

EVALUATION OF LONG-TERM DATA SETS FOR CLIMATE CHANGE DETECTION AND MONITORING

R&D Technical Report X1-043/TR

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The report will help to support the development of Agency policy and processes that involve Planning and Reporting. The target audience is senior Agency managers with responsibility for 'Limiting and Adapting to Climate Change' and those involved in Monitoring and Assessment. The report will also provide useful reference material for other Government agencies, research institutions, businesses and academia.

Keywords

Climate change impacts, monitoring, long-term data sets

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EXECUTIVE SUMMARY

The Earth's climate is changing and the consensus of scientific opinion is that the activities of Man are, at least, contributing to the observed changes. The mechanism of change is the historical and current release of carbon dioxide and other 'greenhouse' gases resulting in an increase in the greenhouse effect leading to global warming.

There is clear evidence that climate change is happening: the global average surface temperature has increased by 0.6% over the 20th Century; the 1990s was the warmest decade and 1998 the warmest year since the instrumental record began; snow cover and ice extent have decreased; and global average sea level has risen (IPCC, 2001).

The Environment Agency identified climate change and its consequences for society and the environment as a high priority issue in its recent assessment of the state of the environment (Environment 2000 and Beyond). Climate change is also one of the key areas to be addressed in the latest statement of the Environment Agency's Vision of the environment – Making it Happen. This document includes the following targets for the next five years:

- Reducing carbon dioxide emissions from Agency-regulated processes to meet the Government's target of 20% lower than 1990 levels by 2010;
- Reducing greenhouse gas emissions from Agency-regulated processes to meet the Government's target of 12.5% lower than 1990 levels between 2008 and 2012;
- Producing up to date assessments of threats to water supplies and the water environment;
- Contributing to local initiatives and influencing national policies to increase use and generation of renewable energy sources.

These targets reflect the fact that the Agency's work in relation to climate change includes both contributions towards tackling the causes and investigating the potential impacts.

The Agency has a wealth of long-term hydrometrical, biological, chemical and physico-chemical data for the environmental media (air, water and land) for which it has responsibilities. However, to date there has been no retrospective analysis of these data sets to determine whether trends in environmental data can be attributed to climate change.

The objectives of this project were to:

- conduct an initial audit of Environment Agency data sets, catalogue them and indicate their potential for detecting climate change impacts;
- identify some key data sets that are external to the Agency but that could be used by the Agency to detect climate change impacts;
- indicate, as far as possible, any gaps in the availability of environmental monitoring data that might be required by the Agency to report on climate change impacts.

Data sets were identified from three main sources:

1. Indicators of climate change impact (including those developed for the UK (Cannell *et al.*, 1999 and 2003), Wales (Buse *et al.*, 2001), the Environment Agency's Flood Defence Function (Environment Agency, 2003a) and the Agency's Headline Indicators (Environment Agency, 2003b);
2. Environment Agency monitoring programmes – including summary documents of Environment Agency monitoring activities, State of the Environment reports and responses to enquiries to Agency functions from the Agency's Climate Change Unit and from the contractor as part of this project. These were cross-referenced with entries in the 'Environment Agency Metadata Repository';
3. Expert knowledge of data sets external to the Agency.

A total of 79 data sets were identified (37 internal to the Agency, 4 external but supported by the Agency and 38 external but available to the Agency). The key features of each data (including information on the geographical scope, sampling network, length of time series, quality assurance, data storage and contact details) were catalogued in standardised proformas and are included as appendices to this report.

Each data set was evaluated against a set of criteria (including a link to a climate state or impact variable, length of time series, frequency of updating, degree of quality assurance, data availability and the presence of confounding factors) and classified as having high, medium or low potential to detect climate change impacts. From the 79 data sets identified, 65 are considered to have some potential (high or medium) to detect climate change impacts. In aquatic environments, the majority of the Agency internal data sets were classified as having medium potential on the basis of the length of the time series (not yet multi-decadel) and the presence of significant confounding factors that may mask any climate change impact signal.

The assessment of information and gaps for climate change impact detection suggested that, as far as information needs had been defined, most of the required monitoring data sets could be sourced. The main exceptions were land use/cover information, human health indicators and climate change induced changes on the coast. The Agency is currently in the process of further defining the links between potential climate change impacts and the business deliverables of each Function. This process needs to be completed before monitoring requirements can be defined. The Flood Defence and Water Resources Functions have progressed furthest in terms of defining climate change impact indicators relevant to their business needs. However, the potential for climate change impact indicators for the remaining Functions (i.e. water quality, land quality, conservation, fisheries, recreation, navigation, waste, PIR, RAS) should be investigated. The data resource outlined in this report would be a useful first step in facilitating the development.

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1. INTRODUCTION

There is clear evidence that climate change is happening: the global average surface temperature has increased by 0.6% over the 20th Century; the 1990s was the warmest decade and 1998 the warmest year since the instrumental record began; snow cover and ice extent have decreased; and global average sea level has risen (IPCC, 2001). Indicators of climate change are needed to show that changes are occurring, to determine at what rate this is happening, to help plan for management of these changes and, at some stage to monitor whether methods of mitigation, such as cuts in carbon dioxide emissions, are working. In 1999, a list of 34 indicators was published for the UK as a whole (Cannell *et al.*, 1999) and these have been reviewed in 2003 (Cannell *et al.*, 2003). Only indicators with long-term data sets and for which the historic record shows sensitivity to climate were included.

The Agency has a wealth of long-term hydrometrical, biological, chemical and physico-chemical data for the environmental media for which it is responsible. However, to date there has been no retrospective analysis of these data to determine whether trends in environmental data can be attributed to climate change, as measured against recommended indicators. There has been little consideration of which of the indicators recommended for the UK would be appropriate for our data to be measured and reported against and no consideration of how our future monitoring strategies might be developed to include climate-related data for use in all sensitive operational and policy activities.

The Agency is now being urged to factor climate change adaptation into all Agency activities and recently produced a paper for the Agency Board to demonstrate how climate change is being considered across the organisation.

This report evaluates existing Environment Agency and some external data sets to determine their actual and potential use for climate change impact detection and future monitoring. This would be a useful resource to users across the wide remit of Agency business and also for many users outside the Agency. As a secondary objective it will also consider other sources of data external to the Agency and how we might use these to supplement the Agency's own information.

The main contractor for this work was WRc, supported by inputs from staff of PISCES Conservation Ltd.

2. OBJECTIVES

The objectives of this project were to:

- conduct an initial audit of Environment Agency data sets, catalogue them and indicate their potential for detecting climate change impacts;
- identify some key data sets that are external to the Agency but that could be used by the Agency to detect climate change impacts;
- indicate, as far as possible, any gaps in the availability of environmental monitoring data that might be required by the Agency to report on climate change impacts.

The primary purpose of this report is to produce a catalogue of data sets that offer some potential for detecting the impacts of climate change. The report enables interested parties to readily identify a data set, be informed of its potential to detect climate change impacts and provide details of how to obtain it.

3. SOURCES OF INFORMATION

The project used a number of sources of information to identify data sets with the potential to detect climate change impacts. The primary data sources were:

- Indicators of climate change impact;
- Environment Agency monitoring programmes – including summary documents of Environment Agency monitoring activities, State of the Environment reports and responses to enquiries to Agency functions from the Agency’s Climate Change Unit and from the contractor as part of this project;
- Expert knowledge of data sets external to the Agency.

Information from each of these sources was examined and data sets identified. A standard proforma was completed, as far as possible, for each data set. Data sets were classified as either:

- **Agency Internal** – a data set generated and maintained entirely within the Agency;
- **Agency supported** – a data set that is generated with Agency support (either financial or in-kind effort) and maintained either by the Agency or an external body;
- **External** – a data set generated and maintained entirely outside the Agency.

Completed proformas for each data set identified and classified as Agency internal, Agency supported and external are presented in Appendices A, B and C respectively.

3.1 Indicators of climate change impact

Indicators of climate change were investigated to identify possible sources of data on the impacts of climate change in the UK. Five sets of indicators were explored:

- a) A set of 34 UK-wide indicators developed by Cannell *et al.* in 1999 and updated in 2003;
- b) The National Assembly for Wales (NAW) commissioned a scoping study in 1999 to review existing information on climate change and research studies and to suggest suitable climate change indicators for Wales (Buse *et al.*, 2001);
- c) The Environment Agency’s Flood Defence function commissioned some R&D to derive environmental change indicators (including those relevant to climate change) relevant to flood management and coastal defence. A final draft report was made available for this work (Environment Agency, 2003a);
- d) The Environment Agency uses a set of Environmental Indicators to provide an overview on the changing state of the environment of England and Wales. The set of headline indicators includes four indicators with a potential link to climate change impacts (Environment Agency, 2003b).

- e) The annual indicator report on the state of Europe’s environment (Environmental Signals, 2002) (EEA, 2002a) lists three indicators of climate change: total emissions of greenhouse gases, emissions of greenhouse gases by sector and gas, and global and European mean temperature. Most recently, the European Environment Agency Topic Centre on Air and Climate Change has identified nine main categories containing 49 indicators (EEA, 2002b).

The majority of these sets of indicators have been developed either within the framework of the Organisation for Economic Co-operation and Development (OECD) **Pressure-State-Response (PSR)** concept of causality or the extended **Driving Forces-Pressures-State of the Environment-Impacts-societal Responses (DPSIR)** framework of the European Environment Agency (EEA, 2002a). Figure 3.1 illustrates the DPSIR framework in relation to climate change.

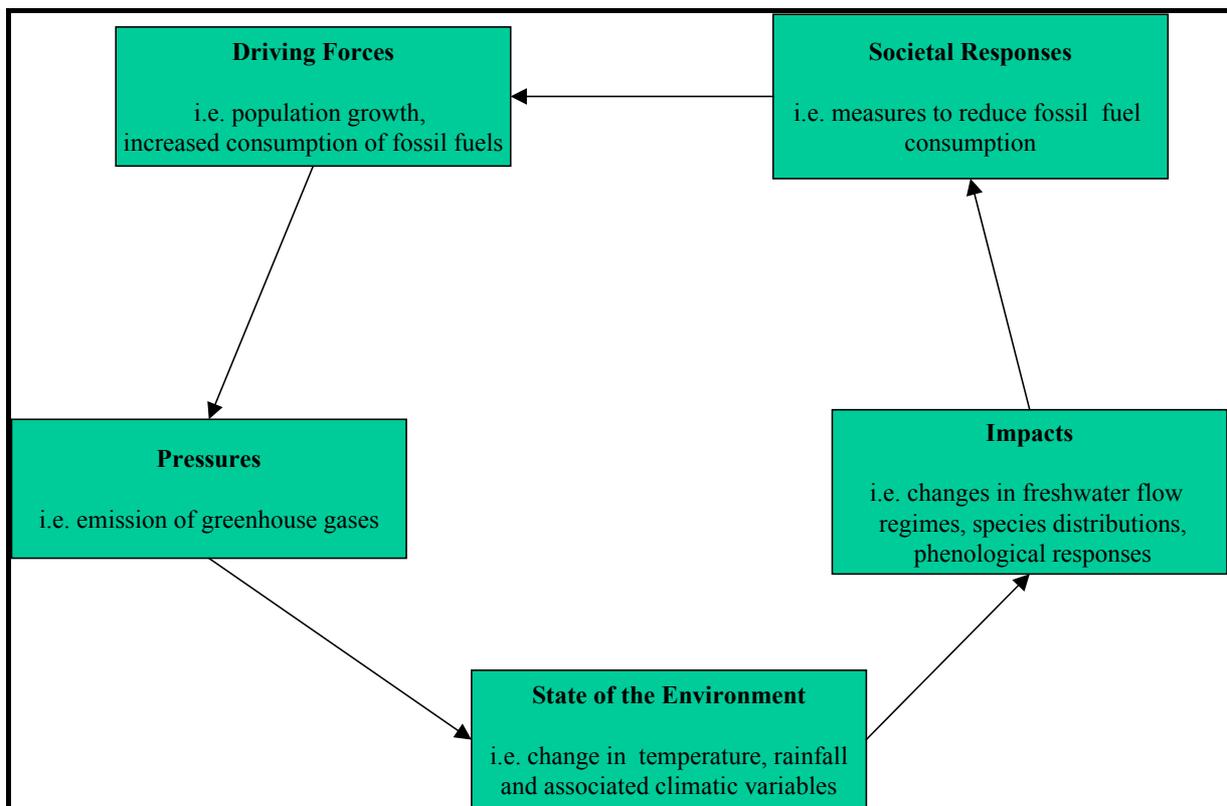


Figure 3.1 The DPSIR framework in relation to climate change

The indicators developed relate either to the Pressure, State or Impact stages of the framework and the data sets identified as part of this work have been assigned to one of these stages.

The study commissioned by the NAW (Buse *et al.*, 2001) considered potential indicators of the impact on the changing state of the climate on the economy, human health, agriculture and forestry, terrestrial wildlife and marine and freshwaters. Fifteen candidate indicators were identified including those with long term data sets to support them and some where data will become available in the future.

The Agency R&D project on environmental change indicators identified 35 potential measures covering all aspects of flood management and coastal defence. Four pilot indicators

were identified for further development primarily on the basis of the existence of a suitable long term data set.

The Agency's headline indicators include abstraction from fresh waters, Thames Barrier closures, flood levels in rivers and salmon catches which all could be influenced by a changing climate as well as other pressures.

The approach to the development of the indicators directly relevant to the UK (Cannell *et al.*, 1999, 2003), NAW, Agency headline indicators and the Agency Flood defence environmental change indicators) has generally been to identify suitable available data sets related to a climate change impact and then to develop indicators based on a correlation with a climate variable. This approach has also been used for the climate change indicators used in the Environmental Signals report (EEA, 2002a).

The indicators developed by the European Environment Agency's Topic Centre on Air and Climate (EEA, 2002b) were derived from a different starting point. The need for information on climate change impact was first identified followed by a search for suitable data sets to generate the indicator. As a consequence the timetable for introducing the use of the indicators has been staggered. Some indicators are suitable for immediate introduction because a suitable data source exists and some will not be operational for some years because a new data source requires development.

For the purposes of this project, the indicators developed for use in the UK were considered most useful for the identification of data sets. Table 3.1 summarises the data sets used for these indicators with references to the appropriate proforma.

Table 3.1 Summary of data sets identified from climate change indicators developed for use in the UK

Indicator	Data needs	Data provider	Proforma reference
DEFRA indicators (Cannell <i>et al.</i>, 1999, 2003)			
Air temperature in central England	Annual mean temperature and number of hot and cold days each year	Met Office - CET record	C32
Seasonality of precipitation	Proportion of England and Wales precipitation falling in winter	England and Wales Precipitation Series (Met Office)	A25/C32
Precipitation gradient across the UK	Winter precipitation in Scotland; Summer precipitation in southeast England.	England and Wales Precipitation Series (Met Office) Scotland Precipitation Series.	A25/C32

Indicator	Data needs	Data provider	Proforma reference
Predominance of westerly weather	Difference in air pressure (measured at sea level) during winter between Gibraltar and southwest Iceland.	Met Office	C32
Dry and wet soil conditions in Southern England	Soil moisture measurements at CEH Wallingford	Met. Office MORECS data set	C32
River flows in northwest and southeast England	River flow	National Water Archive (CEH)	A23
Frequency of low and high river flows in northwest and southeast England	River flow	National Water Archive (CEH)	A23
Groundwater storage in chalk in southeast England	Groundwater level	National Water Archive (CEH)	A24
Sea level rise	Sea level	National Tidal and Sea Level Facility (Proudman Oceanographic Laboratory)	C1
Risk of tidal flooding in London	Operation of the Thames tidal barrier	Environment Agency	A34
Atmospheric ozone levels in summer in rural England	Ozone concentrations	NETCEN	C34
Incidence of lyme disease in humans	Reported cases of lyme disease	Communicable Disease Surveillance Unit (CDSC)	C28
Seasonal pattern of human mortality	Reported deaths	Office for National Statistics (ONS)	C38
Use of irrigation water for agriculture	Abstractions for spray irrigation	National Abstraction Licence Database, Environment Agency	A27
Proportion of potato crop that is irrigated	Area of potato crop that is irrigated	DEFRA (Farming statistics)	¹

¹ This indicator is derived from Farming Statistics. There is no proforma for these data.

Indicator	Data needs	Data provider	Proforma reference
Potato yields	Annual average yield of non-irrigated maincrop potatoes in England and Wales	British Potato Council	²
Warm-weather crops: grapes	Area of vineyards in production	DEFRA (Farming statistics)	¹
Warm-weather crops: forage maize	Area of forage maize grown in the UK	DEFRA (Farming statistics)	¹
Late summer grass production	Summer hay yields at Rothamsted	IACR	C29
Date of leaf emergence on trees in spring	Date of leafing of oak trees in spring in Ashted, Surrey	UKPN	C31
Health of beech trees in Britain	Percentage of beech trees with crown density reductions greater than 25% compared with photographs of fully-foliated trees.	DEFRA (Digest of Environmental Statistics)	³
Dates of insect appearance and activity	First appearance of aphids at Rothamsted; Peak flight time of the orange tip butterfly in Britain; Average timing of activity of common footman in Britain.	Rothamsted suction trap monitoring (IACR) Butterfly Monitoring Scheme (ITE) Rothamsted Insect Survey light traps (IACR)	C23
Insect abundance	Abundance of aphids, common blue butterflies and common footman moths.	Rothamsted suction trap monitoring (IACR) Butterfly Monitoring Scheme (CEH)	C23/C25
Arrival date of the swallow	Average date when swallow first observed at four coastal observatories	Bird Observatories Council	C30

² This indicator was discontinued in the updated set of indicators (Cannell *et al.*, 2003).

³ No information on the supporting data set could be located.

Indicator	Data needs	Data provider	Proforma reference
Egg-laying dates of birds	Earliest egg-laying dates of the robin, and chaffinch	Nest Record Scheme (BTO)	C12
Small bird population changes	Numbers of wrens assessed on both farmland and woodland measured over the UK	BTO Census unit	C12
Marine plankton	Total annual abundance of copepods; Abundance of a cold-temperate water copepod species.	Continuous Plankton Recorder, SAHFOS	C36
Upstream migration of salmon	Percentage of salmon migrating up the River Kent in Cumbria in June and July	Environment Agency (NW Region)	A31 ⁴
Appearance of ice on Lake Windermere	Number of days each year when ice was recorded in a sheltered bay on the west side of Lake Windermere	IFE, Windermere	C35
Environment Agency proposed environmental change indicators for flood defence (EA, 2003a)			
Flood peaks for the R. Taw at Umberleigh, above Barnstaple in west Devon, and for the River Usk at Chain Bridge, between Brecon and Newport in S.E. Wales	Flow records at specified sites	National Water Archive	A23
Chilgrove well water maxima, in the South Downs Chalk behind Chichester, Sussex	Borehole records for Chilgrove	National Water Archive	A24
Newlyn harbour sea levels peaks, West Cornwall	Record of sea-levels at Newlyn	Proudman Oceanographic Laboratory (POL)	C1

⁴ This indicator was discontinued in the updated set of indicators (Cannell *et al.*, 2003)

Indicator	Data needs	Data provider	Proforma reference
National woodland cover of England and Wales	Record of woodland cover	Forestry Research (Woodland Inventory)	C27
Indicators developed for the National Assembly for Wales (Buse <i>et al.</i>, 2001)			
Outdoor fires	Annual number of outdoor fires in Wales	Fire Statistics, Office of the Deputy Prime Minister	C33
Human mortality and morbidity	Daily deaths from all causes per year corrected to mid-year population estimates. National Health Service (NHS) hospital admissions and length of stay.	Health Solutions Wales	C38
Flowering of Clover varieties	Flowering dates of clover at Institute of Grassland and Environmental Research (IGER) at Aberystwyth.	IGER	C37
Ear emergence	Mean date of ear emergence of perennial ryegrass (S24) at Plas Gogerddan.	IGER	C37
Leafing dates	Date of budburst for plant species	UK Phenology Network	C31
Greenness	NASA's measure of greenness calculated from satellite data since 1982	Reprocessed from NASA	⁵
Timing of peak insect abundance	Timing of peak abundance of meadow brown butterfly and a moth species (to be determined).	Butterfly Monitoring Scheme, Rothamsted Insect Survey	C25
Insect abundance	Abundance of a variety of insect species (to be determined)	Rothamsted Insect Survey	C23

⁵ No information on the supporting data set could be located.

