector's involvement in wider national Government resilience and emergency response fora.

Wales & West Utilities won the Business in the Community 'Wales Environment Award' in 2013 for our dual approach to climate change, focussing on both mitigation and adaptation, with reference to our World's First contaminated land remediation projects to be driven by climate change forecasts. Through coaching and development, our frameworks of environmental consultants and contractors have been the first to deliver climate change considerations in contaminated land projects. Our better-than-best practice approach has been the subject of a national conference and workshop for the Construction Industry Research & Information Association (CIRIA), which was delivered to environmental regulators, other clients and supply chain businesses in June 2015.

We introduced the concept of contaminated land and the risks faced by climate change to Defra in London in 2013, with subsequent site visits by Defra, Natural Resources Wales and the other Gas Distribution Networks to see the works in progress.

How effective have organisational monitoring and evaluation processes been to ensure adaptation responses are implemented and on track? If these have not been effective, what barriers prevented this?

As per some of the previous answers, actions detailed in the Adaptation Reports continue to be monitored. These Action Plans have been incorporated within the company business plans as appropriate based on the level of risk.

Progression against the understanding of specific issues, such as flooding risks, coupled with experience of recent events has moved the companies forward in their understanding. Local impacts of river and coastal erosion on assets are also monitored and investment is made where required. Greater understanding and analysis of ground movement is potentially one area requiring further investigation, but monitoring parameters within existing risk and incident management systems provide assurance on any future required action.

Wales & West Utilities have identified that the availability of climate change impact mapping will allow detailed interrogation of assets which interact with projected flooding areas and rivers with significant erosion potential. Such predictive analytics will support the re-prioritisation and frequency of asset monitoring.

How effective were monitoring and evaluation processes in determining how the organisation/sector handled recent extreme weather conditions?

The planning of emergency responses in all conditions is part of business as usual practice, and whilst every severe weather episode provides learning and continuous improvement opportunities, the sector managed the recent extreme weather conditions without significant unforeseen problems. No unforeseen changes to the sector approach to adaptation have been identified from these events.

Has the sector/organisation identified any financial benefits from implementing adaptation actions? Perhaps through cost benefit analysis, fewer working days lost, more efficient operations etc?

Minimal financial benefits have been identified by the companies to date, but there is an appreciation of the benefit of early adaptation response where necessary to help mitigate future costs. The costs incurred in resourcing adaptation related work are subsumed within planned operational expenditure.

Has there been sufficient flexibility in the approach to adaptation within the sector/organisation, which allowed you to pursue alternative courses of action? If not what remedial measures could you take to ensure flexibility?

The industry already works within a framework where long term investment, and its underlying assumptions, is subject to periodic regulatory review. The long term safe operation of the gas networks is separately subject to the approval of safety cases with the Health and Safety Executive on a regular basis. These existing arrangements comfortably sit alongside the Adaptation Reporting framework and provide a sufficiently flexible approach.

Opportunities & Benefits

What action have you taken to exploit opportunities?

Limited opportunities have been identified by the companies to date.

Please refer to the Benefits Assessment in Wales & West Utilities' First Round Report for details regarding the very limited potential benefits posed by UKCP09 forecasts. There are no changes from the last assessment; however it is worth noting that the low-medium benefit potential from reduced water volume collecting in excavations and improved workforce health from dryer summers is now considered to be even less of a benefit as a result of the recent output from the Climate Modelling Intercomparison Project (CMIP5). This project reveals that summer rainfall is now actually more likely to remain the same or even increase slightly.

How effective were your efforts?

Not applicable.

Updated Risk Assessment – July 2015

See next page for details.

There are limited changes to Wales & West Utilities' overall risk categories. Those with minor changes in risk relate largely to slight alterations to likelihood scoring (mainly revised down rather than up). These revisions are predominantly due to experiences to-date, existing controls and that notable changes in climate between 2015 and 2020 are unlikely. Some small changes have been made to normalise likelihood scoring across the varying pressure tiers of above-ground gas regulating equipment with regards to flood risks.