Indicator	Data needs	Data provider	Proforma reference
Bird Migration Timing	Arrival dates of migrating bird species (including blackcap and swallow) at Skomer, Skokholm and Bardsey observatories.	Welsh Bird Observatories	C12
Egg laying timing	Egg laying timing of pied flycatcher at Coedydd Aber NNR, Llysdinam Field Centre and other sites	British Trust for Ornithology	C12
Flowering timing	First flowering date of plants (species and location to be decided)	UK Phenology Network	C31
Sea level	Sea level at Holyhead	UK National Tide Gauge Network	C1
Sea temperature	Sea temperature at location to be decided	British Oceanographic Data Centre (BODC) and Centre for Environment, Fisheries and Aquaculture Science (CEFAS)	C1
Upland and lowland river flows	River flows at Plynlimon and the ECN site on the River Wye	National River Flow Archive	A23
Timing of Frogspawn	Timing of frogspawn at a range of sites (to be decided).	UK Phenology Network	C31
Agency Headline indicators (EA, 2003b)			
Abstraction from fresh waters	National abstraction rates by industry sector	National Abstraction Licensing Database	A27
Thames Barrier closures	Operation of the Thames tidal barrier	Environment Agency	A34
Flood levels in rivers	Flood levels in seven rivers (including the Severn, Wye and Ivel)	National Water Archive (CEH)	A23

Indicator	Data needs	Data provider	Proforma reference
Salmon catches	Salmon catch returns from net and rod licence owners	Environment Agency National Salmon and Trout Fisheries Centre	A32

3.2 Environment Agency monitoring programmes

The Environment Agency undertakes monitoring of the environment to fulfil a number of purposes:

- Statutory requirements;
- Other National commitments (i.e. requirements under international conventions);
- Environmental monitoring (surveillance);
- Operational monitoring.

Statutory monitoring arises largely as a result of the implementation of EU Directives. The monitoring requirements for these Directives vary but are usually highly specified in the legislation and must be undertaken to meet reporting obligations to the Commission. In addition to these, the UK is also committed to undertaking monitoring on a national basis such as the Harmonised Monitoring Scheme and the Environmental Change Network and to fulfil requirements of international conventions such as the Oslo and Paris Commission surveys and the requirements of the North Sea Convention.

The Agency also undertakes non-statutory surveillance monitoring to meet its requirements to report on the state of the environment. Environment Agency Areas also undertake operational monitoring to meet their own business needs.

Monitoring is undertaken by almost all functions within the Agency for a range of purposes. Table 3.2 provides a summary the Agency's routine monitoring programmes across all business areas.

**Table 3.2 Summary of the Agency's routine monitoring programmes (from Monitoring for What? (Environment Agency, 1999)).
All estimates correct in 1999 unless otherwise stated**

Agency business area	Sample type	Number of sites	Number of samples or measurements per year	Comments
Water Quality	Water (Environment and Effluent)	130 fixed site continuous monitoring stations; Approximately 4,700 sites on rivers, estuaries, coastal waters, groundwater and effluents.	Continuous measurements; 300,000 spot samples	
	Biological and microbiological		57,000 spot samples	
Process Industries Regulation	Air and Water: Routine	1550 sampling points at 500 sites	5354 measurements	Check monitoring at stack emissions for 1997/8. Will increase by approximately 1035 by 1999/2000.
	Ad hoc	500 sampling points and 296 sites	5713 measurements	
Radioactives Substances Regulation	Radioactivity in the environment	140 beaches and river bank sites 9 air and rainwater sites 32 drinking water sources 9 major nuclear sites	Approximately 300 results Continuous monitors Daily samples (then bulked) 320 water samples; 172 liquid effluent samples and 2 solid waste consignments (BNFL Brigg)	Check monitoring 1997/1998.
Waste	Waste, water, leachate and gas		Approximately 76,000	Samples and field measurements

Agency business area	Sample type	Number of sites	Number of samples or measurements per year	Comments
Land Quality	Soil and water on contaminated land	14 ongoing projects		Specific (i.e. Supplementary Credit Approval) sites
Water Resources	River flow	1,967 structures 22,607 spot gauges		Includes weirs/flumes, rated sections, electromagnetic and ultrasonic gauges and depth gauges read daily. Boreholes measured monthly (some continuous monitors) Some collected by volunteers
	Groundwater levels	6,044 boreholes		
	Precipitation	1,193 charts 2,481 manually read		
Conservation	River Habitat Survey	4569 reference sites		Already surveyed. No current plans to re-survey them.
	River Corridor Surveys (km inspected in 1997/8)	3,100 km		
Fisheries	River length (km) surveyed for fish stocks and health	9,500 km		

Agency business area	Sample type	Number of sites	Number of samples or measurements per year	Comments
Flood Defence	Condition of flood defence structures (km inspected) Flood Plain Survey	Sea – 800km River – 36,000km 5,500 km ² of fluvial floodplain covering flood risk hotspots		1997 figures Ongoing programme of mapping hotspots in fluvial flood plains. Due to finish in 2001.

While there are numerous drivers for the environmental monitoring undertaken by the Environment Agency, the implementation of the programmes is co-ordinated and integrated to maximise its cost-efficiency. Consequently, monitoring locations and data will be used to meet the needs of as many monitoring programmes as possible.

In order to identify the monitoring data sets held internally by the Agency, the following sources of summary information were consulted:

- Monitoring for What? A strategic review of the Agency's Environmental information needs and monitoring programmes (EA, 1999) – this document provides a summary of the Agency's monitoring programmes with details of the parameters measured along with some information on data storage;
- Database of monitoring programmes – this database was produced by the Collaborative Forum for Environmental Monitoring in 1999 as a single source of information on monitoring programmes undertaken by the members of the Forum (including the Agency, SEPA, NERC and English Nature);
- Environmental Monitoring Manual – this manual describe the details of each water quality monitoring programme undertaken by the Agency with details on the parameters measured, sampling frequency and data storage.

This information was supplemented with material provided by Agency functions in response to enquiries made by the Climate Change Unit.

Data sets arising from the examination of these sources have been catalogued in Appendices A and B.

The Agency has recently established the 'Environment Agency Metadata Repository.' This database is available to all Agency staff from the desktop via the Agency's intranet. The Metadata Repository is designed to keep a record of important sets of information that the Agency holds. The Agency data sets identified for this project were cross-referenced with those in the Metadata Repository and no significant additional data sets were found.

3.3 External data sets

The principle sources of information for the external data sets were those identified in the development of existing climate change impact indicators and a limited review of available data sets based on the expert knowledge of PISCES Conservation Ltd. Data sets arising from the examination of these sources have been catalogued in Appendices B and C.

As well as the individual data sets identified, four metadatabases were identified that contained details of individual data sets. These were:

- United Kingdom Environmental Data Index (UKEDI) (see Proforma C22) – this is a database of data set metadata compiled by NERC and containing mainly, but not exclusively, data sets generated by NERC laboratories and associated Universities;
- Inventory of Marine Observing Programmes (see Proforma C6);

- Climate Change and marine biodiversity (MARCLIM) (Proforma B1) – This multi-agency funded project is addressing the impacts of climate change on marine rocky shore communities;
- Global Population Dynamics database (Proforma C7) – this database contains the largest collection of animal and plant population data in the world, and brings together nearly five thousand time series in one database (NERC Centre for Population Biology, Imperial College (1999));

These sources between them contain several thousand individual data sets. Although some, such as the long-term marine plankton recorder studies, Windermere perch, pike and phytoplankton, and the Rothamsted insect traps, are well known or supported by the Agency, other lesser known sets may well require further review and assessment for their uses in the detection of climate change impacts. Many of the data sets may contain signals from both climate change and other anthropogenic influences and it may be difficult to attribute changes to the appropriate causes. These refer to habitats such as estuaries, rivers and terrestrial sites. There is clearly a renewed interest by others in long-term data as indicated by the Joint Nature Conservation Committee (JNCC) project to produce an inventory of long-term studies on key habitats in the UK to support case work (Morgan, in prep.). Some of the listed sets may also be included in the published inventories.

In addition to the data sources examined for this project, there are further sources that would be worthy of investigation, for example:

- water companies (e.g. Brian Moss of Liverpool University used chemical data (chloride concentrations) from a water intake source in the Norfolk Broads to detect reduced freshwater inputs to the system), reservoir outlets and records;
- untapped Environment Agency record books and files that may not have been discarded, (e.g. old Lincolnshire chemical data reputedly may still be stored in outbuildings);
- a full collection of old water Board, River Board and River Authority reports where data summaries were included (may go back to the 1940s or earlier. Lester (1975) includes chemical data from the Trent for 1923-30 which must be from reports somewhere);
- retired individuals from the Agency or earlier versions may have data they did not discard (e.g. The Woodiwiss collection of copies of Trent invertebrate data, Langford's early records from Lincolnshire);
- searches of individual operating power stations, water pumping stations, breweries, other industries, canal organisations, docks and harbour board records, Ministry of Defence (MoD) (e.g. sea temperatures) other than those listed for both current data and any historic records (the MoD reputedly has comprehensive records of sea temperatures which may be secret or not); and
- published scientific papers, grey literature reports from various organisations (e.g. universities, Nature Conservancy (now English Nature), Wildlife Trusts, single interest group societies (e.g. Butterfly, Dragonfly) from their archives. Archives of the

Balfour-Browne Club and the Linnean Society (which has records back to the 1800s). Records at Kew and other regional botanical gardens and collections. Archives of local (e.g. Birmingham, Manchester) and national museums, professional institutions such as the Institute of Electrical Engineers, Civil Engineers, etc who may have old operational or project data from rivers, land or coastal waters.

Table 3.3 summarises the data sets identified as a result of the investigations of all of the data sources.

Table 3.3 Summary of data sets included

Data set type	Environmental compartment	DPSIR stage	Agency business area (for Internal data sets only)	Data set	Proforma
Internal	Water	I	Water quality	Surface Water Abstraction Directive	A1
Internal	Water	I	Water quality	Freshwater Fish Directive	A2
Internal	Water	I	Water quality	Dangerous Substances Directive	A3
Internal	Water	I	Water quality	List II substances	A4
Internal	Water	I	Water quality	Exchange of information Decision	A5
Internal	Water	I	Water quality	Urban Waste Water Treatment Directive	A6
Internal	Water	I	Water quality	Nitrate Directive	A7
Internal	Water	I	Water quality	Bathing Waters Directive	A8
Internal	Water	I	Water quality	Shellfish Waters Directive	A9
Internal	Water	I	Water quality	Titanium Dioxide Directive	A10
Internal	Water	I	Water quality	Harmonised Monitoring Scheme	A11
Internal	Water	I	Water quality	Paris Commission inputs survey	A12
Internal	Water	I	Water quality	North Sea	A13
Internal	Water	I	Water quality	National Marine Monitoring Plan	A14
Internal	Water	I	Water quality	Groundwater quality	A15
Internal	Water	I	Water quality	General Quality Assessment (GQA) – chemistry	A16
Internal	Water	I	Water quality	GQA – biology	A17
Internal	Water	I	Water quality	GQA – nutrients	A18

Data set type	Environmental compartment	DPSIR stage	Agency business area (for Internal data sets only)	Data set	Proforma
Internal	Water	I	Water quality	GQA – aesthetics rivers	A19
Internal	Water	I	Water quality	GQA – aesthetics coasts	A20
Internal	Water	I	Water quality	Blue green algae	A21
Internal	Water	I	Water quality	Marine microalgae	A22
Internal	Water	I	Water Resources	Flow in rivers	A23
Internal	Water	I	Water Resources	Groundwater level	A24
Internal	Water	S	Water Resources	Rainfall	A25
Internal	Water	I	Water Resources	Stocks reservoir flow series	A26
Internal	Water	I	Water Resources	National Abstraction Licence Database	A27
Internal	Water	I	Conservation	River Habitat Survey	A28
Internal	Water	I	Conservation	River Corridor Surveys	A29
Internal	Water	I	Fisheries	Stock assessment	A30
Internal	Water	I	Fisheries	Fish counters	A31
Internal	Water	I	Fisheries	Fish Licence return data	A32
Internal	Water	I	Flood defence	Condition of flood defence structures	A33
Internal	Water	I	Flood defence	Barrier closures	A34
Internal	Water	P	PIR	Pollution Inventory – water	A35
Internal	Air	P	PIR	Pollution Inventory – air	A36
Internal	Water	I	Water quality	Thames estuary recovery data sets	A37
External – Agency supported	Water	I		MARCLIM	B1
External – Agency supported	Water/Terrestrial	S + I		Environmental Change Network (ECN)	B2
External – Agency supported	Water/Terrestrial	I		National Biodiversity Network (NBN)	B3
External – Agency supported	Water	I		Severn estuary data set	B4

Data set type	Environmental compartment	DPSIR stage	Agency business area (for Internal data sets only)	Data set	Proforma
External	Water	S		UK National Tidal Gauge Network	C1
External	Water	I		River Trent angler catches	C2
External	Water	I		Cyprinid catches UK rivers	C3
External	Terrestrial	I		Inventory of long-term studies on terrestrial habitats	C4
External	Water	I		River Frome fish movements	C5
External	Water	S + I		Inventory of UK Marine Observing Programmes	C6
External	Air/Water/Terr estrial	I		Global Population Dynamics database	C7
External	Water	I		Acid Waters Monitoring Network	C8
External	Terrestrial	I		Biological Records Centre	C9
External	Water	I		Various off-line biological data sets	C10
External	Water	I		Various water quality data sets	C11
External	Terrestrial	I		British Trust for Ornithology (BTO) bird population data	C12
External	Water	I		Nutrient changes in Irish Sea	C13
External	Terrestrial	I		EXAMINE	C14
External	Water	I		UK Power stations	C15
External	Water	I		Effects of power station use on rivers	C16
External	Water	I		Operational monitoring of power stations	C17
External	Water	I		Changing temperature of river systems	C18
External	Terrestrial	I		Plant and climate relationships in France	C19
External	Water	I		Seaweeds in Britain and Ireland	C20

Data set type	Environmental compartment	DPSIR stage	Agency business area (for Internal data sets only)	Data set	Proforma
External	Water	I		Long-term data sets in rivers	C21
External	Air/Water/ Terrestrial	I		UKEDI	C22
External	Terrestrial	I		Rothamsted Insect Survey	C23
External	Water	I		Plants of Lancaster canal	C24
External	Terrestrial	I		Butterfly monitoring scheme	C25
External	Terrestrial	I		Constant Efforts Sites scheme	C26
External	Terrestrial	I		National Inventory of Woodland and Trees	C27
External		I		Incidence of Lyme Disease in Humans	C28
External	Terrestrial	I		Park Grass experiment	C29
External	Terrestrial	I		Arrival date of swallow	C30
External	Water/ Terrestrial	I		UK Phenology network	C31
External	Air	S		Long-term temperature and precipitation records	C32
External	Terrestrial	I		UK Fire statistics	C33
External	Air	S + I		UK National Air Quality Information Archive	C34
External	Water	I		Ice on Lake Windermere records	C35
External	Water	I		SAHFOS Continuous Plankton Recorder data	C36
External	Terrestrial	I		IACR Rothamsted crops data sets	C37
External		I		Office of National Statistics information on human deaths	C38

4. IDENTIFICATION OF DATA SETS WITH THE POTENTIAL TO DETECT CLIMATE CHANGE IMPACTS

4.1 Introduction

Following the identification of the environmental monitoring data sets, the next stage of the work was to assess their potential for identifying climate change impacts.

4.2 Climate change impacts

Potential changes in the UK climate over the next century have been predicted and published as a set of scenarios by the UK Climate Change Impacts Programme (UKCIP) in 2002 (UKCIP02) (Hulme *et al.*, 2002). The scenarios relate to possible combinations and levels of emissions. These have been labelled: Low Emissions, Medium-Low Emissions, Medium-High Emissions and High Emissions. These emissions scenarios form the input to the latest global climate model from the Hadley Centre to produce potential changes to the world's climate. These changes in global climate are then used as input to a higher resolution regional model, which simulates changes in UK climate on a grid with 50km resolution.

The key results are summarised in Box 1.

Box 1. Key changes in UK climate taken from UKCIP02 (Hulme *et al.*, 2002)

UK climate will⁶ become warmer. By the 2080s, annual temperature averaged across the UK may⁷ rise by between 2°C for the Low Emissions scenario and by 3.5°C for the High Emissions scenario. There will be greater warming in the south and east than in the north and west, and there may be greater warming in summer and autumn than in winter and spring. By the 2080s for the High Emissions scenario, parts of the southeast may be up to 5°C warmer in summer. The temperature of UK coastal waters will also increase, although not as rapidly as over land.

High summer temperatures will become more frequent and very cold winters will become increasingly rare. A very hot August, such as experienced in 1995 when temperatures over central England averaged 3.4°C above normal, may occur one year in five by the 2050s for the Medium-High Emissions scenario, and as often as three years in five by the 2080s. Even for the Low Emissions scenario, by the 2080s about two summers in three may be as hot as, or hotter than, the exceptionally warm summer of 1995.

Winters will become wetter and summers may become drier everywhere. The relative changes will be largest for the High Emissions scenario and in the south and east of the UK,

⁶ The word 'will' is used where there is High Confidence about an outcome.

⁷ The word 'may' is used where there is less than High Confidence about an outcome.

where summer precipitation may decrease by 50 per cent or more by the 2080s and winter precipitation may increase by up to 30 per cent. Summer soil moisture by the 2080s may be reduced by 40 per cent or more over large parts of England for the High Emissions scenario.

Snowfall amounts will decrease throughout the UK. The reductions in average snowfall over Scotland might be between 60 and 90 per cent (depending on the region) by the 2080s for the High Emissions scenario.

Heavy winter precipitation (rain and snow) will become more frequent. By the 2080s, winter daily precipitation intensities that are experienced once every two years on average may become between 5 per cent (Low Emissions) and 20 per cent (High Emissions) heavier.

Relative sea level will continue to rise around most of the UK's shoreline. The rate of increase will depend on the natural vertical land movements in each region and on the emission scenario. By the 2080s, sea level may be between 2 cm below (Low Emissions) and 58 cm (High Emissions) above the current level in western Scotland, but between 26 and 86 cm above the current level in southeast England.

Extreme sea levels will be experienced more frequently. For some east coast locations, extreme sea levels could occur between 10 and 20 times more frequently by the 2080s for the Medium-High Emissions scenario than they do now.

The Gulf Stream may weaken in future and the changes in climate described by UKCIP02 scenarios reflect this. It is unlikely that this weakening would lead to a cooling of UK climate within the next 100 years. Not enough is understood about the factors that control this ocean circulation, however, to be completely confident about this prediction, especially in the longer term.

The results from the scenarios indicate that the primary climate change state variables are:

- Air (and water) temperature regime;
- Precipitation (rainfall and snowfall) patterns;
- Sea level.

The impacts of climate change arising from changes in these climate state variables are complex and potentially far reaching. The first order responses to the predicted changes in the climate state variables include the following and comprise the key climate change impact variables:

- Changes in the distribution of flora and fauna in response to changes in the temperature regime favouring species living at lower latitudes and altitudes;
- Changes in the flow regime of rivers (including the increased risk of flooding) and the level of groundwater as a result changes in the pattern of precipitation;
- Increased risk of coastal flooding and loss of coastal habitats as a result of rising sea levels.

There is also a wide range of second order impacts resulting from changes, and responses to, these first order impacts.

4.3 Climate change impacts and the Environment Agency

The Environment Agency has commissioned R&D to determine the potential impacts of climate change on its core business.

In 1999, a document summarising the implications of climate change to the Agency's core business was produced (ERM, 1999). This report examined the main implications of climate change for the Agency by considering the Agency's role in contributing to UK greenhouse gas emission reductions and the potential impacts of a changing climate upon the environmental resources managed by the Agency.

The following bullet points indicate some potential impacts on the main Agency functions:

- **Flood defence** – increasingly severe storms and more intense rainfall will place ever-greater demands on river and coastal flood defences, which are built and maintained by the Agency (e.g. the Thames Barrier);
- **Water resources** – much drier summers, particularly in the south east, will put a huge strain on inland water resources such as rivers and reservoirs. The Agency's water conservation agenda and ongoing work with the water industry will be critical to ensure sufficient water to supply demand;
- **Water quality** – possible increases in algal growth, reduced river flows from droughts and more sewer overflows caused by floods could all have significant effects;
- **Air quality** – with more warm weather, ozone formations and concentrations of hydrocarbons will increase, with potentially harmful effects on people;
- **Wildlife and conservation** – coastal habitats will be threatened by rising sea levels, wetlands could be subjected to drought and flooding, many species may struggle to adapt to fast-changing conditions while new species, some of which may be pests, could move in;
- **Land quality** – hotter, drier summers will increase soil cracking, while wetter winters and more severe downpours will increase soil erosion. Agriculture will have to adapt to these changing conditions, and may experience radically different cropping patterns;
- **Fisheries** – changes in sea temperatures may seriously affect certain fish species such as salmon;
- **Navigation** – more rainfall in autumn and spring means higher river flows, which could restrict boating activities.

4.4 Data sets with the potential to detect climate change impacts

In assessing whether a data set has the potential to detect climate change impacts, six criteria were considered:

1. Potential direct or indirect link to climate state or impact variable;
2. Length of time series;
3. Regularly updated;
4. Quality assurance;
5. Data availability;
6. Confounding factors.

Clearly, the most basic requirement for a monitoring data set to detect a climate change impact is to have a **link (direct or indirect) to a climate change state or impact variable**. The relevant climate change state variables considered were changes in air or water temperature, rainfall patterns or sea level. The climate change impact variables considered were the first order responses to changes in the state variables such as changes in flow regime resulting from changes in rainfall patterns or changes in animal and plant populations due to changes in air or water temperature.

The **length of the time series** of a data set was an important consideration for two main reasons. Firstly, the variability from year to year in the climate variables is great and consequently a long time series is required in order to determine directional trends in any one variable. For example, the UKCIP02 scenarios (Hulme *et al*, 2002) provide information on change over 20, 50 and 80 year time horizons and demonstrations of changes in climate state variables such as the warming of central England and surrounding coastal waters only show directional change over the last 50 to 100 years (Figure 4.1). The issue of homogeneity in variation is also important in the response data set. Highly variable data sets such as river flows may need many years of data before reliable estimates of sustained directional change can be made. The proposed environmental change indicators (including those relevant to climate change) relevant to flood management and coastal defence (Environment Agency, 2003a) were developed on using data sets with 20 full years of data. At the very least data sets with the potential to detect climate change impacts should have a multi-decadel time series.

A further desirable feature of suitable data sets was that data was **regularly (and frequently) updated** and that for current monitoring programme data sets that this is ongoing. Similarly information on **quality assurance** for the data set was considered important. Data sets with information on quality assurance during sampling, analysis and data storage were considered most useful in this regard.

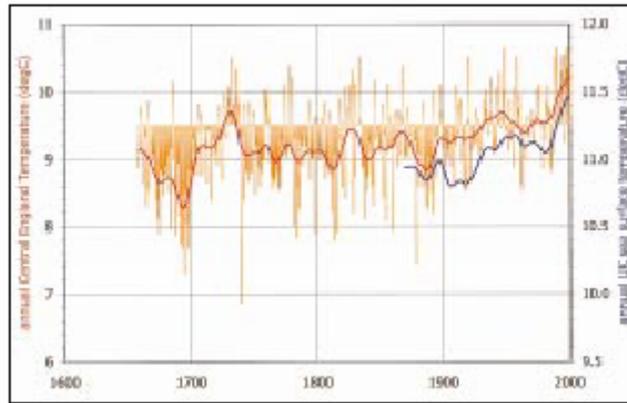


Figure 4.1 The warming of central England climate (red) and surrounding UK coastal waters (blue). Deviations are relative to 1961-1990 average. Note different scales (from Hulme *et al.*, 2002)

In order for data sets to be used by the Agency for detecting climate change impacts, they need to be **available** to the appropriate staff with minimal effort and cost. A basic requirement was that the data should be stored electronically preferably on dedicated databases. Very few of the data sets evaluated will be available without some effort. Even those relating to Agency monitoring programmes will probably need to be compiled from source databases and if data from more than one database are required (for example, a combination of chemical and biological data) some considerable effort may be required. Another issue related to data availability for external data sets is the costs involved for obtaining the data sets. In most cases, the Agency will not have to pay for the data *per se* but may have to pay for the time of the host organisation to compile the data set in line with the request from the Agency.

The final criterion considered in the evaluation of the data sets was the influence of **confounding factors** on the ability of the data set to detect a climate change impact. Confounding factors influenced almost all of the data sets evaluated. This was to be expected because the data sets arose from monitoring programmes designed to detect the effects of impacts other than climate change. For example, changes in river flow regime will respond from climate change induced changes in rainfall patterns but will also be modified by changes in the land-use of the catchment (such as increased urbanisation), the effects of abstractions and discharges and modifications to the river channel.

Table 4.1 summarises the application of these criteria in the evaluation of the data sets and their classification as having high, medium or low potential to detect climate change impacts. Further information on the reasons for the classification is provided on the data set proformas in Appendices A, B and C.

Table 4.1 Criteria for the classification of data sets with respect to their potential for detecting climate change impacts

Potential for detecting climate change impacts	Criteria
High	<ul style="list-style-type: none"> • can relate data sets directly or indirectly to a climate change state or impact variable; • comprises a multi-decadel time-series; • data set is regularly updated; • has evidence of quality assurance in relation to sampling, analysis and data storage; • data is stored in a dedicated database and is available to Agency staff at minimal effort and cost; • has no or few known confounding factors.
Medium	<ul style="list-style-type: none"> • can relate data sets directly or indirectly to a climate change state or impact variable; • does not yet comprise a multi-decadel time-series; • data set is regularly updated; • has some evidence of quality assurance in relation to either sampling, analysis and data storage; • data is stored electronically and is available to Agency staff at minimal effort and cost; • has some known confounding factors.
Low	<ul style="list-style-type: none"> • cannot relate data sets directly or indirectly to a climate change state or impact variable; • does not comprise a multi-decadel time-series; • data set is not regularly updated; • has limited evidence of quality assurance in relation to either sampling, analysis and data storage; • data is stored on paper and/or electronically and is not readily available to Agency staff at minimal effort and cost; • has many confounding factors.

Table 4.2 summarises the evaluation of the identified data sets in relation to the above criteria and Table 4.3 details the data sets of high and medium potential in the main environmental compartments.

Table 4.2 Summary of the evaluation of identified data sets against six criteria and the resulting classification of potential to detect climate change impacts (high, medium or low). (✓denotes compliance with the criterion and X denotes non-compliance).

Proforma	Data set	Potential link to climatic state or impact variable	Time-series	Regularly updated?	Quality Assured?	Data availability	Confounding factors?	Classification
A1	Surface Water Abstraction Directive	✓	x	✓	✓	✓	✓	Medium
A2	Freshwater Fish Directive	✓	x	✓	✓	✓	✓	Medium
A3	Dangerous Substances Directive	x	x	✓	✓	✓	✓	Low
A4	List II substances	x	x	✓	✓	✓	✓	Low
A5	Exchange of information Decision	✓	✓	✓	✓	✓	✓	Medium
A6	Urban Waste Water Treatment Directive	✓	x	✓	✓	✓	✓	Medium
A7	Nitrate Directive	x	x	✓	✓	✓	✓	Low
A8	Bathing Waters Directive	x	x	✓	✓	✓	✓	Low
A9	Shellfish Waters Directive	x	✓	✓	✓	✓	✓	Low
A10	Titanium Dioxide Directive	✓	x	✓	✓	✓	✓	Medium
A11	Harmonised Monitoring Scheme	✓	✓	✓	✓	✓	✓	Medium
A12	Paris Commission inputs survey	x	x	✓	✓	✓	✓	Low
A13	North Sea	x	x	✓	✓	✓	✓	Low
A14	National Marine Monitoring Plan	✓	x	✓	✓	✓	✓	Medium
A15	Groundwater quality	x	x	✓	✓	x	✓	Low
A16	General Quality Assessment (GQA) – chemistry	✓	x	✓	✓	✓	✓	Medium
A17	GQA – biology	✓	x	✓	✓	✓	✓	Low

Proforma	Data set	Potential link to climatic state or impact variable	Time-series	Regularly updated?	Quality Assured?	Data availability	Confounding factors?	Classification
A18	GQA – nutrients	x	x	✓	✓	✓	✓	Low
A19	GQA – aesthetics rivers	x	x	✓	✓	✓	✓	Low
A20	GQA – aesthetics coasts	x	x	✓	✓	✓	✓	Low
A21	Blue green algae	✓	x	✓	✓	✓	✓	Medium
A22	Marine microalgae	✓	x	✓	✓	✓	✓	Medium
A23	Flow in rivers	✓	✓	✓	✓	✓	✓	High
A24	Groundwater level	✓	✓	✓	✓	✓	✓	High
A25	Rainfall	✓	✓	✓	✓	✓	x	Low
A26	Stocks reservoir flow series	✓	✓	✓	✓	✓	✓	High
A27	National Abstraction Licence Database	✓		✓	✓	✓	✓	High
A28	River Habitat Survey	✓	x	x	✓	✓	✓	Low
A29	River Corridor Surveys	✓	x	x	✓	✓	✓	Low
A30	Stock assessment	✓	✓	✓	✓	✓	✓	Medium
A31	Fish counters	✓	✓	✓	✓	✓	✓	Medium
A32	Fish Licence return data	✓	x	✓	x	✓	✓	Medium
A33	Flood defence monitoring	✓	✓	✓	✓	✓	✓	High
A34	Barrier closures	✓	✓	✓	✓	✓	✓	High
A35	Pollution Inventory – water	x	x	✓	✓	✓	✓	Low
A36	Pollution Inventory – air	x	x	✓	✓	✓	✓	Low
A37	Thames estuary recovery data sets	✓	✓	x	✓	x	✓	Medium
B1	MARCLIM	✓	✓	✓	✓	✓	✓	High
B2	Environmental Change Network (ECN)	✓	x	✓	✓	✓	x	Medium
B3	National Biodiversity Network (NBN)	✓	✓	✓	✓	✓	✓	High
B4	Severn estuary data set	✓	✓	✓	✓	✓	✓	Medium

Proforma	Data set	Potential link to climatic state or impact variable	Time-series	Regularly updated?	Quality Assured?	Data availability	Confounding factors?	Classification
C1	UK National Tidal Gauge Network	✓	✓	✓	✓	✓	x	High
C2	River Trent angler catches	✓	x	x	x	x	✓	Low
C3	Cyprinid catches UK rivers	✓	x	x	x	x	✓	Low
C4	Inventory of long-term studies on terrestrial habitats	✓	✓	x	✓	✓	✓	Medium
C5	River Frome fish movements	✓	✓	✓	✓	✓	✓	Medium
C6	Inventory of UK Marine Observing Programmes	✓	✓	x	x	x	✓	Medium
C7	Global Population Dynamics database	✓	✓	x	x	x	✓	Medium
C8	Acid Waters Monitoring Network	✓	x	✓	✓	✓	✓	Medium
C9	Biological Records Centre	✓	✓	✓	✓	✓	✓	High
C10	Various off-line biological data sets	✓	x	x	x	x	✓	Low
C11	Various water quality data sets	✓	✓	x	x	x	✓	Low
C12	British Trust for Ornithology (BTO) bird population data	✓	✓	✓	✓	✓	✓	High
C13	Nutrient changes in Irish Sea	✓	✓	✓	✓	✓	✓	Medium
C14	EXAMINE	✓	✓	✓	✓	✓	✓	High
C15	UK Power stations	✓	✓	✓	x	x	✓	Medium
C16	Effects of power station use on rivers	✓	✓	x	x	x	✓	Medium
C17	Operational monitoring of power stations	✓	✓	✓	x	x	✓	Medium

Proforma	Data set	Potential link to climatic state or impact variable	Time-series	Regularly updated?	Quality Assured?	Data availability	Confounding factors?	Classification
C18	Changing temperature of river systems in Austria	✓	✓	x	x	x	✓	Medium
C19	Plant and climate relationships in France	✓	✓	x	x	x	✓	Medium
C20	Seaweeds in Britain and Ireland	✓	✓	✓	x	x	✓	Medium
C21	Long-term data sets in rivers	✓	x	✓	x	x	✓	Low
C22	UKEDI	✓	✓	x	x	x	✓	Medium
C23	Rothamsted Insect Survey	✓	✓	✓	✓	✓	✓	High
C24	Plants of Lancaster canal	✓	✓	x	x	x	✓	Medium
C25	Butterfly monitoring scheme	✓	✓	✓	✓	✓	✓	High
C26	Constant Efforts Sites scheme	✓	x	✓	✓	✓	✓	Medium
C27	National Inventory of Woodland and Trees	x	✓	✓	✓	✓	✓	Low
C28	Incidence of Lyme Disease in Humans	✓	x	✓	✓	✓	✓	High
C29	Park Grass experiment	✓	✓	✓	✓	✓	✓	High
C30	Arrival date of swallow	✓	✓	✓	✓	✓	✓	High
C31	UK Phenology network	✓	✓	✓	✓	x	✓	High
C32	Long-term temperature and precipitation records	✓	✓	✓	✓	✓	x	Low
C33	UK Fire statistics	✓	✓	✓	✓	✓	✓	Medium
C34	UK National Air Quality Information Archive	x	✓	✓	✓	✓	✓	Low

Proforma	Data set	Potential link to climatic state or impact variable	Time-series	Regularly updated?	Quality Assured?	Data availability	Confounding factors?	Classification
C35	Ice on Lake Windermere records	✓	✓	✓	✓	✓	✓	High
C36	SAHFOS Continuous Plankton Recorder data	✓	✓	✓	✓	✓	✓	High
C37	IACR Rothamsted crops data sets	✓	x	✓	✓	✓	✓	High
C38	Office of National Statistics information on human deaths	✓	✓	✓	✓	✓	✓	High

Table 4.3 Data sets with the potential to detect climate change impacts

Environmental Compartment	Potential for detecting climate change impacts	Data set proforma reference
Water	High	A23, A24, A27, A33, A34, B1, B3, C1, C31, C35, C36
	Medium	A1, A2, A5, A6, A7, A8, A10, A11, A14, A16, A21, A22, A26, A30, A31, A32, A37, B2, B4, C4, C5, C6, C7, C8, C13, C15, C16, C17, C18, C20, C22, C24
Terrestrial	High	C9, C12, C14, C23, C25, C29, C30, C31, C37
	Medium	B2, B3, C4, C7, C19, C22, C26, C28, C33
Air	High	C38
	Medium	B2, C7, C22

From the 79 data sets identified, 65 are considered to have some potential (high or medium) to detect climate change impacts. In aquatic environments, the majority of the internal data sets were classified as having medium potential on the basis of the length of the time series and the presence of significant confounding factors that may mask any climate change impact signal.

5. INFORMATION NEEDS AND GAPS FOR CLIMATE CHANGE IMPACT DETECTION

The final objective of this project was to cross-reference the available environmental monitoring data sets with the information needs of the Agency with respect to monitoring for climate change impact detection.

The Environment Agency is currently developing its data needs for detecting climate change impacts. The primary needs at present are to provide information to report against the sets of climate change impacts indicators that exist. The Agency's set of headline indicators includes four with a link to climate change impacts using data from water resources, flood defence and fisheries monitoring. The UK set (Cannell *et al.*, 1999, 2003) is currently under review and have not been reported against since their introduction. The newly developed sets of proposed indicators for the National Assembly for Wales (Buse *et al.*, 2001) and the Agency's Flood Defence function will need to be reported against in the future if the proposals are adopted.

The Environment Agency made an assessment of information needs for climate change impact monitoring from the viewpoint of reporting on the state of the environment (Environment Agency, 1999). Table 5.1 summarises the perceived information needs at the time (1999) and indicates where the information was believed to be available.

Table 5.1 Information needs of the Environment Agency in relation to climate change impacts (adapted from Environment Agency, 1999 Annex 2)

Information needs	Information need met by existing Agency programme? Y/N. If Y, which.	Information available elsewhere? Y/N. If Y, how.	Is there a gap that needs to be filled? Y/N. If Y, how.
No. of drought orders issued	Y, Water Resources	N	N
Major flooding incidents	Y, National Water Archive	N	N
No. of flood warnings issued	Y, Flood Warning service	N	N
Area of land at risk of flooding	Y, Section 105 surveys	Y, Ordnance survey	N
Past relative sea level	N	Y, British Oceanographic Data Centre	N

Information needs	Information need met by existing Agency programme? Y/N. If Y, which.	Information available elsewhere? Y/N. If Y, how.	Is there a gap that needs to be filled? Y/N. If Y, how.
Future sea level	N	Y, British Oceanographic Data Centre	N
Change in land use/cover	N	Y (partly) – Centre for Ecology and Hydrology (CEH), DEFRA, NAW	Y, need for better more detailed information
Distribution/availability of water resources	Y, Water Resources	Y, CEH	N
Distribution of key habitat types	Y, Conservation/Habitats Directive team	Y, Joint Nature Conservation Committee, via National Biodiversity Network	N
Distribution/status of vulnerable species	Y, Conservation/Habitats Directive team	Y, Joint Nature Conservation Committee, via National Biodiversity Network	N
Breeding timing of birds	N	British Trust for Ornithology	N
Butterfly distribution	N	CEH	N
Distribution/status of exotic species	Y, some contribution, but main source is:	Y, Joint Nature Conservation Committee, via National Biodiversity Network	N
Low flows in rivers	Y, low flow alleviation scheme	N	Y

Information needs	Information need met by existing Agency programme? Y/N. If Y, which.	Information available elsewhere? Y/N. If Y, how.	Is there a gap that needs to be filled? Y/N. If Y, how.
Failure to meet water quality targets (e.g. due to low flows)	Y, Compliance monitoring/ GQA	N	N
Human health indicators	N	Y, National Health Service, NAW	Y
Changing state of coasts	Y, partly from GQA and local operational monitoring	Y, Joint Nature Conservation Committee	Y

For most of the information needs identified, suitable data sources were identified from both within and outside the Agency. The perceived gaps in available information related to information required to better describe the impact of climate change on changes in land-use and cover, low flows in rivers, human health indicators and changes on the coast.

Climate change induced changes to atmospheric carbon dioxide concentrations, air temperature regime and rainfall patterns have the potential to impact on agriculture by changing the location of agricultural activities, earlier development and growth of crops and changed yields and quality (MAFF, 2000). In time, the pattern of agricultural land use in England and Wales could change and the monitoring of this change is important from a number of perspectives for the Agency. These include the understanding of pressures from agricultural activity (e.g. pesticide use, fertiliser application and pollution prevention) in order to better control the threats of diffuse pollution from these sources as well as understanding climate change impacts. Monitoring of land-use change is undertaken by CEH (in the form of the Land Cover Map) and the results of agricultural census surveys co-ordinated by DEFRA and NAW detail changes in cropping patterns. The gap is how information from these, and any other, sources are combined and made available for Agency use to meet its business needs.

One of the potential impacts of climate change is the increased incidence of low flow events in rivers particularly during the summer. Information on low flow events is available from the Agency's hydrometric monitoring network and from the distribution of low flow alleviation scheme projects across England and Wales. Since this gap in information needs was identified in 1999, a modelling approach has been developed to describe low flow events in gauged and ungauged catchments (Low Flows 2000⁸) by CEH in collaboration with the Agency. This application provides the Agency with a tool to use alongside existing hydrometric monitoring to detect and characterise low flow events in rivers.

⁸ For further information, see <http://www.nwl.ac.uk/ih/www/products/Lowflow/LF2KSited.htm>.

Human health indicators have been proposed as potential indicators of climate change impact in the UK (Cannell *et al.*, 1999, 2003) and in Wales (Buse *et al.*, 2001) based on human mortality and morbidity and the reporting of the incidence of Lyme's disease. The Agency has responsibility for human health issues where these are related to the quality of the environment and include the setting of human health standards for chemicals and pathogens in the environment. The Agency has no monitoring programme that would provide information on the health of the human population and this information gap will need to be filled using external data sets. However, the Agency does have the responsibility to set standards for water, air and soil to protect human health and to monitor compliance against these standards. A recent study commissioned by the Agency concluded that the compliance monitoring strategy for such standards should be assessed against the possibility of the influence of regional climate change impacts (Crane *et al.*, 2003).