Wales & West Utilities Climate Change Adaptation Risk Assessment - July 2015

Risk ID	Confidence Level	Current Risk Category	2020 Risk Category	2050 Risk Category	Climate Change Forecast	Effect to Environment	Effect to WWU	Sub-Effects (if applicable)
CC1	2	Low	Low	Medium	Summer mean temperature increase	Increase in peak temperatures	Warmer working conditions	Increased demand on air conditioning
CC2	3	Low	Low	Low	Sea level increase	Rise in sea level	Flooding	Difficult access to <7bar Pressure Reduction Installations in emergency situations
CC3	3	Low	Low	Low	Sea level increase	Rise in sea level	Flooding	Operating difficulties due to loss of electrics on <7bar Pressure Reduction Installations
CC4	1	Low	Low	Low	Sea level increase	Rise in sea level	Flooding	Increased corrosion of pipes
CC5	1	Low	Low	Low	Sea level increase	Rise in sea level	Flooding	Low pressure pipes floating
CC6	1	Low	Low	Low	Winter mean precipitation increase	Increase in winter ground saturation	Escape reporting	Understanding the relationship between ground saturation and gas escapes
CC7	1	Low	Low	Low	Summer mean precipitation decrease	Decrease in summer ground saturation	Escape reporting	Understanding the relationship between ground saturation and gas escapes
CC8	2	Low	Low	Low	Winter cloud amount increase	Decrease in sunlight	Lower efficiency solar panels	
CC9	1	Low	Low	Medium	Wettest day in winter increase	Increase in peak water	Flooding	Access to place of work for critical staff
CC10	3	Medium	Medium	Medium	Wettest day in winter increase	Increase in peak water	Flooding	Access to place of work for non-critical staff
CC11	2	Low	Low	Medium	Summer mean temperature increase	Increase in peak temperatures	Warmer working conditions	Heat exhaustion of engineers
CC12	2	Low	Low	Low	Winter cloud amount increase	Decrease in sunlight	Seasonal affected disorder (SAD) increases	
CC13	2	Medium	Medium	High	Wettest day in winter increase	Increase in water table	Pipes submerged in water	Increased water ingress to pipes
CC14	1	Low	Low	Medium	Wettest day in winter increase	Increase in winter ground saturation	Ground movement	Pipes become exposed
CC15	2	Low	Low	Medium	Wettest day in winter increase	Increase in ground movement	Pipe movement will increase	Increased number and size of fractures on metallic mains
CC16	2	Low	Low	Low	Winter mean precipitation increase	Increase in water table	Pipes submerged in water	Increased corrosion of pipes
CC17	3	Medium	Medium	Medium	Wettest day in winter increase	Increase in peak water (Fluvial)	Flooding	Difficult access to >7bar Pressure Reduction Installations in emergency situations
CC18	3	Medium	Medium	Medium	Wettest day in winter increase	Increase in peak water (Fluvial)	Flooding	Operating difficulties due to loss of electrics on >7bar Pressure Reduction Installations
CC19	3	Medium	Medium	High	Winter mean precipitation increase	Increase in peak water in rivers (Fluvial)	River changes	Under river pipes become exposed and damaged
CC20	3	Medium	Medium	High	Winter mean precipitation increase	Increase in peak water in rivers (Fluvial)	River changes	Pipes parallel to rivers become exposed and damaged from meandering
CC21	3	Medium	Medium	High	Winter mean precipitation increase	Increase in peak water in rivers (Fluvial)	River changes	Over river pipes attached to 3rd party structures impacted by debris contact and water volume and velocity
CC22	1	Low	Low	Low	Annual mean humidity increase	Increase moisture in atmosphere	Sweating of pipes	Additional sweat on pipes causing corrosion and associated maintenance increase
CC23	0	Awaiting further data	Awaiting further data	Awaiting further data	Annual mean temperature increase	Increase in temperatures	Warmer working conditions	Change in pipe thermal conductivity
CC24	3	Low	Low	Low	Winter mean precipitation increase	Increase in winter ground saturation	Water in gasholders	Increase volumes via discharge consents
CC25	2	Low	Low	Low	Annual mean humidity increase	Increase moisture in atmosphere	PE fusion	Issues with bonding of joints
CC26	2	Low	Low	Low	Winter mean precipitation increase	Increase in water	Wetter working conditions	Reduction in reuse of excavated material