Information on the changing state of the coasts in response to climate change would need to be compiled from a range of sources including Agency (i.e. Bathing Water and Shellfish Waters Directives), Agency supported (e.g. National Marine Monitoring Plan) and external monitoring programmes (i.e. sea level rise). There is a lack of co-ordinated monitoring in the coastal environment of England and Wales (which should be addressed in the future through the implementation of the Water Framework Directive) and certainly a lack of focus on climate change impacts in coastal waters. The MARCLIM project (see proforma B1) is due to deliver proposals for a low cost monitoring programme for climate change impacts in the intertidal in the future.

The Environment Agency's Climate Change Unit (CCU) has recently completed a series of workshops on climate change impacts and adaptation strategies where the issues were discussed with the key Agency Functions (Environment Agency, 2003c). For the majority of these Functions the consideration of climate change impacts on their activity was in an early stage of development. The 'source-pathway-receptor' concept for assessing impacts is a convenient framework to address the issue of whether climate change impacts will affect Agency Function's deliverables. Information from the workshops suggests that much of the 'source' (i.e. potential climate change impacts) issues were understood and that progress was being made to establish potential 'pathways' to the Function's deliverables ('receptors'). In some cases modelling studies are planned to predict potential impacts on key aspects of a Function's business (e.g. work to predict changes in water flows or distribution of key species and habitats under climate change scenarios). However, the consideration of these issues was not sufficiently advanced to recommend appropriate monitoring to confirm whether modelled predictions are actually happening now and in the future. There are sets of climate change impact indicators that relate to the Water Resources and Flood Defence Functions and the monitoring data sets required to report against these are available. There is potential for other Agency Functions (i.e. water quality, land quality, conservation, fisheries, recreation, navigation, waste, PIR, RAS) to develop climate change impact indicators. The data resource outlined in this report would be a useful first step in facilitating the development.

6. DISCUSSION AND CONCLUSIONS

6.1 Discussion

The approach to identifying long term data sets for the assessment of climate change impacts adopted in this project was to use readily available summary information on Agency monitoring programmes, information supplied by identified contacts within the Agency and the experience of the contractors. While every effort has been made to identify as many data sets as possible within the time frame of this project, there is a risk that some data sets may have been missed. A range of Functions within the Agency generate monitoring data sets and data management tends to rest with that Function giving rise to a number of data sets and databases. The 'Environment Agency Metadata Repository' offers great potential for the Agency to capture essential information on all such data sets (metadata) and such a resource would be invaluable in identifying suitable data sets for climate change impact detection.

The search for external data sets was limited to the data sets supporting existing climate change impact indicators and the specific knowledge of the contractors. Nevertheless, the 42 (4 external but supported by the Agency and 38 external to the Agency) data sets identified cover the majority of the Agency's Functions and include several metadatabases that will provide access to many more data sets.

The evaluation of the identified data sets resulted in 65 data sets with some potential (classified as high or medium potential) to detect climate change impacts. The most useful data sets generated by the Agency (i.e. river flow and groundwater level data in the National Water Archive, operation of the Thames barrier and long term migratory fish records) have been exploited for their climate change impact detection potential already. Agency generated rainfall records form part of the national data set and have been used to describe changes in the state of the climate.

The approach to establishing a link between a climate change impact variable (i.e. river flow) and a climate state variable (i.e. rainfall patterns) is essentially correlative. In practice, this involves collating suitable data sets of these primary variables along with other data on potentially confounding factors that might contribute to the better understanding of the variation in the response variable. Such confounding factors might be information on catchment changes or other socio-economic factors. The data collation exercise required to undertake such a task could then involve sourcing three or more data sets from perhaps the same number of different organisations. The logistics and cost of such an exercise will need to be taken into consideration in any future attempt to use the data sets identified to detect a climate change impact.

The use of indicators to describe environmental change is widespread and used by most environmental regulators including the Environment Agency. Indicators for climate change impact have been proposed for the UK (Cannell *et al.*, 1999, 2003) and for Wales (Buse *et al.*, 2001). The UK indicators have recently been reviewed but there are no provisions for reporting against these indicators. However, there is the potential to generate climate change impact indicators for Agency Functions based on available data sets and to organise reporting against them on a regular basis. The Hadley Centre has a range of climate state indicators agreed with DEFRA against which they report every three months. The results are available to

view on the internet⁹. A similar arrangement for climate change impact indicators for Agency Functions could be set up for regular reporting on the Agency's web site.

The assessment of information and gaps for climate change impact detection suggested that as far as information needs had been defined then most of the required monitoring data sets could be sourced. The main exceptions were land use/cover information, human health indicators and climate change induced changes on the coast. The Agency is currently in the process of further defining the links between potential climate change impacts and the business deliverables of each Function. This process needs to be completed before monitoring requirements can be defined. The Flood Defence and Water Resources Functions have progressed furthest in terms of defining climate change impact indicators relevant to their business needs. However, the potential for climate change impact indicators for the remaining Functions (i.e. water quality, land quality, conservation, fisheries, recreation, navigation, waste, PIR, RAS) should be investigated. The data resource outlined in this report would be a useful first step in facilitating the development.

6.2 Conclusions

- 79 data sets identified (37 Internal, 4 external but supported by the Agency and 38 external but available to the Agency);
- details of the 37 Internal and 4 external but supported by the Agency data sets should be included on the Environment Agency Metadata Repository with appropriate keywords in relation to climate change impacts;
- 65 data sets with some potential (classified as high or medium) to detect climate change impacts covering most of the Agency's core functions;
- For the most part the available data sets meet the requirements of the information needs of the Agency as far as they have been defined;
- The gaps in information appear to be:
 - land-use and cover;
 - human health indicators;
 - changes on the coast.
- The data sets identified offer some potential to begin to develop climate change indicators for Agency Functions that as yet do not have them, namely:
 - water quality:
 - land quality:

⁹ see <http://www.metoffice.com/research/hadleycentre/obsdata/climateindicators.html>.

- conservation;
 - fisheries;
 - recreation;
 - navigation;
 - waste;
 - PIR;
 - RAS.
- Arrangements for regular updating of developed indicators on the Environment Agency web site should be investigated.

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APPENDIX A DATA SETS HELD BY THE AGENCY

Proforma reference	A1	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Directive concerning the Quality required of Surface Water intended for the Abstraction of Drinking Water					
<i>Objective of Programme</i>					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
A total of 456 sites (2001) (2364 samples) are monitored in surface freshwaters at a frequency ranging from 8 to 1 times per year.					
Dates of Monitoring Programme					
START	1984	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Colouration (after simple filtration), Temperature, Nitrates, Fluorides, Dissolved Iron, Copper, Zinc, Arsenic, Cadmium, Total Chromium, Lead, Selenium, Mercury, Barium, Cyanide, Sulphates, Phenols (phenol index) paranitraniline 4 aminoantipyrine, Dissolved or Emulsified Hydrocarbons (after extraction by petroleum ether), Polycyclic Aromatic Hydrocarbons, Total Pesticides (parathion, hexachlorocyclohexane, dieldrin), Ammonia.					
Statement of Quality Assurance					
Sampling and laboratory analysis of samples was undertaken in accordance with Environment Agency standard procedures.					
Data Storage					
Data arising from laboratory analysis are stored on the Water Information Management System (WIMS). Collated data are available in database or spreadsheet format.					
Location					
Contact EC Directives Officer at Agency Head Office.					
Potential for detecting climate change impacts					
Medium – climate change induced changes in water temperature could be detected directly using this data set. There are some confounding factors such as the influence of discharges from industry (including the power industry) that produce heated effluents and have in the past artificially raised river water temperatures in some localities.					

Proforma reference	A2	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Quality of Freshwater to support Fish Life Directive					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
26568 samples at 2214 sites (based on minimum frequency of 12 per year)					
Dates of Monitoring Programme					
START	1983	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Temperature, Dissolved oxygen, pH, Unionised Ammonia, Total Ammonia, Total Zinc, Total residue Chlorine (in situ), Suspended Solids, BOD, Nitrate, Dissolved Copper					
Statement of Quality Assurance					
Sampling and laboratory analysis of samples was undertaken in accordance with Environment Agency standard procedures.					
Data Storage					
Data arising from laboratory analysis are stored on the Water Information Management System (WIMS). Collated data available in database or spreadsheet format.					
Location					
Contact EC Directives Officer at Agency Head Office.					
Potential for detecting climate change impacts					
Medium – climate change induced changes in water temperature could be detected directly using this data set. There are some confounding factors such as the influence of discharges from industry (including the power industry) that produce heated effluents and have in the past artificially raised river water temperatures in some localities.					

Proforma reference	A3	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Dangerous Substances Directive List I monitoring					
<i>Objective of Programme</i>					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
The network comprises 686 sites downstream of discharges known to contain List I substances for sampling in the water column. In addition to this 523 sites in affected areas are sampled for substances in sediment and/or shellfish and/or fish. There are also a further 135 sites in the National Network that are sampled for water column parameters.					
Dates of Monitoring Programme					
START	1980	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
At National Network sites all determinands from the list below should be monitored. At sites downstream of known discharges only determinands specific to the discharges should be monitored.					
Aldrin, Dieldrin, Endrin, Isodrin, *Cadmium and its Compounds, Carbon Tetrachloride, Chloroform, DDT (all isomers), para-para DDT, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclohexane (all isomers), *Mercury and its Compounds, Pentachlorophenol and its Compounds, 1,2 Dichloroethane, Trichloroethylene, Perchloroethylene, Trichlorobenzene					
Statement of Quality Assurance					
Sampling and laboratory analysis of samples was undertaken in accordance with Environment Agency standard procedures.					
Data Storage					
Data arising from laboratory analysis are stored on the Water Information Management System (WIMS). Collated data available in database or spreadsheet format.					
Location					
Contact EC Directives Officer at Agency Head Office.					
Potential for detecting climate change impacts					
Low – this data set cannot be related to a climate change state or impact variable.					

Proforma reference	A4	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
List II Surface Water Regulations					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
1920 samples at 160 sites.					
Dates of Monitoring Programme					
START	1980	END	In progress		
Environmental Compartment					
Air		Water	3 (Freshwaters and Tidal Waters)	Land	
Determinands Monitored					
Arsenic, Dichorvos, Atrazine, Simazine, Azinphos-methyl, Endosulphan, Fenitrothion, Malathion, trifluralin, Triphenyltin, Tributyltin, 4-chloro-3-methyl-phenol, 2-chlorophenol, 2,4-dichlorophenol, 2,4-D, 2,4-D(ester), 1,1,1-trichloroethane, Bentazone, benzene, Biphenyl, Chloronitrotoluenes, Demeton, Dimethoate, Linuron, Mecoprop, Mevinphos, Napthalene, Omethoate, Toluene, Triazophos, Xylene					
Statement of Quality Assurance					
Sampling and laboratory analysis of samples was undertaken in accordance with Environment Agency standard procedures.					
Data Storage					
Data arising from laboratory analysis are stored on the Water Information Management System (WIMS). Collated data available in database or spreadsheet format.					
Location					
Contact EC Directives Officer at Agency Head Office.					
Potential for detecting climate change impacts					
Low – this data set cannot be related to a climate change state or impact variable.					

Proforma reference	A5	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Exchange of Information on the Quality of Surface Freshwater					
Objective of Programme					
Σ Geographical scope UK					
Σ Sampling Network 168 samples at 14 sites in the UK. Data collection is monthly.					
Dates of Monitoring Programme					
START	1980	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Flow, Temperature, pH. Conductivity at 20 ⁰ C, Chlorides, Nitrates, Ammonia, Dissolved Oxygen, BOD, COD, Total Phosphorus, Surfactants reacting to Methylene Blue, Total Cadmium, Mercury, Faecal Coliforms, Total Coliforms, Faecal Streptococci, Salmonella, Biological Quality					
Statement of Quality Assurance					
Sampling and laboratory analysis of samples was undertaken in accordance with Environment Agency standard procedures.					
Data Storage					
Data arising from laboratory analysis are stored on the Water Laboratory Information Management System (WIMS). Collated data available in database or spreadsheet format.					
Location					
Contact EC Directives Officer at Agency Head Office.					
Potential for detecting climate change impacts					
Medium – climate change induced changes in water temperature could be detected directly using this data set. There are some confounding factors such as the influence of discharges from industry (including the power industry) that produce heated effluents and have in the past artificially raised river water temperatures in some localities.					

Proforma reference	A6	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Directive concerning Urban Waste Water Treatment (UWWTD)					
<i>Objective of Programme</i>					
Σ Geographical scope England and Wales					
Σ Sampling Network The sampling network comprises sites at 232 qualifying discharges and 85 designated sensitive areas in surface fresh and marine waters.					
Dates of Monitoring Programme					
START	1992	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored Phosphate, Nitrate, Dissolved Oxygen, Ammonia, Chlorophyll <i>a</i> . Macrophyte surveys in freshwater and macroalgae audits in saline waters for designated areas.					
Statement of Quality Assurance Sampling and laboratory analysis of samples was undertaken in accordance with Environment Agency standard procedures.					
Data Storage Data arising from laboratory analysis are stored on the Water Information Management System (WIMS). Collated data available in database or spreadsheet format. Macrophyte/macroalgal data are stored in Biology 4 Windows (B4W) and can be accessed by Area staff.					
Location Contact EC Directives Officer at Agency Head Office.					
Potential for detecting climate change impacts					
Medium – climate change induced changes in water temperature could affect macrophyte and macroalgal distributions which may be detected in this data set. However, these groups of plants are very susceptible to changes in nutrient concentrations (and hence their use in this monitoring programme) and this may confound any climate change signal.					

Proforma reference	A7	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme Directive concerning the Protection of Waters against pollution caused by Nitrates from Agricultural sources (Nitrates Directive)					
Objective of Programme Σ Geographical scope Sites in England and Wales					
Σ Sampling Network A total of 559 sites in rivers were sampled monthly in 1996 (6708 samples) as part of the monitoring requirements of the Directive.					
Dates of Monitoring Programme					
START	1996	END	ongoing		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored Nitrate					
Statement of Quality Assurance Sampling and laboratory analysis of samples was undertaken in accordance with Environment Agency standard procedures.					
Data Storage Data arising from laboratory analysis are stored on the Water Information Management System (WIMS). Collated data available in database or spreadsheet format.					
Location Contact EC Directives Officer at Agency Head Office.					
Potential for detecting climate change impacts Low – this data set cannot be related to a climate change state or impact variable.					

Proforma reference	A8	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Directive concerning the quality of Bathing Water (Bathing Waters Directive)					
Objective of Programme					
Σ Geographical scope					
Tidal and coastal waters designated as bathing waters in England and Wales					
Σ Sampling Network					
A total of 482 sites (in 2000) (473 (saline) and 9 (freshwater) sites) have been sampled weekly during the bathing season (1 st May to 30 th September) since 1985.					
Dates of Monitoring Programme					
START	1985	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Faecal coliforms and total coliforms, Salmonella, Enteroviruses, pH, Colour, Mineral Oils, Surface Active Substances reacting with Methylene Blue, Phenols (phenol indices), Transparency, Faecal Streptococci					
Statement of Quality Assurance					
Sampling and laboratory analysis of samples was undertaken in accordance with Environment Agency standard procedures.					
Data Storage					
Data arising from laboratory analysis are stored on the Water Information Management System (WIMS). Collated data available in database or spreadsheet format.					
Location					
Contact EC Directives Officer at Agency Head Office.					
Potential for detecting climate change impacts					
Low – this data set cannot be related to a climate change state or impact variable.					

Proforma reference	A9	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Directive on the Quality required of Shellfish Waters (Shellfish Waters Directive)					
Objective of Programme					
Σ Geographical scope					
Designated Shellfish Waters in coastal waters of England and Wales					
Σ Sampling Network					
A total of 124 sites ((1488 samples) in 2001) in surface marine waters are sampled at a maximum frequency of 12 times per year.					
Dates of Monitoring Programme					
START	1980	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Salinity, Dissolved Oxygen Saturation, pH, Colouration (after filtration), Suspended Solids, Petroleum Hydrocarbons, Organohalogenated Substances (DDT), Lindane, Dieldrin, Aldrin, Isodrin, Endrin, Total Drins, PCBs, Hexachlorobenzene, Hexachlorobutadiene, Silver, Arsenic, Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, Substances affecting the taste of shellfish.					
Statement of Quality Assurance					
Sampling and laboratory analysis of samples was undertaken in accordance with Environment Agency standard procedures.					
Data Storage					
Data arising from laboratory analysis are stored on the Water Information Management System (WIMS). Collated data available in database or spreadsheet format.					
Location					
Contact EC Directives Officer at Agency Head Office.					
Potential for detecting climate change impacts					
Low – this data set cannot be related to a climate change state or impact variable.					

Proforma reference	A10	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Directive on Waste from the Titanium Dioxide Industry & Monitoring of environments concerned by waste from the Titanium Dioxide Industry.					
Objective of Programme					
Σ Geographical scope					
Monitoring under this Directive is limited to two locations – one in North-east and one in Anglian Region.					
Σ Sampling Network					
The sampling network comprises 19 sites for water column parameters with samples taken 3 times per year and 12 sites for sediment and biota with samples taken once per year.					
Dates of Monitoring Programme					
START	1988	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Water: Iron (total dissolved, hydrated oxides and hydroxides); Sediment: Titanium, Iron (total, hydrated oxides and hydroxides); Living organisms: Titanium, Chromium, Iron, Nickel, Zinc, Lead; Diversity and relative abundance of benthic fauna; presence of morbid anatomical lesions in fish.					
Statement of Quality Assurance					
Sampling and laboratory analysis of samples was undertaken in accordance with Environment Agency standard procedures.					
Data Storage					
Data arising from laboratory analysis are stored on the Water Information Management System (WIMS). Collated data available in database or spreadsheet format.					
The benthic faunal data may be available in UNICORN (a database designed to store such information) maintained at Area level.					
Location					
Contact EC Directives Officer at Agency Head Office.					
Potential for detecting climate change impacts					
Medium – climate change induced shifts in marine benthic invertebrate species distributions could be detected at sites not impacted by discharges from the titanium dioxide plants (reference sites) used in this monitoring programme.					

Proforma reference	A11	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Harmonised Monitoring Scheme					
Objective of Programme					
Σ Geographical scope					
England and Wales (major rivers).					
Σ Sampling Network					
170 sites, 2040 samples (some sites coincident with GQA chemistry sites – see proforma A16), monthly sampling.					
Dates of Monitoring Programme					
START	1974	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Chemical and physical parameters (at 170 sites).					
Full list of determinand suites is to be maintained as follows: Average Flow, Instantaneous Flow, Temperature, Turbidity, pH, Conductivity, Suspended Solids, Ash (from suspended solids), Dissolved Oxygen (instantaneous), BOD (inhibited), COD, 4-hour PV, Total Dissolved Organic Carbon, Ammoniacal Nitrogen, Nitrite, Nitrate, Hardness, Un-ionised Ammonia, Chloride, Total Alkalinity, Chlorophyll <i>a</i> , Boron, Fluoride, Orthophosphate, Total Phosphorus, Silica, Sulphate, Calcium, Magnesium, Potassium, Sodium, Arsenic, Cadmium, Total Chromium, Copper, Total Iron, Lead, Manganese, Total mercury, Nickel, Selenium, Vanadium, Zinc, Anionic Detergent as Manoxol OT, Non-ionic Detergent as Lissapol N, Cyanide (Total), Monohydric Phenols as Phenol, Benzo (g,h,I) perylene, Fluoroanthene, Indeno (1,2,3-c,d) pyrene, 11, 12-					
Benzofluoranthene, 3,4-Benzofluoranthene, 3,4-Benzpyrene, Aldrin, γ -Hexachlorocyclohexane, Heptachlor, para-para DDE, Dieldrin, para-para DDT, Total Phosphate, Faecal Coliforms, Total Coliforms, Faecal Streptococci, Salmonella, Antimony, Barium, Beryllium, Cobalt, Molybdenum, Tellurium, Thallium, Tin, Titanium, Uranium, Silver, Phosphorus (elemental yellow), Total Organic Phosphorus, Total Organic Chlorine, Total Organic Silicon, Total Organic Tin, Non-persistent Oils and Hydrocarbons, Polychlorinated Biphenyls, Chlorinated Phenols, para-para TDE, Polycyclic Aromatic Hydrocarbons, Endrin.					
Statement of Quality Assurance					
Sampling and laboratory analysis of samples was undertaken in accordance with Environment Agency standard procedures.					
Data Storage					
Data arising from laboratory analysis are stored on the Water Information Management System (WIMS). Collated data available in database or spreadsheet format.					

Location

Stored at Agency regions, with annual data sent to the National Centre for Environmental Data and Surveillance (NCEDS).

Potential for detecting climate change impacts

Medium – climate change induced changes in water temperature could be detected directly using this data set. There are some confounding factors such as the influence of discharges from industry (including the power industry) that produce heated effluents and have in the past artificially raised river water temperatures in some localities.

Proforma reference	A12	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Paris Commission Survey					
Objective of Programme					
Σ Geographical scope					
UK					
Σ Sampling Network					
163 sites on major rivers and direct discharges to sea in England and Wales. 11 rivers, 4 industries and 13 sewage treatment works in N Ireland.					
Dates of Monitoring Programme					
START	1990	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Site specific analytical suites: Mercury, Cadmium, Copper, Zinc, Lead, PCBs (the following congeners: IUPAC Nos 28, 52, 101, 118, 138, 153, 180), γ -Hexachlorocyclohexane, Nitrate as N, Total Nitrogen (taken as total inorganic N), Orthophosphate as P, Suspended Particulate Matter.					
Statement of Quality Assurance					
Sampling and laboratory analysis of samples was undertaken in accordance with Environment Agency standard procedures.					
Data Storage					
Data arising from laboratory analysis are stored on the Water Information Management System (WIMS). Collated data available in database or spreadsheet format.					
Location					
Stored at Agency regions, with annual data sent to the National Centre for Environmental Data and Surveillance (NCEDS).					
Potential for detecting climate change impacts					
Low – this data set cannot be related to a climate change state or impact variable.					

Proforma reference	A13	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Third North Sea Conference Declaration					
Objective of Programme					
Σ Geographical scope					
England					
Σ Sampling Network					
1596 samples at 133 river sites at input point to the North Sea					
Dates of Monitoring Programme					
START	1991	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Mercury, cadmium, Copper, Zinc, lead, arsenic, Chromium, Nickel, Drins (Aldrin, Dieldrin, Endrin), Hexachlorobenzene, Hexachlorobutadiene, Carbon Tetrachloride, Chloroform, trifluralin, Endosulfan, Simazine, Atrazine, Tributyltin compounds, Triphenyltin compounds, Azinphos-ethyl, Azinphos-methyl, Fenitrothion, Fenthion, malathion, parathion, Parathion-methyl, Dichlorvos, Trichloroethylene, tetrachloroethylene, trichlorobenzene, 1,2-Dichloroethane, Trichlorethane					
Statement of Quality Assurance					
Sampling and laboratory analysis of samples was undertaken in accordance with Environment Agency standard procedures.					
Data Storage					
Data arising from laboratory analysis are stored on the Water Information Management System (WIMS). Collated data available in database or spreadsheet format.					
Location					
Stored at Agency regions, with annual data sent to the National Centre for Environmental Data and Surveillance (NCEDS).					
Potential for detecting climate change impacts					
Low – this data set cannot be related to a climate change state or impact variable.					

Proforma reference	A14	DPSIR descriptor:	Impact		
Agency Internal	3 ¹⁰	Agency Supported External		External	
Title of Programme					
UK National Marine Monitoring Programme (NMMP) organised by the Marine Pollution Monitoring Management Group (MPMMG)					
Objective of Programme					
Σ Geographical scope					
Sites across the UK					
Σ Sampling Network					
87 sites across the UK including estuarine, intermediate and offshore sites. Monitoring: Quarterly for water quality at estuarine sites; annually for water quality at intermediate sites; annually for sediment samples; annually (between Nov & Feb) for biota sampling; twice per year (winter and summer) for oyster embryo bioassay at estuarine sites					
Dates of Monitoring Programme					
START	01/01/93	END	in progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Unfiltered Water: Tributyltin, γ and α -Hexachlorocyclohexane, β -Hexachlorocyclohexane, *Dieldrin, *Aldrin, *Endrin, *Isodrin, Hexachlorobenzene, *Hexachlorobutadiene, Pentachlorophenol, *DDT (opDDT), *Priority Hazardous Substances (Carbon Tetrachloride, Chloroform, Trifluralin, Endosulfan, Simazine, Atrazine, Azinphos-ethyl, Azinphos-methyl, Dichlorvos, Fenitrothion, Fenthion, Malathion, Parathion, Parathion-methyl, Trichloroethylene, Tetrachloroethylene, Trichlorobenzene, 1,2-Dichloroethane, Trichloroethane) Dissolved Oxygen, Suspended Solids, Chlorophyll a, Secchi-depth, Salinity, Temperature, Oyster Embryo Bioassay					
Filtered Water Sample: Mercury, Cadmium, Copper, Lead, Nickel, Zinc, Chromium, Ammoniacal Nitrogen, Nitrate as N, Nitrite as N, Orthophosphate as P, Silicate as Si					
Total Surficial Sediment: Aluminium, Mercury, Cadmium, Copper, Lead, Nickel, Zinc, Arsenic, Chromium, Tributyltin, Polychlorinated Biphenyls, Dieldrin, *Aldrin, *Endrin,					
Benthic macrofauna species composition					

¹⁰ The Environment Agency are responsible for the sampling and the sample analysis at a subset of the site network in England and Wales. The Agency also manage the database for the NMMP on behalf of all participants.

Statement of Quality Assurance

Three analytical quality control (AQC) programmes (for chemical, biology and ecotoxicology) to ensure strict quality control of data collection and analysis.

Data Storage

Stored centrally on computer database

Location

Database managed by Environment Agency National Centre for Environmental Data and Surveillance (NCEDS).

For further information on the NMMP see <http://www.marlab.ac.uk/NMMP/NMP.htm>.

Potential for detecting climate change impacts

Medium – climate change induced changes in coastal water temperatures and consequent changes in the distribution of benthic invertebrate species could be detected using this data set. Confounding factors for the benthic invertebrate communities include the effects of pollution.

Proforma reference	A15	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Groundwater Quality Monitoring					
Objective of Programme					
Σ Geographical scope					
National network sites selected to characterise and represent each groundwater unit					
Σ Sampling Network					
The network currently comprises a borehole network of 2547 sites. 60% of these sites are sampled by the water companies, 30 % are private abstractions and 10% are sampled by the Environment Agency.					
Dates of Monitoring Programme					
START	1985	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
pH, temperature, conductivity, Ca, Mg, K, Na, Cl, SO ₄ , alkalinity, NH ₄ , NO ₃ , NO ₂ , hardness, P, Total organic carbon, Fe, Mn, Cd, Cr, Cu, Ni, PB, Zn (Note: not all parameters are measured in all samples and not all measurements are made on raw waters).					
Statement of Quality Assurance					
Sampling, in-situ measurements and laboratory analysis are undertaken according to standard quality assurance procedures.					
Data Storage					
Data is largely stored in electronic databases in Agency Regions.					
Location					
Contact for information on groundwater quality data is the Agency's National Centre for Groundwater and Contaminated Land in Solihull.					
Potential for detecting climate change impacts					
Low – this data set cannot be related to a climate change state or impact variable.					

Proforma reference	A16	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme General Quality Assessment (Chemistry) (including sampling for predecessor NWC scheme)					
Objective of Programme Σ Geographical scope England and Wales					
Σ Sampling Network 7070 sites monitored representing 40000 km of rivers and canals in England and Wales. Sampling on a monthly basis					
Dates of Monitoring Programme					
START	1985	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored Chemical parameters: dissolved oxygen, BOD, ammonia (plus pH, unionised ammonia, phosphate, nitrate (TON), temperature, dissolved copper, total zinc – non mandatory).					
Statement of Quality Assurance Sampling and analysis subject to Agency QA procedures.					
Data Storage Data are stored on the Water Information Management System (WIMS). Information on GQA classes is stored on database held at NCEDS, Twerton.					
Location Access to raw data is via Areas and national GQA class information is held at NCEDS, Twerton.					
Potential for detecting climate change impacts Medium – climate change induced changes in water temperature could be detected directly using this data set. There are some confounding factors such as the influence of discharges from industry (including the power industry) that produce heated effluents and have in the past artificially raised river water temperatures in some localities. The GQA data set time series is nearly 25 years but information on some sites may be longer.					

Proforma reference	A17	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme General Quality Assessment (Biology) (including sampling for predecessor NWC scheme)					
Objective of Programme Σ Geographical scope England and Wales					
Σ Sampling Network A total of 6000 sites have been sampled in 1990, 1995 and 2000 at a frequency of once in every 3 seasons (spring, summer and autumn).					
Dates of Monitoring Programme					
START	1985	END	Ongoing		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored Macroinvertebrate taxon (at family level) composition and abundance. These primary measures are used to calculate indices (BMWP, ASPT and No. of scoring taxa).					
Statement of Quality Assurance Sampling methods are documented in the Sampling Methods manual (available from the Agency's intranet) and quality assurance on taxon identification is undertaken under contract by CEH during survey years.					
Data Storage Taxon composition, abundance category, indices and site location information is stored on Biology for Windows. National results of GQA surveys are stored on databases maintained by NCEDS at Twerton.					
Location Access to Biology for Windows is via biologists at Area level. Access to national GQA databases at NCEDS, Twerton					
Potential for detecting climate change impacts Low – river benthic invertebrate species will respond to climate change induced changes in water temperature as temperature limited species distributions change. However, identification for GQA purposes is at family level and changes at this coarser taxonomic level may take longer to emerge. Furthermore, changes in water quality over time are likely to confound any climate change impact signal.					

Proforma reference	A18	DPSIR descriptor:	Impact		
Agency Internal	✓	Agency Supported External		External	
Title of Programme General Quality Assessment – nutrients in rivers and canals					
Objective of Programme Σ Geographical scope England and Wales					
Σ Sampling Network Sampled at all GQA chemistry sites (see proforma A16) 12 times per year (monthly)					
Dates of Monitoring Programme					
START	1998	END	Ongoing		
Environmental Compartment					
Air		Water	✓	Land	
Determinands Monitored Phosphate and total oxidised nitrogen (TON) – these are included in the suite of determinands for GQA chemistry (see proforma A16)					
Statement of Quality Assurance Sampling is undertaken according to Environment Agency procedures set out in the National Sampling Procedures Manual. Laboratory analyses are undertaken by the National Laboratory Service according to the appropriate quality assurance procedures.					
Data Storage Data are stored with the GQA chemistry data at the National Centre for Environmental Data and Surveillance (NCEDS) in a standard database.					
Location NCEDS (Twerton).					
Potential for detecting climate change impacts Medium – climate change induced changes in rainfall patterns may affect river nutrient concentrations by changing the timing and extent of runoff events from the catchment (i.e. a significant diffuse source of nutrients). However, the long term changes in nutrient concentrations will be due mainly to improved sewage treatment, changes in agricultural practice and changes in the detection limits used in the analysis of samples.					

Proforma reference	A19	DPSIR descriptor:	Impact		
Agency Internal	✓	Agency Supported External		External	
Title of Programme					
General Quality Assessment – aesthetics in rivers and canals					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
There is no national network of sites. Agency regions monitor river aesthetics as part of their local operational monitoring.					
Dates of Monitoring Programme					
START	2000	END	Ongoing		
Environmental Compartment					
Air		Water	✓	Land	
Determinands Monitored					
Litter and dog faeces (including gross, general and sewage derived litter), Oil, surface scum. Foam, sewage fungus and ochreous deposits, colour, turbidity and odour.					
Statement of Quality Assurance					
Sampling is undertaken according to a standard Environment Agency protocol and the survey form is completed by trained field assessors.					
Data Storage					
Data are stored with the GQA data at the National Centre for Environmental Data and Surveillance (NCEDS) in a standard database.					
Location					
NCEDS (Twerton).					
Potential for detecting climate change impacts					
Low – this data set cannot be related to a climate change state or impact variable.					

Proforma reference	A20	DPSIR descriptor:	Impact		
Agency Internal	✓	Agency Supported External		External	
Title of Programme					
General Quality Assessment – aesthetics for bathing and coastal beaches					
Objective of Programme					
Σ Geographical scope England and Wales					
Σ Sampling Network The sampling network comprises all EC Bathing Water designated beaches and sampling in undertaken once per year in July.					
Dates of Monitoring Programme					
START	2000	END	Ongoing		
Environmental Compartment					
Air		Water	✓	Land	
Determinands Monitored Sewage related debris, gross, general and potentially harmful litter, accumulations, oil and faeces.					
Statement of Quality Assurance Sampling is undertaken according to a standard Environment Agency protocol and the survey form is completed by trained field assessors.					
Data Storage Data are stored with the GQA data at the National Centre for Environmental Data and Surveillance (NCEDS) in a standard database.					
Location NCEDS (Twerton).					
Potential for detecting climate change impacts					
Low – this data set cannot be related to a climate change state or impact variable.					

Proforma reference	A21	DPSIR descriptor:	Impact		
Agency Internal	✓	Agency Supported External		External	
Title of Programme					
Blue green algae (cyanobacteria)					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
Sampling undertaken on a reactive basis in rivers, canals and standing waters at the request of customers and one site per Region (8 sites) is monitored for long-term trend purposes on a monthly basis.					
Dates of Monitoring Programme					
START	1989	END	Ongoing		
Environmental Compartment					
Air		Water	✓	Land	
Determinands Monitored					
Blue green algal species and their numbers, toxicity (where scums are present), chlorophyll a, temperature, total phosphorus, dissolved inorganic phosphorus, total nitrogeen, total oxidised nitrogeen, nitrite, ammonia, silica.					
Statement of Quality Assurance					
Sampling is undertaken according to a standard Environment Agency protocols. Laboratory analysis is undertaken by the National Laboratory Service (NLS) according to appropriate quality assurance procedures.					
Data Storage					
Data are stored in a database at the National Centre for Ecotoxicology and Hazardous Substances (NCEHS) in Wallingford coordinated by the Algal Scientist					
Location					
NCEHS (Wallingford)					
Potential for detecting climate change impacts					
Medium – algal species composition will respond to climate change induced changes in water temperatures and the timings of blooms may also change. However, changes in the nutrient status will confound any climate change impact signal.					

Proforma reference	A22	DPSIR descriptor:	Impact		
Agency Internal	✓	Agency Supported External		External	
Title of Programme					
Marine microalgae (toxic algal blooms)					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
Sampling undertaken at EC Bathing Water beaches (see proforma A8) on a 'minimum effort' (sample taken when bloom present) and 'best endeavours' (sample taken each time a site visited) basis.					
Dates of Monitoring Programme					
START	1991	END	Ongoing		
Environmental Compartment					
Air		Water	✓	Land	
Determinands Monitored					
Marine microalgae species composition.					
Statement of Quality Assurance					
Sampling is undertaken according to a standard Environment Agency protocols. Identification of marine microalgal species is undertaken by trained operatives or sent to specialist laboratories.					
Data Storage					
Data are stored in a database at the National Centre for Ecotoxicology and Hazardous Substances (NCEHS) in Wallingford co-ordinated by the Algal Scientist.					
Location					
NCEHS (Wallingford).					
Potential for detecting climate change impacts					
Medium – algal species composition will respond to climate change induced changes in coastal water temperatures and the timings of blooms may also change. However, changes in the nutrient status and the effect of resting spores from previous blooms will confound any climate change impact signal.					

Proforma reference	A23	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
River flow monitoring					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
Flow monitoring from 1967 permanent flow gauges and over 22,000 spot gauges					
Dates of Monitoring Programme					
START	1935	END	Ongoing		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Mean daily flow (calculated value from measurements of stage height and conversion using stage discharge relationships).					
Statement of Quality Assurance					
Measurements are undertaken according to set procedures depending on the measuring device. Data are quality checked before admission to the National Water Archive.					
Data Storage					
Data are stored in electronic database – National River Flow Archive.					
Location					
National River Flow Archive is part of the National Water Archive operated by CEH Wallingford (further information at http://www.nwl.ac.uk/ih/nwa/index.html). Data from England and Wales are supplemented by data from Scotland and Northern Ireland. Requests for data retrievals should be sent to CEH Wallingford.					
Contact: Mr. Martin Lees Head, National Water Archive CEH Wallingford, Crowmarsh Gifford, Wallingford Oxon. OX10 8BB Tel: 01491 838800, Fax: 01491 692424 E-mail: mll@ceh.ac.uk					
Potential for detecting climate change impacts					
High – river flows could be impacted by climate change induced changes in rainfall patterns. However, flows could be confounded by changes in abstraction rates and land-use. An indicator based on river flows has been proposed as an indicator of climate change impact in the UK (Cannell <i>et al.</i> , 1999, 2003) and in Wales (Buse <i>et al.</i> , 2001).					

Proforma reference	A24	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Ground Water Levels					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
175 observation boreholes located in the major aquifers					
Dates of Monitoring Programme					
START	1836 (earliest record)	END	Ongoing		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Water level in boreholes					
Statement of Quality Assurance					
Measurements are made by automatic level monitors. Data are quality assured before admission into the database.					
Data Storage					
Data are stored in an electronic database – National Groundwater Level Archive (NGLA).					
Location					
National Groundwater Level Archive is part of the National Water Archive operated by CEH Wallingford (further information at http://www.nwl.ac.uk/ih/nwa/index.html). Data from England and Wales are supplemented by data from Scotland and Northern Ireland. Requests for data retrievals should be sent to CEH Wallingford.					
Contact:					
Mr. Martin Lees					
Head, National Water Archive					
CEH Wallingford, Crowmarsh Gifford, Wallingford					
Oxon. OX10 8BB					
Tel: 01491 838800, Fax: 01491 692424					
E-mail: mll@ceh.ac.uk					
Potential for detecting climate change impacts					
High – groundwater levels could be impacted by climate change induced changes in rainfall patterns. However, levels could be confounded by changes in abstraction rates and land-use. An indicator based on groundwater level has been proposed as an indicator of climate change impact in the UK (Cannell <i>et al.</i> , 1999, 2003).					

Proforma reference	A25	DPSIR descriptor:	State		
Agency Internal	✓	Agency Supported External		External	
Title of Programme Rainfall monitoring					
Objective of Programme Σ Geographical scope England and Wales					
Σ Sampling Network Daily recording of rainfall is undertaken at gauges and chart recorders from 3700 locations					
Dates of Monitoring Programme					
START	1900	END	Ongoing		
Environmental Compartment					
Air		Water	✓	Land	
Determinands Monitored Rainfall					
Statement of Quality Assurance Recording of rainfall measurements is undertaken to strict guidelines issued by the Met. Office.					
Data Storage Records for individual gauges are kept in spreadsheet format by Area hydrometric staff. Data is passed onto the Met.Office for inclusion in national records.					
Location For Agency collected - contact Area hydrometric staff. For nationally collated data - see proforma C33.					
Potential for detecting climate change impacts Low – long term changes in rainfall patterns are indicative of climate state rather than impact.					

Proforma reference	A26	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Stocks Reservoir Inflows					
Objective of Programme					
Σ Geographical scope					
Derived time series of daily inflows to Stocks Reservoir, North West Region.					
Σ Sampling Network					
Water Company measured abstractions and releases. EA operated hydrometric flow gauge for spill.					
Dates of Monitoring Programme					
START	01/01/1927	END	Ongoing		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Data are derived from individual components of the water balance. Inflows = Outflows + Abstractions ± Change in Storage. Outflows are composed of measured compensation, waterbank and freshet releases, spill and water treatment works washwater. Change in storage is calculated by converting measured levels to storage via a conversion table. The resultant time series is equivalent to natural flow to the point of the dam wall.					
Statement of Quality Assurance					
Component data are checked on receipt and missing values infilled where appropriate to ensure the highest possible quality. The method of derivation of the series may have differed in the past. In particular, periods of missing data may have been modelled rather than calculated from components. This information is not readily available, but could probably be obtained from earlier reports.					
Data Storage					
Stored on a networked computer database at Richard Fairclough House in Warrington.					
Location					
Database managed by Hydrology Section of the EA North West, North Area Water Resources Regulatory and Technical Team, at Richard Fairclough House in Warrington For further information contact: Helen Stanley.					
Potential for detection of climate change impacts					
Medium – inflows to Stocks reservoir may have been impacted by climate change induced changes in river flows upstream. However, changes in the catchment, the river channel and abstractions over the years may confound any climate change impact signal.					