CC27	2	Low	Low	Low	Winter mean precipitation increase	Increase in water	Wetter working conditions	Reduction in reuse of recycled material
CC28	3	Low	Low	Low	Wettest day in winter increase	Increase in peak water	Flooding	Damage to data loggers
CC29	3	Medium	Medium	Medium	Wettest day in winter increase	Increase in peak water	Flooding	Impact on PRI's protected to current flood depth - not protected to forecast future flood depth
CC30	2	Medium	Medium	Medium	Summer mean temperature increase	Increase in temperatures	Warmer working conditions	Effects on engineers welfare
CC31	1	Low	Low	Low	Winter mean precipitation increase	Increase in water	Wetter working conditions	Increased time and difficulties with setting concrete
CC32	1	Low	Low	Medium	Winter mean precipitation increase	Increase in water	Wetter working conditions	Difficulties with trench water
CC33	1	Medium	Medium	Medium	General	0	Supply chain costs increase due to environmental impact focus	
CC34	1	Low	Low	Low	General	0	Change in purchasing strategy for environmental focus	
CC35	1	Medium	Medium	Medium	Summer mean temperature increase	Increase in temperatures	Warmer working conditions	Changing requirements of PPE
CC36	3	Low	Low	Medium	Winter mean precipitation increase	Increase in water	Flooding	Depot drainage issues
CC37	3	Medium	Medium	Medium	Wettest day in winter increase	Increase in peak water (Fluvial)	Flooding	Difficult access to NTS Offtakes in emergency situations
CC38	3	Medium	Medium	Medium	Wettest day in winter increase	Increase in peak water (Fluvial)	Flooding	Operating difficulties due to loss of electrics on NTS Offtakes
CC39	0	Awaiting further data	Awaiting further data	Awaiting further data	Annual mean temperature increase	Increase in temperatures	Change to the specific gravity of gas	Difficulties meeting regulatory requirements
CC40	3	Medium	Medium	Medium	Sea level increase	Rise in sea level	Flooding	Difficult access to NTS Offtakes in emergency situations
CC41	3	Medium	Medium	Medium	Sea level increase	Rise in sea level	Flooding	Operating difficulties due to loss of electrics on NTS Offtakes
CC42	3	Medium	Medium	Medium	Sea level increase	Rise in sea level	Flooding	Difficult access to >7bar Pressure Reduction Installations in emergency situations
CC43	3	Medium	Medium	Medium	Sea level increase	Rise in sea level	Flooding	Operating difficulties due to loss of electrics on >7bar Pressure Reduction Installations
CC44	3	Low	Low	Low	Wettest day in winter increase	Increase in peak water (Fluvial)	Flooding	Difficult access to <7bar Pressure Reduction Installations in emergency situations
CC45	3	Low	Low	Low	Wettest day in winter increase	Increase in peak water (Fluvial)	Flooding	Operating difficulties due to loss of electrics on <7bar Pressure Reduction Installations
CC46	3	Medium	Medium	Medium	Wettest day in winter increase	Increase in peak water	Flooding	Deterioration of site assets
CC47	3	Low	Low	Low	Sea level increase	Increase in ground saturation	Pipes submerged in water	Large diameter pipes floating
CC48	3	Medium	Medium	Medium	Winter mean precipitation increase	Increase in winter ground saturation	Pipes submerged in water	Large diameter pipes floating
CC49	3	Low	Low	Low	Wettest day in winter increase	Increase in peak water	Flooding	Impact on cathodic protection
CC50	3	Medium	Medium	Medium	Wettest day in winter increase	Increase in peak water in rivers (Fluvial)	Flooding	Difficult access to >7bar Pressure Reduction Installations in emergency situations
CC51	3	Medium	Medium	Medium	Wettest day in winter increase	Increase in peak water in rivers (Fluvial)	Flooding	Operating difficulties due to loss of electrics on >7bar Pressure Reduction Installations
CC52	3	Medium	Medium	Medium	Wettest day in winter increase	Increase in peak water in rivers (Fluvial)	Flooding	Difficult access to NTS Offtakes in emergency situations
CC53	3	Medium	Medium	Medium	Wettest day in winter increase	Increase in peak water in rivers (Fluvial)	Flooding	Operating difficulties due to loss of electrics on NTS Offtakes