Proforma reference	A27	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
National Abstraction Licence Database (NALD)					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
All licenced astractions from rivers and groundwaters					
Dates of Monitoring Programme					
START	1970	END	Ongoing		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
The details of each abstraction are kept. Each licence holder has to provide returns detailing how much water has been taken to ensure compliance with the terms of the licence.					
Statement of Quality Assurance					
The details of the licence conditions should be accurately transposed into the database. Efforts are made to ensure that pumps to measure abstraction are calibrated so that return information is accurate.					
Data Storage					
Data are stored on a specially designed electronic database.					
Location					
Access to the database can be made from Environment Agency Area offices.					
Potential for detecting climate change impacts					
High – volumes of water abstracted for certain uses (i.e. public supply and irrigation) can be related to climate induced changes in weather patterns. However, changes in amounts abstracted due to changing industrial and agricultural economies might confound any climate change impact signal. The use of irrigation water in agriculture is a proposed UK climate change impact indicator (Cannell <i>et al.</i> , 1999, 2003).					

Proforma reference	A28	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
River Habitat Surveys (RHS)					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
Survey of 4559 RHS Reference between 1994 and 1997					
Dates of Monitoring Programme					
START	1994	END	1997		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Channel substrate, habitat features, aquatic vegetation types, the complexity of bank vegetation structure and type of any artificial modification to the channel and banks.					
Statement of Quality Assurance					
Data collected by trained surveyors.					
Data Storage					
Data are stored in an electronic database.					
Location					
RHS information is held by the RHS team based at Environment Agency offices in Warrington. Contact: RHS manager.					
Potential for detecting climate change impacts					
Low – While in-channel river habitats are determined to some degree by the river flow regime, this data set is too short a time series to be useful in climate change impact assessment.					

Proforma reference	A29	DPSIR descriptor:	Impact		
Agency Internal	✓	Agency Supported External		External	
Title of Programme					
River Corridor Surveys					
Objective of Programme					
Σ Geographical scope England and Wales					
Σ Sampling Network River corridor surveys have been undertaken on 3,100 km of rivers (1997/8).					
Dates of Monitoring Programme					
START	1988 (approx)	END	1998		
Environmental Compartment					
Air		Water	✓	Land	
Determinands Monitored Vegetation types, physical habitat features and significant riparian features, channel depth, water depth and bank slope					
Statement of Quality Assurance Standard methodology undertaken by trained surveyors.					
Data Storage Not known					
Location Contact Agency Head Office conservation function.					
Potential for detecting climate change impacts Low – information arising from river corridor surveys cannot readily be linked to climate change state or impact variables.					

Proforma reference	A30	DPSIR descriptor:	Impact		
Agency Internal	✓	Agency Supported External		External	
Title of Programme					
National Fisheries Monitoring Programme – stock assessment surveys					
Objective of Programme					
Σ Geographical scope England and Wales					
Σ Sampling Network 7,500 km of main river are surveyed for stock assessment purposes.					
Dates of Monitoring Programme					
START	1970	END	ongoing		
Environmental Compartment					
Air		Water	✓	Land	
Determinands Monitored					
Fish species, length, weight, age data. Results from recent coarse fisheries surveys are classified using the Fisheries Classification Scheme.					
Statement of Quality Assurance					
Standard methodology undertaken by trained fisheries survey teams.					
Data Storage					
Data are stored in a custom database.					
Location					
The data set for coarse fish is available from: National Coarse Fisheries Centre Environment Agency Arthur Drive Hoo Farm Industrial Estate Worcester Road Kidderminster Worcs DY11 7RA Tel: 01562 68975					
Potential for detecting climate change impacts					
Medium – coarse fish populations could be affected by climate change induced changes in river flows and water quality. However, pollution alleviation, pollution incidents, restocking programmes and activities in the river channel can also affect these populations which might confound any climate change impact signal.					

Proforma reference	A31	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
National Fisheries Monitoring Programme - Resistivity and Acoustic Fish counters					
Objective of Programme					
Σ Geographical scope England and Wales.					
Σ Sampling Network 41 sites across England and Wales. Monitoring is automatic and continuous.					
Dates of Monitoring Programme					
START	continuous from varied start dates, some as early as late 1960's		END	ongoing	
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Counters recognise and store signals generated by upstream and downstream migrating adult fish and are strategically located to count mainly salmon and sea trout, although other fish species may also be counted, such as eels and shad. The counter records the following: <ul style="list-style-type: none"> • the time and date of the signal; • the size of the signal (which equates directly to the size of the fish); • the prevailing conductivity at the time of signal generation; • the direction of fish movement – upstream or downstream or un-recognisable. Other environmental variables such as water depth and water temperature are measured and recorded at some but not all counter sites.					
Statement of Quality Assurance					
Data are analysed to varying degrees, depending on the site. Some data are analysed and reported to a high degree of accuracy.					
Data Storage					
Stored locally on computer databases in Area Offices.					
Location					
Various Area Offices – Contact can be made through National Fisheries Technical Team, Nigel Milner or Miran Aprahamian.					
Potential for detecting climate change impacts					
Medium - salmon and sea trout populations could be affected by climate change induced changes in river flows and water quality. However, physical barriers to migration, pollution incidents, restocking programmes and pressures during stages of their life cycle at sea also affect these populations which might confound any climate change impact signal. Examples of long term fish counter records have been proposed as UK indicators of climate change impact (Cannell <i>et al.</i> , 1999, 2003).					

Proforma reference	A32	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
National Fisheries Monitoring Programme – Licence return data (salmon and sea trout licences)					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
68 salmon and sea trout fishery rivers and coastal net fisheries in the North East and Anglian Regions.					
Dates of Monitoring Programme					
START	1989	END	ongoing		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Number, weight and species of salmon and sea trout declared by licence holders for rod and net fishing. Sale of licences provides an estimate of fishing effort.					
Statement of Quality Assurance					
Licence return data are treated with a degree of caution because the quality of the information is dependent on the effort and honesty of the licence holder. There are established methods for accounting for this when these data are published.					
Data Storage					
Returns are stored on an electronic database.					
Location					
Various Area Offices – Contact can be made through National Fisheries Technical Team, Nigel Milner or Miran Aprahamian.					
Potential for detecting climate change impacts					
Medium – salmon and sea trout populations could be affected by climate change induced changes in river flows and water quality. However, physical barriers to migration, pollution incidents, restocking programmes and pressures during stages of their life cycle at sea also affect these populations which might confound any climate change impact signal.					

Proforma reference	A33	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Flood Management and Coastal Defence					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
The sampling network covers the main river network and the coastal areas of England and Wales.					
Dates of Monitoring Programme					
START	Various	END	in progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Flood defence related monitoring draws on data from Agency hydrometric monitoring and from external monitoring of sea levels and wave climate as well as including monitoring of ground levels and the status of flood defences. Determinands used include:					
Peak River Levels (annual maximum levels, peaks over threshold and flood duration), Peak flows, Seasonal flows, Groundwater levels, Soil moisture deficits, Flood Volumes, Sea levels, Storm surges (annual maxima and Peaks over threshold), Wave climate, Coastal erosion (cliff edge recession, longshore drift and beach surveys), Barrier operations, Number of properties flooded, Land use changes, reservoir spills, Ground levels.					
Statement of Quality Assurance					
The data sets used for Flood Defence purposes are fully quality assured.					
Data Storage					
Data storage is on a dedicated computer database that allows operational information on flood warnings, for example, to be produced. Data should be available within the Agency.					
Location					
Information on flood defence related data sets is available through the Flood Defence function at Agency Head Office.					
Potential for detecting climate change impacts					
High – many flood defence related data sets can be readily correlates with climate change state or impact variables (namely, changes in rainfall patterns). Changes in the catchment (i.e. increasing urbanisation and other land uses) and in the river channel may confound the climate change impact signal.					

Proforma reference	A34	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Flood barrier closures (including the Thames Barrier)					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
The Agency operates a number of flood barriers for the protection of coastal areas from flooding due to tidal surges and/or river flooding.					
Dates of Monitoring Programme					
START	1982 ¹¹	END	Ongoing		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Periods of barrier closures are recorded routinely.					
Statement of Quality Assurance					
Periods of barrier closure are recorded by operators.					
Data Storage					
Methods of data storage are unknown. The information is available from individual barrier operators.					
Location					
Information on barriers other than the Thames Barrier can be accessed via the Agency Head Office Flood Defence function.					
Information on Thames Barrier closures can be obtained from:					
Environment Agency					
Thames Barrier					
Eastmoor Street					
Charlton					
London SE7 8LX					
Potential for detecting climate change impacts					
High – flood barrier closures are related to changes in sea level rise and to storminess which in turn influences tidal surges and river flood flows. The data set for the Thames Barrier is used in the proposed UK climate change impact indicator set (Cannell <i>et al.</i> , 1999, 2003) and the in the Agency’s headline indicators. Information on the reason for the barrier closures would assist in detecting the climate change impact signal.					

¹¹ For the Thames Barrier. Information for previous decades have been back-calculated to indicate when the barrier would have been closed if it were in place.

Proforma reference	A35	DPSIR descriptor:	Pressure		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Pollution Inventory (water)					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
Discharges to the aquatic environment from Agency regulated industries					
Dates of Monitoring Programme					
START	1998	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
1998 onwards:					
Aldrin, Arsenic, Atrazine, Azinphos-ethyl, Azinphos-methyl, Bentazone, , Benzene, Biphenyl, Cadmium, Carbon tetrachloride, Chlorofenvinphos, Chloroform, 4-Chloro-3-Methylphenol, Chloronitroluenes, 2-Chlorophenol, Chromium, Copper, Demeton, Diazinon, Dichlorodiphenyltrichloroethane, 2,4-Dichlorophenol, 2,4-D (ester), 2,4-D (non-ester), Dichlorvos, Dieldrin, Dimethoate, Endosulfan, Endrin, Ethylene dichloride, Fenitrothion, Hexachlorobenzene, hexachlorobutadiene, Hexachlorocyclohexane, Isondrin, lead, Linuron, malathion, mecoprop, Mercury, Mevinphos, naphthalene, Nickel, Nonphenools, Octylphenols, Omethoate, parathion, Parathion methyl, Pentachlorophenol, Permethrin, Polychlorinated biphenyls, Simazine, Tetrachloroethene, Toluene, Triazophose, Tribuylin compounds, trichlorobenzene, 1,1,1-Trichloroethane, 1,1,2-Trichloroethane, Trichloroethylene, trifluralin, Triphenyltin compounds, Xylene, Zinc.					
New for 2002:					
Aniline, Benzyl butyl phthalate, Bisphenol-A, Brominated diphenylethers, Chlorides, Chlorpyrifos, Cyanides, Cypermethrin, 2,4-Dichloropheoxyacetic acid (ester and non-ester), Di(2-ethylhexyl)phthalate, Dichloromethane, Diuron, Ethylbenzene, Flurorides, halogenated organic compounds, Hexabromocyclododecane, Isoproturon, Long chain chlorinated paraffins, medium chain chlorinated paraffins, Methyl chlorophenoxy acetic acid, 4-4'Methylene-dianiline, Nitrogen, Octylphenol ethoxylates, Organic tin compounds, Phenols, Phosphorus, Polycyclic aromatic hydrocarbons, Proptamphos, Propylene oxide, Short chain chlorinated paraffins, tert-Butyl methyl ether, tetrabromo-bisphemol A, Total organic carbon					
Statement of Quality Assurance					
None given					
Data Storage					
Data are collected on standard forms and collated into a specialised electronic database.					

Location

The Agency's Pollution Inventory team collates this information.

Contact:

Claudia Towner

E-mail: claudia.towner@environment-agency.gov.uk

Potential for detecting climate change impacts

Low – This data set cannot be related to a climate change state or impact variable and so has low potential to detect climate impacts.

Proforma reference	A36	DPSIR descriptor:	Pressure		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Pollution Inventory (Air)					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
Discharges to the atmosphere from Agency regulated industries					
Dates of Monitoring Programme					
START	1998	END	In progress		
Environmental Compartment					
Air	3	Water		Land	
Determinands Monitored					
1998 onwards:					
Acetaldehyde, Acetonitrile, Acrylonitrile, Aldrin, Allyl alcohol, Amitrole, Ammonia, Aniline, Antimony, Arsenic, Atrazine, Azinphos-methyl, Benzaldehyde, Benzene, Benzo(a)pyrene, Benzyl chloride, Beryllium, Boron, Butadiene, Butene, Cadmium, Calcium cyanamide, Carbon dioxide, Carbon disulphide, Carbon monoxide, Carbon tetrachloride, Chlorofluorocarbons, Chloroform, Chromium, Copper, Cyanamide, Diallylate, Diaminotoluene, Dichlorodiphenyltrichloroethane, Dichloromethane, Dichlorvos, Dieldrin, Diethyl sulphate, Dimethyl disulphide, Dimethyl sulphate, Dimethylformamide, Dinoseb, Dioxane, Dioxins and Furans, Endosulfan, Endrin, Epichlorohydrin, 2-Ethoxyethanol, 2-Ethoxyethylacetate, Ethyl acrylate, Ethyl toluene, Ethylene, Ethylene dichloride, Ethylene oxide, Formaldehyde, Halons, Hexachlorobenzene, Hexachlorofluorocarbons, Hydrofluorocarbons, Hydrogen chloride, Hydroxyethyl acrylate, I-Butyraldehyde, Iodomethane, Isophorone di-isocyanate, lead, Maleic anhydride, manganese, Mercury, Methane, Methyl bromide, Methyl chloride, Methyl chloroform, 4,4-Methylene-bis, Methyl isocyanate, Methylamine, Methylene diphenyl diisocyanate, Nickel, Nitrobenzene, Nitrogen oxides, 2-Nitropane, Nitrous oxide, Non-methane volatile organic compounds, Ozone, para-Dichlorobenzene, Particulates (PM10 and smaller), PM10 total, Pentachlorophenol, Pentanal, Pentene, Perfluorocarbons, Phenol, Phorate, Phosgene, Polychlorinated biphenyls, Polycyclic aromatic hydrocarbons, Propylene, Propylene oxide, Selenium, Simazine, Styrene, Sulphur dioxide, Sulphur hexafluoride, Tetrachloroethane, tetrachloroethylene, Toluene diisocyanate, Trichloroethylene, Trichlorotoluene, Trimellitic anhydride, Trimethylbenzene, vanadium, Vinyl chloride, Xylene, Zinc.					
2002 onwards:					
Acrylamide, Benzyl butyl phthalate, Brominated diphenylethers, Chlorine and total inorganic chlorine compounds, Dibutylphthalate, Dioxins and Furans, Ethyl bromide, Di(2-ethylhexyl) phthalate, Fluorine and total inorganic fluorine compounds, Hexabromocyclododecane, Hydrobromofluorocarbons, Hydrogen cyanide, Hydrogen fluoride, 3-Methyl-1-butene, 4,4'-Methylene dianiline, pentane, Polycyclic Aromatic Hydrocarbon, Propylene Oxide, Sulphur					

oxides, Toluene, Trichlorobenzene
<p>Statement of Quality Assurance None given</p>
<p>Data Storage Data are collected on standard forms and collated into a specialised electronic database.</p>
<p>Location</p> <p>The Agency's Pollution Inventory team collates this information.</p> <p>Contact:</p> <p>Claudia Towner E-mail: claudia.towner@environment-agency.gov.uk</p>
<p>Potential for detecting climate change impacts</p> <p>Low – this information is used as part of the UK's reporting on emissions to air and is therefore useful for work with climate change mitigation/inventory work. This data set is not suitable for detecting climate change impacts.</p>

Proforma reference	A37	DPSIR descriptor:	Impact		
Agency Internal	3	Agency Supported External		External	
Title of Programme					
Studies of the Biological Recovery of the Thames Estuary					
Objective of Programme					
Σ Geographical scope					
England					
Σ Sampling Network					
The Agency has co-ordinated numerous surveys into the status of the Thames estuary including fish entrained on the intakes of West Thurrock Power station, multi-method fish surveys and macrobenthic surveys. Sites have been located throughout the estuary and sampling undertaken annually (for fish surveys) and every 5 years (macrobenthic surveys).					
Dates of Monitoring Programme					
START	1977 (some from 1963 and 1967)	END	1992 and ongoing		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Water Quality, (temperature, salinity, DO, SS, pH, N) climatic variation as NAOI, freshwater flow, 16 species of fish and three species of invertebrates (abundance, fish growth) diversity, evenness and macrobenthic species.					
Statement of Quality Assurance					
None, methodology well described in publications					
Data Storage					
Data sets for fish, water quality and macrobenthos are stored separately on MS Excel spreadsheets/MS Access databases and other electronic media.					
Location					
Data are available from Agency Thames region and also from University of Plymouth, (C/O Dr. Martin Attrill)					
Potential for detecting climate change impacts					
Medium – the primary aim of these data sets has been to document the status of the Thames estuary over time and they have been used to describe the recovery of the estuary from pollution (see Attrill, 1998). Fish and macrobenthic invertebrate populations will respond to climate change induced sea level rise and changes in water temperature regime. However, the effects of pollution may have been too great in the past to allow a climate change impact signal to be detected.					

APPENDIX B AGENCY SUPPORTED DATA SETS

Proforma reference	B1	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External	3	External	
Title of Programme					
MARCLIM (Climate change and marine biodiversity) (multi-partner collaboration)					
Objective of Programme					
Σ Geographical scope					
Forecasting effects of climate change on marine and coastal communities					
Σ Sampling Network					
UK and Irish coasts and near-shore tidal waters (600 sites, some up to 100 years data)					
Dates of Monitoring Programme					
START	Unknown and various		END	Various and continuing (some up to 100 years)	
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Hydrography, temperature, invertebrate communities, single species populations, climate indicator species, rocky shore communities					
Statement of Quality Assurance					
Unknown. Mostly research standards					
Data Storage					
A dedicated database conforming to National Biodiversity Network (NBN) standards is used to store historical data.					
Location					
For more information: see http://www.mba.ac.uk/marclim/					
Contact:					
The MarClim Programme					
The Marine Biological Association of the UK					
The Laboratory, Citadel Hill					
Plymouth, PL1 2PB					
Devon, UK					
Tel: +44(0)1752 633334 Fax: +44(0)1752 633102					
Email: marclim@mba.ac.uk					
Potential for detecting climate change impacts					
<p>High – one of the objectives of this 4 year project is to collate data sets relating to intertidal ecology with the potential to detect the impact of climate change. Intertidal flora and fauna will respond to the effects of sea level rise and changes in water and air temperature regime. Each data set would need to be assessed on its merits for potential to detect climate change impacts. A further objective is to establish a low cost monitoring programme for the impacts of climate change on the intertidal.</p>					

Proforma reference	B2	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External	3	External	
Title of Programme					
Environmental Change Network					
Objective of Programme					
Σ Geographical scope					
United Kingdom					
Σ Sampling Network					
There are 42 freshwater sites and 12 terrestrial sites. Weekly sampling and fortnightly sampling for lakes is undertaken for physico-chemical variables. Biological variables are measured three times per year. For terrestrial sites the frequency sampling varies from hourly to annually depending on the parameter.					
Dates of Monitoring Programme					
START	22/01/92	END	Ongoing		
Environmental Compartment					
Air	3	Water	3	Land	3
Determinands Monitored					
Freshwater sites					
Basic Determinands: pH, Turbidity, Colour, Temperature, Conductivity, Dissolved Oxygen (% sat), Dissolved Oxygen (mg/l), BOD 5 ATU, Ammoniacal Nitrogen, TON, Nitrate, Nitrite, Suspended solids, Hardness, Alkalinity, Chloride, Cyanide, Fluoride, Orthophosphate, Silicate, Sulphate, E. Coli, Total Coliforms					
Metals: Sodium, Potassium, Total Copper, Total Silver, Total Magnesium, Total Calcium, Total Zinc, Total Cadmium, Total Aluminium, Total Tin, Total Lead, Total Vanadium, Total Chromium, Total Manganese, Total Iron, Total Nickel, Total Mercury.					
Discharge (flow measurements) at river sites Macroinvertebrate species and abundance.					
Terrestrial sites					
Variables for meteorology, atmospheric chemistry, precipitation chemistry, surface water discharge, chemistry and quantity, soil solution chemistry, soil properties, vegetation, vertebrates, invertebrates and site management.					
Statement of Quality Assurance					
Data collection is undertaken according to strict protocols. Laboratory analyses are undertaken according to appropriate quality assurance procedures. Data are collated into the ECN database and quality checked.					
Data Storage					
Data are stored in an integrated data management system. ECN data can be obtained under licence from the ECN co-ordinator at CEH Merlewood.					

Location

Further information about ECN is available at:

<http://www.ecn.ac.uk/>

Potential for detecting climate change impacts

Medium – The ECN provides one of the very few examples of a monitoring programme with a specific objective of detecting long-term environmental change. The programme integrates weather measurements and terrestrial and aquatic habitat responses (i.e. climate state and impact variables). Despite the relatively short time series, data sets arising from ECN have been identified as having the potential to detect climate change impacts in the UK (Cannell *et al.*, 1999, 2003) and in Wales (Buse *et al.*, 2001).

Proforma reference	B3	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External	3	External	
Title of Programme					
National Biodiversity Network (NBN)					
Objective of Programme					
Σ Geographical scope					
United Kingdom					
Σ Sampling Network					
The NBN provides access to biodiversity data sets from across the UK					
Dates of Monitoring Programme					
START	Data set dependent	END	Ongoing		
Environmental Compartment					
Air		Water	3	Land	3
Determinands Monitored					
Species presence. The NBN platform provides information on the species recorded, geographical spread and length of the time series.					
Statement of Quality Assurance					
Quality of component data sets will be variable. Many collected by amateur enthusiasts.					
Data Storage					
Data sets are accessed via a website (www.nbn.org.uk) and data sets can be sourced from the original owners. The NBN sets data quality standards for those included on the NBN gateway.					
Location					
Information available at www.nbn.org.uk					
Potential for detecting climate change impacts					
High – the NBN is a metadatabase of data sets. Some of these have been used as indicators of climate change impact. Each data set would need to be assessed on its merits for potential to detect climate change impacts.					

Proforma reference	B4	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External	3	External	
Title of Programme					
Severn Estuary Data set.					
Objective of Programme					
To monitor the fish and crustacean populations in the Severn estuary					
Σ Geographical scope					
Severn Estuary					
Σ Sampling Network					
1 station current - Hinkley Point Power station in Bridgwater Bay.					
Dates of Monitoring Programme					
START	October 1980	END	in progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
80 species of fish and 25 species of macro crustacean. Sampled monthly identified to species and counted. Length measured for the last 10 years. Temperature and salinity spot measurements. Length/weight relationship available for major species.					
Statement of Quality Assurance					
Collected by experienced qualified fishery researchers					
Data Storage					
Current report can be seen at http://www.irchouse.demon.co.uk/latestreports.html Data are stored in MS Excel spread sheets. The Agency part supports this monitoring programme.					
Location					
PISCES Conservation Ltd, IRC House, The Square, Pennington, Lymington, SO41 8GN. Contact: pisc@irchouse.demon.co.uk					
Potential for detecting climate change impacts					
Medium – fish and macro-crustacean populations in the Bristol channel may respond to climate change induced temperature changes in coastal waters. This data set provides a multidecadel baseline of information against which future changes can be assessed. Fish and macro-crustacean populations also respond to other factors such as water and habitat quality changes which may confound any climate change induced impact signal.					

APPENDIX C DATA SETS HELD EXTERNAL TO THE AGENCY

Proforma reference	C1	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
UK National Tide Gauge Network					
Objective of Programme					
Σ Geographical scope					
UK, 44 stations					
Σ Sampling Network					
35 sites around mainland England, Scotland and Wales, 7 island sites and 2 sites in Northern Ireland					
Dates of Monitoring Programme					
START	1956	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Sea level is measured every 15 minutes, together with wind speed at some (eight) sites					
Statement of Quality Assurance					
Measurements at these permanent tide gauges is strictly controlled. Stations are checked annually and data are checked weekly. Data from 1993 have been quality controlled to modern standards.					
Data Storage					
Data are stored on a dedicated database.					
Location					
Sea level data are available from the British Oceanographic Data Centre (at www.bodc.ac.uk); Monthly and annual average sea level data are available from the Permanent Service for Mean Sea Level at www.nerc-bidston.ac.uk/psmsl/					
Potential for detecting climate change impacts					
High – changes in sea level due to the melting of polar ice and thermal expansion of the oceans are one the anticipated impacts of climate change. Indicators based on this survey have been proposed for the UK (Cannell <i>et al.</i> , 1999, 2003) and for Wales (Buse <i>et al.</i> , 2001).					

Proforma reference	C2	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
1. Angler catches in the River Trent in relation to Power stations (Langford) 2. Angler catches in the River Trent (Cowx, Hull International Fisheries Institute (HIFI))					
Objective of Programme					
Σ Geographical scope England					
Σ Sampling Network Several sites along the mainland River Trent for two projects.					
Dates of Monitoring Programme					
START	1.1967-1975 2.1969-1997	END	1997		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored Species occurrence, numbers caught and fishing effort.					
Statement of Quality Assurance Unknown					
Data Storage Earlier on paper, later electronic (At least three published reports or papers available).					
Location					
1. Langford archives (not raw data). Contact : T. E. Langford e-mail: tel2@soton.ac.uk 2. HIFI (later data than 1997 also available within the Agency - see proforma A31). Contact: hifi@hull.ac.uk					
Potential for detecting climate change impacts					
Low – long-terms trends in angler catches may be affected by changes in the target fish populations resulting from climate change induced temperature and flow regime variations. The project linking angler catches and the effects of power stations may provide some indications of likely temperature related impacts. Angler catch return data is treated with some caution and there may be many confounding factors influencing these data.					

Proforma reference	C3	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Recruitment of Cyprinid fishes in UK Rivers					
Objective of Programme					
Σ Geographical scope England					
Σ Sampling Network					
Selected sites on Rivers 1) Great Ouse, 2) Trent, 3) Warwickshire Avon over varying periods					
Dates of Monitoring Programme					
START	1. 1981, 2) 1989 3) 1989 (sporadic)	END	All continuous		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Species abundance for all species present, water temperature, river flow.					
Statement of Quality Assurance					
Unknown, research standard.					
Data Storage					
Unknown but probably electronic.					
Location					
All data held at Hull International Fisheries Institute (HIFI) (contact: hifi@hull.ac.uk) (Hull University), Ouse data in collaboration with Paul Frear, EA. (not available on web).					
Potential for detecting climate change impacts					
Medium – recruitment of cyprinid fish may be affected by changes in water temperature and flow regime resulting from climate change. However, many other factors including water quality and fish habitat quality are also important and may mask climate change related impacts.					

Proforma reference	C4	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Inventory of long-term studies on terrestrial habitats					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
Long-term studies of key UK Biodiversity Action Plan habitats.					
Dates of Monitoring Programme					
START	Various but at least 6 years		END	Various, some continuing	
Environmental Compartment					
Air		Water	3	Land	3
Determinands Monitored					
The inventory contains long-term studies of freshwater, uplands, lowland grasslands, woodlands, coastal, lowland wetland and lowland heathland habitats. Determinands measured are specific to each study.					
Statement of Quality Assurance					
The inventory was restricted to well-documented, replicated experimental studies (historic or current) of at least six years' duration.					
Data Storage					
Varies with study but more recently electronic					
Location					
The inventory is being compiled by the Lowland Grassland Lead Co-ordination Network Officer of the Joint Nature Conservation Committee (JNCC).					
Contact:					
Vicky Morgan, Lowland Grassland Lead Co-ordination Network Officer, JNCC, c/o Terrestrial Wildlife Team, English Nature, Northminster House, Peterborough PE1 1UA.					
Tel 01733 455405					
vicky.morgan@english-nature.org.uk					
Potential for detecting climate change impacts					
Medium - This is a metadatabase containing references to individual data sets on plant and animal populations. Each data set would need to be assessed on its merits for potential to detect climate change impacts.					

Proforma reference	C5	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Monitoring fish movements and abundance in the River Frome					
Objective of Programme					
Σ Geographical scope					
England					
Σ Sampling Network					
River Frome, East Stoke, Dorset. Single continuous recorder/counter and videotape.					
Dates of Monitoring Programme					
START	1973	END	Ongoing		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Temperature, flow, number and size of fish and species (mainly atlantic salmon). Information is linked to Agency fisheries monitoring (see proforma A31).					
Statement of Quality Assurance					
Continuous checking against film					
Data Storage					
Information is stored on an electronic database.					
Location					
Further information at:					
http://dorset.ceh.ac.uk/our_science/General%20Sections/Fisheries/fisheries.htm					
Contact: Dr. William Beaumont, at CEH Dorset, Winfrith Technology Centre, Dorchester DT2 8DH.					
Potential for detecting climate change impacts					
Medium – this data set has been used to monitor long term changes in the salmon population of this river and changes in water temperature and flow regime due to climate change may affect this population. There are other confounding factors that affect salmon populations (both in river and during the adult life stages at sea) that could mask any impact from climate change.					

Proforma reference	C6	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
UK Inventory of Marine Monitoring Observations					
Objective of Programme					
Σ Geographical scope					
Whole of UK and parts of Ireland, other regions including polar.					
Σ Sampling Network					
Data from UK funded monitoring programmes and research projects including stations onshore, near-shore and off-shore.					
Dates of Monitoring Programme					
START	1893	END	2002 (ongoing)		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
The database includes details of monitoring programmes measuring physico-chemical determinands (including temperature), nutrients, benthic invertebrate communities and plankton.					
Statement of Quality Assurance					
Unknown but all research standards					
Data Storage					
The Inventory is searchable over the internet providing details of the data sets and where to access them. The data is not available from the Inventory directly.					
Location					
The Inventory can be accessed at: http://www.oceannet.org/catalogues/ukmmo/mop_frontpage.html					
The Inventory is maintained by: National Marine Co-ordinator, British Oceanographic data centre, Bidston Observatory, Birkenhead, Merseyside L43 7RA (ljr@ccms.ac.uk)					
Potential for detecting climate change impacts					
Medium - This is a metadatabase containing references to many individual data sets on plant and animal populations. Each data set would need to be assessed on its merits for potential to detect climate change impacts.					

Proforma reference	C7	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Global Population Dynamics database					
Objective of Programme					
Σ Geographical scope					
Archiving data from population studies of animals and plants from many biotopes from various regions of the world					
Σ Sampling Network					
Over 5000 individual data sets from population studies located by registration, then by taxon, location, biotope or data source.					
Dates of Monitoring Programme					
START	various	END	Various but may be continuing		
Environmental Compartment					
Air	3	Water	3	Land	3
Determinands Monitored					
Abundance and life history data for many species from terrestrial and aquatic habitats worldwide.					
Statement of Quality Assurance					
Mostly to research standards					
Data Storage					
Not fully known but mostly electronic.					
Location					
Accessible through http://www.sw.ic.ac.uk/cpb/cpb/gpdd.html					
Potential for detecting climate change impacts					
Medium – This is a metadatabase containing references to many individual data sets on plant and animal populations. Each data set would need to be assessed on its merits for potential to detect climate change impacts.					

Proforma reference	C8	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme Acid Waters Monitoring Network					
Objective of Programme Σ Geographical scope UK sites chosen for their susceptibility to acidification					
Σ Sampling Network 11 lake and 11 stream sites					
Dates of Monitoring Programme					
START	01/01/88	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored Water chemistry and ecological quality (fish, invertebrates, diatoms and macrophytes).					
Statement of Quality Assurance Internally defined supported by own proficiency testing programme					
Data Storage Data are stored on a dedicated database. Access to summary data is available over the internet.					
Location Information and summary data are available from www.ukawmn.ucl.ac.uk					
Potential for detecting climate change impacts Medium – Data on water temperature and flora and fauna species associations are available offering the potential to detect climate change impacts. Four of the sites are shared with the ECN (see proforma B2). However, the monitoring programme was designed specifically to detect the effects of acidification, which will confound attempts to detect a climate change signal.					

Proforma reference	C9	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Biological Records Centre (BRC)					
Objective of Programme					
Σ Geographical scope					
British Isles					
Σ Sampling Network					
Data are typically grouped by 10 km squares for reporting and mapping purposes					
Dates of Monitoring Programme					
START	01/01/60	END	In progress		
Environmental Compartment					
Air		Water		Land	3
Determinands Monitored					
Distribution, habitats, ecology, biodiversity, behaviour of hundreds of species of flora and fauna					
Statement of Quality Assurance					
Data QA by scheme Co-ordinators and BRC scientists					
Data Storage					
Data are stored on a dedicated database. Access to information on data sets (and to some data sets) is via the National Biodiversity Network (NBN) (see proforma B3).					
Location					
Further information on the BRC is available at www.brc.ac.uk					
Contact: Biological Records Centre CEH Monks Wood, Abbots Ripton, Huntingdon, Cambridgeshire, PE28 2LS. ENGLAND Fax - 01487 773467 Telephone - 01487 772406 E-mail mgt@ceh.ac.uk					
Potential for detecting climate change impacts					
High – the BRC contains data sets that have been used to detect the impacts of climate change where species occurrence and abundance have been correlated with variations in temperature.					

Proforma reference	C10	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Various Off-line biological datasets possibly not on EA registers of current data. Known examples only. All pre-1980 data.					
Objective of Programme					
Σ Geographical scope					
Various regions of the UK, 1) Lincolnshire, 2) Anglian, 3) Severn 4) CEGB 5) North-West, (Yorkshire)					
Σ Sampling Network					
Biological sampling sites on various rivers					
Dates of Monitoring Programme					
START	1960s/1970s	END	1980s continuing in modern form		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Invertebrate communities and species					
Statement of Quality Assurance					
Not known, variable but carried out by trained biologists					
Data Storage					
Mostly paper, some on MS Excel spreadsheets or written cards					
Location					
Various, some in old archives in EA offices or stores eg. 1. Langford archives, EA Spalding, 2) paper records from 1970s in EA local office, 3) Studies of Ironbridge power station (monthly 1965-1967 some to 1975). Identified to species plus emergence trap data for 1969-71, daily in summer). Occasional records from other power station sites. 4) data from invertebrate surveys in NW rivers. Not known if raw data still exist.					
Potential for detecting climate change impacts					
Medium - Most of the data are either not long enough or aimed at specific problems. However, as the records are historic, even sporadic data can be used to compare with the post 1988 data for the most part. Data from the Severn are probably most useful as pollution was less of a problem than other rivers and temperature data exist (see Langford, 1970, 1975, Langford and Daffern, 1975).					

Proforma reference	C11	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Woodiwiss/ Freshwater Biological Association (FBA)/Environment Agency databases, Langford archive and others (libraries, British Library etc) Water Quality data from River Board, and River Authority Reports					
Objective of Programme					
Σ Geographical scope Various regions of the EA					
Σ Sampling Network Originally several hundreds of sites, much of the data summarised as averages, maxima and minima					
Dates of Monitoring Programme					
START	1950s	END	1980s (continued by NRA and EA but not reported in detail publicly).		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored Most regular water quality determinands, e.g. Temperature, DO, BOD, NH ₃ , NO ₃ , NO ₂ , SS and others, various periods from weekly to monthly but only summarised in reports.					
Statement of Quality Assurance None					
Data Storage Mostly in Annual reports of Water Boards, River Boards, River Authorities, (ceased in 1980) Not fully known but may be in British Library, some in University libraries, some in Personal archives.					
Location Not fully known but some in personal possessions (Langford, FBA/Woodiwiss/Southampton University). Some may be in CEH archives, local University Libraries.					
Potential for detecting climate change impacts					
Medium - The summarised data are mainly of use for overall trends (e.g. shows annual average temperature decline in the River Trent as power stations closed from 1950s to 1980s and then on to 2001).					

Proforma reference	C12	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
British Trust for Ornithology (BTO) Bird Population data					
Objective of Programme					
Σ Geographical scope					
UK and Europe					
Σ Sampling Network					
Observations by professionals and volunteers in various regions					
Dates of Monitoring Programme					
START	Various	END	Various and continuing		
Environmental Compartment					
Air		Water		Land	3
Determinands Monitored					
The BTO organise a range of annual surveys of bird populations. The Common Birds Census (CBC), National Ringing Scheme and the Nest Record Scheme are responsible for monitoring population sizes and distribution, survival rates and the timing and success of breeding events respectively at a national scale. These data sets have been used to detect the impact of climate change on bird populations.					
Statement of Quality Assurance					
Trained professionals and volunteers undertake recording. Data are quality assured at the BTO.					
Data Storage					
Unknown but much may be electronic (not available on web).					
Location					
Dr Stephen R Baillie, British Trust for Ornithology, The Nunnery, Nunnery Place, Thetford, Norfolk IP24 2PU, UK. email: stephen.baillie@bto.org					
Potential for detecting climate change impacts					
High – data sets from the BTO have been used to detect climate change impacts. Crick <i>et al.</i> , (1997) demonstrated earlier nesting times in 51 of 65 species studied using data from the Nest Record Scheme. Data from the Nest Records Scheme and the CBC have been used to generate proposed indicators for the UK (Cannell <i>et al.</i> , 1999, 2003).					

Proforma reference	C13	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Nutrient changes in the Irish Sea: the dual importance of anthropogenic and climatic factors					
Objective of Programme					
Σ Geographical scope Irish Sea					
Σ Sampling Network Single site near Isle of Man					
Dates of Monitoring Programme					
START	1954 (some)	END	in progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Phosphate (since 1954), silica (since 1958), nitrate (since 1960), temperature may also be monitored					
Statement of Quality Assurance					
Research monitoring					
Data Storage					
Electronic					
Location					
Port Erin Laboratory of the Isle of man (Liverpool University) (via Richard Hartnoll: rgh@liv.ac.uk)					
Potential for detecting climate change impacts					
Medium – this long term nutrient data set has been analysed with respect to climatic factors though the details not unknown. The effects of eutrophication have the potential to confound and climate signal.					

Proforma reference	C14	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
EXploitation of Aphid Monitoring systems IN Europe (EXAMINE)					
Objective of Programme					
A resource for studies on the impacts of global change, as it has the potential to be analysed in relation to other long-term data sets such as those on climate, atmospheric composition, pollutants and land use.					
Σ Geographical scope					
Europe					
Σ Sampling Network					
The first trap began operating at Rothamsted, UK, in 1965. There are now 73 traps in 19 countries throughout Europe and Scandinavia					
Dates of Monitoring Programme					
START	1965	END	in progress		
Environmental Compartment					
Air		Water		Land	3
Determinands Monitored					
Insect species, abundance and records of insect activity. This data set is an extension of the Rothamsted Insect Survey (see proforma C23) to a European scale.					
Statement of Quality Assurance					
Collected by experienced qualified researchers at a major research laboratory and the same methods are used at European recording stations.					
Data Storage					
Some paper - some electronic					
Location					
Further information on EXAMINE can be found at: www.iacr.bbsrc.ac.uk/examine					
Potential for detecting climate change impacts					
High – data sets from this survey have been used to demonstrate potential climate change impacts. Population levels and dates of insect appearance and activity have been shown to be correlated with summer temperatures.					

Proforma reference	C15	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Studies of power stations on UK Rivers (see Langford, 1983, 1990)					
Objective of Programme					
Σ Geographical scope					
River Trent					
Σ Sampling Network					
Power stations (old and current) along the River Trent, including Drakelow, High Marnham and West Burton. Inlet sampling data only; effluent data are also available for some sites and some data are stored on the public register.					
Dates of Monitoring Programme					
START	Various from 1960s to present, some from 1970s		END	Various, some continuing	
Environmental Compartment					
Air		Water	3	Land	
Determinands					
Monitored (vary with site) inlet and outlet temperature, suspended solids, conductivity, ammonia, nitrates, phosphates, sodium					
Statement of Quality Assurance					
None, but as data were used for measuring performance and operational needs, accuracy is important					
Data Storage					
Some on paper, some on electronic storage. (contact, tel2@soton.ac.uk or terry.langford@btinternet.com)					
Location					
Data for Drakelow, High Marnham and West Burton are in T.E.Langford and Pisces Conservation Ltd. archives. Current data are retained at power stations. All are the property of the appropriate power companies; these are currently Powergen (High Marnham and Drakelow), and London Power Company (West Burton). (Not available on web)					
Potential for detecting climate change impacts					
Medium - inlet temperatures at power stations may provide a good indication of background temperatures in the lower reaches of rivers. Some effort would be required to compile data and issues surrounding data availability are unclear.					