CC54	3	Low	Low	Low	Wettest day in winter increase	Increase in peak water in rivers (Fluvial)	Flooding	Difficult access to <7bar Pressure Reduction Installations in emergency situations
CC55	3	Low	Low	Low	Wettest day in winter increase	Increase in peak water in rivers (Fluvial)	Flooding	Operating difficulties due to loss of electrics on <7bar Pressure Reduction Installations
CC56	1	Low	Low	Low	Annual mean temperature increase	Increase in temperatures	Warmer working conditions	Increased demand for cooling at IT server data centre
CC57	1	Low	Low	Low	Annual mean humidity increase	Increase moisture in atmosphere	Humidity increase at data centres	Requirement for dehumidifiers at IT server data centre
CC58	1	Medium	Medium	Medium	Annual mean temperature increase	Increase in temperatures	Warmer working conditions	Potential overheating of PCs
CC59	2	Low	Low	Low	Wettest day in winter increase	Increase in ground movement	Pipe movement will increase	Gradual ground movement will increase the stress on gas assets
CC60	3	Medium	Medium	High	Wettest day in winter increase	Increase in winter ground saturation	Movement of land contaminants increase	Increase in statutory liability and risk to sensitive receptors
CC61	0	Awaiting further data	Awaiting further data	Awaiting further data	Wettest day in winter increase	Increase in winter ground saturation	Corrosion increase to pipes	Effect on cathodic protection
CC62	1	Low	Low	Low	Annual mean temperature increase	Increase in temperatures	Warmer temperatures impacting compressor efficiencies	Lower gas pressure supplied to offtakes from national gas transmission pipelines
CC63	0	Awaiting further data	Awaiting further data	Awaiting further data		Increase instances of lightning	Lightening strike to gas sites	Damage and loss of control to gas sites
CC64	0	Awaiting further data	Awaiting further data	Awaiting further data		Increase instances of lightning	Lightening strike to hill top radio towers	Loss of data transmission to multiple sites
CC65	0	Awaiting further data	Awaiting further data	Awaiting further data	Wind	Increased frequency of strong winds	Material blown off site	
CC66	1	Low	Low	Low	Summer mean temperature increase	Drought	Limited water supply	Difficulties in performing hydrostatic testing
CC67	0	Awaiting further data	Awaiting further data	Awaiting further data	Wind	Increased frequency of strong winds	Issues with gasholder operation	
CC68	0	Awaiting further data	Awaiting further data	Awaiting further data	Wind	Increased frequency of strong winds	Working at heights associated issues	
CC69	1	Medium	Medium	Medium	Summer mean temperature increase	Drought	Wild fires	Damage to WWU assets
CC70	1	Medium	Medium	High	General	0	Impact on suppliers from other countries effecting supply of materials	Supply of materials
CC71	0	Awaiting further data	Awaiting further data	Awaiting further data	Summer mean temperature increase	Increase in temperatures	Store temperatures increased	Impact on chemical storage
CC72	0	Awaiting further data	Awaiting further data	Awaiting further data	Wind	Increased frequency of strong winds	Damage to telemetry masts	Loss of data transmission to multiple sites
CC73	0	Awaiting further data	Awaiting further data	Awaiting further data	Wind	Increased frequency of strong winds	Damage to WWU assets and staff from material / uprooted trees	
CC74	0	Awaiting further data	Awaiting further data	Awaiting further data	Wind	Increased frequency of strong winds	Dust migration increase	
CC75	0	Awaiting further data	Awaiting further data	Awaiting further data	Wind	Increased frequency of strong winds	Operations sign movement	
CC76	1	Low	Low	Low	Summer mean temperature increase	Increase in temperatures	Warmer working conditions	Overheating of vehicles
CC77	1	Medium	Medium	High	Winter mean precipitation increase	Increase in peak water in rivers (Fluvial)	River changes	Stand-alone over river pipes impacted by debris contact and water volume and velocity
CC78	2	Medium	Medium	Medium	Wettest day in winter increase	Increase in ground movement	Pipe movement will increase	Intense one off large scale land movement resulting in loss of a pipeline