Proforma reference	C16	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Studies of the effects of power station water use on rivers (see Langford 1983, 1990)					
Objective of Programme					
Σ Geographical scope					
River Severn, Ironbridge Gorge reach					
Σ Sampling Network					
Hourly to weekly sampling at the Ironbridge power station intake					
Dates of Monitoring Programme					
START	Some 1965, later 1975	END		1997 for some	determinands, some current
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Weekly intervals for varying periods:- mainly river level, temperature, suspended solids, BOD or OA, Ammonia, nitrate, pH, TH, CaH, SO ₄ , Cl, SiO ₂ , Na, Fe, Ca, Mn, PO ₄ , TDS					
Air and water temperature and river stage for 1965-1970 are hourly, 24 hours per day, data in degrees Fahrenheit and feet					
Statement of Quality Assurance					
None though all information is important for performance and operational purposes					
Data Storage					
Paper and mostly electronic, 5 years of hourly data are in electronic form					
Location					
T.E. Langford and Pisces Conservation Ltd. archives (not available on web). Contact: T. E. Langford E-mail: tel2@soton.ac.uk)					
Potential for detecting climate change impacts					
Medium - Large river temperatures change slowly and thus data may reflect real annual changes over the long-term (see Langford, 1970). No power station upstream of Ironbridge therefore temperatures may be regarded as natural. (Historic biological and chemical data are in old records also in the Langford archive).					

Proforma reference	C17	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Operational monitoring of inlet temperatures and make-up water chemistry at power stations (continuous and various)					
Objective of Programme					
Σ Geographical scope					
Power stations on various rivers not previously noted and not investigated in detail as yet, e.g. Thames (Didcot), Trent (Rugeley, Ratcliffe, Cottam), Yorkshire Ouse (Ferrybridge, Drax,) and others					
Σ Sampling Network					
At power station intakes mostly in lower reaches of rivers.					
Dates of Monitoring Programme					
START	1970s	END	continuous		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
At least temperature, suspended solids, ammonia (may vary with site)					
Statement of Quality Assurance					
Unknown					
Data Storage					
Earlier data on paper, current data may be stored electronically. At some sites data are not kept for more than a few years					
Location					
Usually stored on power station site but may now be kept centrally by individual companies (Not available on web)					
Potential for detecting climate change impacts					
Medium – inlet temperatures at power stations may provide a good indication of background temperatures in the lower reaches of rivers. Some effort would be required to compile data and issues surrounding data availability are unclear.					

Proforma reference	C18	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Changing temperature of river systems – a long-term perspective (this programme compares rivers with an English reservoir)					
Objective of Programme					
Σ Geographical scope 10 Austrian Rivers, Wimbleball Lake, S.W. England					
Σ Sampling Network Sites on headwaters, lake outflows and mainstream of the rivers and on the outflow of the English lake					
Dates of Monitoring Programme					
START	Rivers 1901-2000 Lake 1976- present	END	Ongoing		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored Temperature, flow (Exeter University may also have other data sets for other rivers)					
Statement of Quality Assurance None, research standards					
Data Storage Not fully known, probably mostly electronic.					
Location Contact: Professor Bruce Webb, School of Geography and Archaeology, University of Exeter, Amory Building, Rennes Drive, Exeter, EX4 4RJ.					
Potential for detecting climate change impacts					
Medium – the long term data set on Wimbleball Lake may have the potential to detect a climate change impacts providing sufficient information on other pressures affecting water temperature are known.					

Proforma reference	C19	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Relationships between plants and climate calibrated using botanical and meteorological databases at the scale of France: Perspectives for the estimation of plants distribution in the context of Global Climate Change					
Objective of Programme					
Σ Geographical scope France					
Σ Sampling Network 574 sites, 3 million observations on 2861 taxa					
Dates of Monitoring Programme					
START	unknown	END	50 years		
Environmental Compartment					
Air		Water		Land	3
Determinands Monitored					
Occurrence of species, temperature, precipitation, number of rainy days					
Statement of Quality Assurance					
Unknown, research programme					
Data Storage					
Not known but probably electronic					
Location					
Contact: Emmanuel Garbolino ¹² Ecole des Mines de Paris, pôle Cindyniques, BP 207, F-06904 Sophia-Antipolis.					
Potential for detecting climate change impacts					
Medium – the data set used for this study has been analysed with respect to climate change impacts and may provide an indication of changes likely to occur in the UK in the future.					

¹² Correspondent author

Proforma reference	C20	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Mapping the seaweeds of Britain and Ireland					
Objective of Programme					
Σ Geographical scope					
Recording seaweed occurrence UK and Ireland					
Σ Sampling Network					
Most coastal areas (250,000 records)					
Dates of Monitoring Programme					
START	Various at least 50 years (some over 200 years)		END	continuous	
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Species occurrence (some abundance)					
Statement of Quality Assurance					
None but all data sets were checked					
Data Storage					
At present in map form but data over time in electronic form (629 maps to date)					
Location					
Dr F.G. Hardy (University of Newcastle upon Tyne).					
Potential for detecting climate change impacts					
Medium – this long term data set has the potential to show climate change impacts arising from changes in the coastal water temperature regime and change in sea level. Confounding factors such as eutrophication could mask these impacts in some areas.					

Proforma reference	C21	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Use of long-term biological data sets for predicting ecological status in rivers					
Objective of Programme					
Σ Geographical scope					
River Trent catchment					
Σ Sampling Network					
Estimated 250 + sites on rivers, drains, canals and standing waters; 21,900 samples					
Dates of Monitoring Programme					
START	1952/56	END	1986 this set plus continuous to present		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Invertebrate communities mostly identified at least to BMWP family level (though before BMWP score began)					
Statement of Quality Assurance					
None as QA was not instituted (all work by qualified, trained and supervised biologists)					
Data Storage					
Paper records, electronic storage of site data completed to 1986, later data for same sites are on Agency databases					
Location					
Originally a Trent River Board/WRA/NRA data set discarded in 1988 but copies retained at the archive at Southampton University part supervised by Freshwater Biological Association (FBA) (not available on web).					
Contact: T. E. Langford E-mail: tel2@soton.ac.uk					
Potential for detecting climate change impacts					
Low – this long term data set could be extended to the present day by including information held by the Agency. Invertebrate taxa have been identified to family level and this reduces the usefulness of the data set for detecting climate change impacts because shifts in species composition will occur before they are detected at family level. Changes in water quality over the last 40 years will also be a significant confounding factor affecting this data set.					

Proforma reference	C22	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
UK Environmental Data Inventory (UKEDI)					
Objective of Programme					
Σ Geographical scope					
Mostly UK but some other regions, some 553 data sets recorded as long-term data.					
Σ Sampling Network					
UK various regions and locations plus some other countries and regions.					
Dates of Monitoring Programme					
START	various	END	Various and continuing		
Environmental Compartment					
Air	3	Water	3	Land	3
Determinands Monitored					
Many physical, chemical and biological single species and communities on a wide range of habitats.					
Statement of Quality Assurance					
Various - depends on data set but mostly to research standards					
Data Storage					
Various but mostly electronic					
Location					
All via the Environmental Information Centre, which is the CEH designated data centre.					
Available to registered account users via:- http://gane.ceh.ac.uk/UKEDIapp/default.jsp					
Potential for detecting climate change impacts					
Medium – this is a meta-database of data sets held by NERC laboratories. Each data set would need to be assessed on its merits for potential to detect climate change impacts.					

Proforma reference	C23	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
The Rothamsted Insect Survey					
Objective of Programme					
Σ Geographical scope					
Rothamsted 1933 – 1965 Expanded to several other sites 1965 - onwards					
Σ Sampling Network					
Light traps and suction traps at Rothamsted – varying over the period					
Dates of Monitoring Programme					
START	1933	END	Current and continuing		
Environmental Compartment					
Air		Water		Land	3
Determinands monitored					
Light and suction trap data on many insect groups. Very large datasets – for example 150 species of bugs have been recorded in the traps from 1933 to present. Many moth species also monitored (may be well over 1000 species in all)					
Statement of Quality Assurance					
Collected by experienced qualified researchers at a major research laboratory					
Data Storage					
Some paper - some electronic					
Location					
Further information is available at: www.rothamsted.bbsrc.ac.uk/insect-survey					
Insect Survey data available from:					
Dr Richard Harrington E-mail:richard.harrington@bbsrc.ac.uk					
Contact: Dr Elspeth Bartlet, Rothamsted Research, Harpenden, Hertfordshire, AL5 2JQ 01582 763133 (x 2260) email: elspeth.bartlet@bbsrc.ac.uk					
Potential for detecting climate change impacts					
High – data sets from this survey have been used to demonstrate potential climate change impacts. Population levels and dates of insect appearance and activity have been shown to be correlated with summer temperatures. Indicators based on this survey have been proposed for the UK (Cannell <i>et al.</i> , 1999, 2003) and for Wales (Buse <i>et al.</i> , 2001).					

Proforma reference	C24	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Plants of the Lancaster Canal since 1800					
Objective of Programme					
Σ Geographical scope					
Isolated reach of the Lancaster canal (built in 1797).					
Σ Sampling Network					
Short reach of the Lancaster canal					
Dates of Monitoring Programme					
START	1800	END	Present or recent years		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Occurrence of major plant species					
Statement of Quality Assurance					
Unknown					
Data Storage					
Unknown (likely to be in written format originally and more recently in electronic format)					
Location					
This data set is held by an individual (C/o F.L. Greenwood FLS).					
Contact: T. E. Langford E-mail: terry.langford@btinternet.com					
Potential for detecting climate change impacts					
Medium – this very long term data set could be used to detect climate change impacts providing sufficient information on confounding factors (i.e. changes in water quality, weed cutting practices) are known and a suitable temperature record could be located for correlation.					

Proforma reference	C25	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme Butterfly Monitoring Scheme (BMS)					
Objective of Programme Σ Geographical scope UK					
Σ Sampling Network Records are collected from up to 130 sites (including 12 sites from the ECN (proforma B2)) distributed through various habitats in the UK. Sampling is undertaken weekly throughout the summer (April to September) under standard weather conditions.					
Dates of Monitoring Programme					
START	01/01/76	END	In progress		
Environmental Compartment					
Air		Water		Land	3
Determinands Monitored Data on butterfly species, abundance, associated habitats and weather conditions are recorded.					
Statement of Quality Assurance Quality assurance of sampling (recording) and data received is undertaken. Conservation professionals and volunteers undertake recording.					
Data Storage Data are stored on a dedicated database at the Biological Records Centre at CEH Monks Wood. Data sets are available free of charge under license to users.					
Location Further information is available at: www.bms.ceh.ac.uk					
Contact: Mr J N Greaiores-Davies E-mail: ngd@ceh.ac.uk					
Potential for detecting climate change impacts High – this data set has the potential to detect a climate change impact because butterfly activity is very dependent on the air temperature regime. The influence of potential confounding factors is controlled to some extent in this data set because of the site specific information collected as part of the survey.					

Proforma reference	C26	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Constant Effort Sites Scheme (CES)					
Objective of Programme					
Σ Geographical scope Britain and Ireland					
Σ Sampling Network Over 130 sites (varies slightly year on year)					
Dates of Monitoring Programme					
START	01/01/83	END	In progress		
Environmental Compartment					
Air		Water		Land	3
Determinands Monitored					
For 28 species of common songbird: Abundance, Number of births (breeding success/productivity), Number of deaths. Habitat information (about once every three years)					
Statement of Quality Assurance					
Only sites with more than or equal to eight paired visits used for between year comparison					
Data Storage					
Hard Disk, pc diskette and hard copy					
Location					
Further information on the scheme available at: www.bto.org/ringing/ringinfo/ces/ Contact: British Trust for Ornithology BTO, The Nunnery, Thetford, Norfolk IP24 2PU dawn.balmer@bto.org.uk					
Potential for detecting climate change impacts					
Medium – this data set complements other surveys undertaken by BTO and provides comparable data on a range of bird species. There are confounding factors such as changes in agricultural practice and conservation interventions that would mask impacts of climate change. However, some of the species monitored appear to respond to dry summers.					

Proforma reference	C27	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
National Inventory of Woodland and Trees					
Objective of Programme					
Σ Geographical scope					
UK					
Σ Sampling Network					
Main Woodland Survey: woodlands of over 2 hectares in size; and Survey of Small Woodland and Trees covering small woods, groups of trees, linear features and individual trees					
Dates of Monitoring Programme					
START	1980	END	In progress		
Environmental Compartment					
Air		Water		Land	3
Determinands Monitored					
Predominantly woodland coverage mapped onto a polygon data set at 2 hectare level. Nine types of trees identified.					
Statement of Quality Assurance					
Defined internally by the Forestry Commission.					
Data Storage					
In printed form, held in Forestry Commission library.					
Location					
Further details from: Steve Smith, Head of Woodland Surveys, Forest Research, 231 Corstorphine Road, Edinburgh EH12 7AT Telephone: 0131 445 6991 Email: woodland.surveys@forestry.gsi.gov.uk or steve.smith@forestry.gsi.gov.uk					
Potential for detecting climate change impacts					
Low – While the Forestry Commission has been undertaking woodland surveys since 1919, the woodland inventory data is only compared to baseline census data in 1980. Figures on woodland cover can be produced from historical records dating back centuries. However, the confounding factors of woodland usage and replanting programmes will mask any changes due to climate change. This data set was referred to in the environmental change indicators for flood management (Environment Agency, 2003a) in relation to the risk of floods taking wood debris from woodlands and causing bridge blockages.					

Proforma reference	C28	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Incidence of Lyme Disease in Humans					
Objective of Programme					
Σ Geographical scope UK					
Σ Sampling Network N/A					
Dates of Monitoring Programme					
START	1986	END	In progress		
Environmental Compartment					
Air		Water		Land	3
Determinands Monitored					
Number of cases of Lyme disease reported in the UK each year. Voluntary reporting of serologically confirmed cases to Communicable Diseases Surveillance Unit (CDSC) by microbiology laboratories.					
Statement of Quality Assurance					
Enhanced surveillance scheme introduced in 1996 with the Public Health Laboratory Service (PHLS) Performance Laboratory also reporting to the CDSC.					
Data Storage					
Data are stored electronically by the CDSC and published via the internet.					
Location					
Data published in the Communicable Disease and Public Health quarterly Journal, available at: http://www.phls.co.uk/publications/cdph/index.html					
Communicable Disease Surveillance Centre, 61 Colindale Avenue, London NW9 5EQ Website: http://www.phls.co.uk					
Potential for detecting climate change impacts					
Medium – the cases of lyme disease diagnosed and reported has doubled since records began in 1985 and correlates with average summer temperature (Cannell <i>et al.</i> , 1999, 2003). Ticks spread lyme disease. Tick populations could benefit from a milder climate and increased recreation in warmer summers could bring humans into contact with ticks more often. This data set is not yet multi-decadel and issues surrounding increased reporting as a result of raised awareness of the climate change link could confound this measure. A climate change impact indicator for the UK has been proposed using these data (Cannell <i>et al.</i> , 1999, 2003).					

Proforma reference	C29	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Park Grass Experiment					
Objective of Programme					
Σ Geographical scope					
England					
Σ Sampling Network					
Observations made at Rothamsted, Hertfordshire.					
Dates of Monitoring Programme					
START	1856	END	In progress		
Environmental Compartment					
Air		Water		Land	3
Determinands Monitored					
Summer hay yields at Rothamsted, Hertfordshire					
Statement of Quality Assurance					
Recorded with standard measurement methods since 1965.					
Data Storage					
Stored centrally on computer within the Rothamsted archive and available once registered.					
Location					
Contact:					
Institute of Arable Crops Research Rothamsted, Harpenden, Herts. AL5 2JQ					
Data available from web once registered with the Electronic Rothamsted Archive, by contacting: Kevin.Crowley@bbsrc.ac.uk					
Potential for detecting climate change impacts					
High – Summer hay yields at Rothamsted have shown a good correlation with temperature with low yields corresponding to hot dry summers. A climate change impact indicator for the UK has been proposed using these data (Cannell <i>et al.</i> , 1999, 2003).					

Proforma reference	C30	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Arrival date of the swallow					
Objective of Programme					
Σ Geographical scope					
UK and Ireland					
Σ Sampling Network					
Daily records of 20 species of migrating bird are kept at 17 coastal observatories in the UK and Ireland.					
Dates of Monitoring Programme					
START	1959 (swallow)	END	In progress		
Environmental Compartment					
Air		Water		Land	3
Determinands Monitored					
Bird observatories record arrival dates of 20 species of migrating bird. The arrival date of swallow is a proposed climate change impact indicator for the UK and the specific indicator is the average date when swallow is first observed at four locations (Dungeness, Portland, Bardsey and Calf of Man).					
Statement of Quality Assurance					
Individual Bird Observatories are accredited by the British Trust for Ornithology (BTO).					
Data Storage					
Individual observatories are obliged to keep records of their observations and copies are held by the BTO. Observatories accredited after 1 st January 2001 are obliged to keep their records in electronic form. Requests for data are to be made to the BTO and data is available subject to terms and conditions.					
Location					
Contact: British Trust for Ornithology BTO, The Nunnery, Thetford, Norfolk IP24 2PU Tel: +44 (0)1842 750050 Fax: +44 (0)1842 750030 Email: info@bto.org					
Potential for detecting climate change impacts					
High – average arrival date of the swallow has shown a relationship with temperature such that warm springs correspond to earlier swallow arrivals. A climate change impact indicator for the UK has been proposed using these data (Cannell <i>et al.</i> , 1999, 2003).					

Proforma reference	C31	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
UK Phenology Network					
Objective of Programme					
Σ Geographical scope					
UK					
Σ Sampling Network					
Currently a volunteer network of over 19,000 recorders (April 2003)					
Dates of Monitoring Programme					
START	various, from 1947(oak budburst)		END	In progress	
Environmental Compartment					
Air		Water	3	Land	3
Determinands Monitored					
<p>The UK Phenology Network is actively recording observation and obtaining historical records on a wide range of phenological responses of flora and fauna. These include:</p> <p>Date of leafing of pedunculate oak trees in Spring: 1947 onwards at site in Surrey. Data also available for first leaf/flower and/or budburst for ash, horse chestnut, lime, blackthorn, hazel, elder, european larch, silver birch, sycamore, beech, rowan, field maple, sessile oak, downy birch,</p> <p>Butterfly Monitoring Scheme: 1976 onwards – abundance monitoring along fixed route, recording weekly, April-September, extended over time to 120 sites. Includes orange tip, ringlet and brimstone species.</p> <p>Flowering of garden species: 1965 onwards. Woodland ground vegetation species, including winter aconite, dog rose, garlic mustard, lesser celandine, primrose, bluebell, cuckooflower, purple lilac, snowdrop, oxeye daisy</p> <p>Frog spawning: 1978 onwards at site in Grange-over-Sands, Cumbria. More recently data also available for returning newts and tadpoles (frog).</p>					
Statement of Quality Assurance					
Recorded observations are generated by volunteers.					
Data Storage					
Recorded observations are stored on a dedicated database with results displayed interactively on a website. Data availability is not known.					

Location

Information on the UK Phenology Network is available at:

www.phenology.org.uk

Contact:

Amanda Sharp
Phenology Project Administrator
Conservation Policy Advisor
The Woodland Trust
Autumn Park
Dysart Road
Grantham
Lincs
NG31 6LL

Telephone: 01476 581111

Email: phenology@woodland-trust.org.uk

Potential for detecting climate change impacts

High – phenological responses of flora and fauna have shown good relationships with temperature changes over long time periods. There are confounding factors that may contribute to changes in light availability and temperature and these should be accounted for when undertaking correlation. Indicators based on phenological responses have been proposed for the UK (Cannell *et al.*, 1999, 2003) and for Wales (Buse *et al.*, 2001).

Proforma reference	C32	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Temperature and precipitation records for the UK					
Objective of Programme					
Σ Geographical scope					
UK and global (specified according to determinands)					
Σ Sampling Network					
Temperature and precipitation records are generated at a network of thousands of sites including many individual gauges read by volunteers and others by Agency staff.					
Dates of Monitoring Programme					
START	1659 (various)	END	In progress		
Environmental Compartment					
Air	3	Water		Land	
Determinands Monitored					
<p>The Hadley Centre compiles numerous data sets from individual observations of temperature, precipitation and other weather-related variables. These include those used as indicators of climate state such as Central England Temperature and England and Wales precipitation.</p> <p>Central England temperature (CET) monitoring (triangular area enclosing Bristol, Manchester and London) annual and monthly mean temperature from 1659; mean minimum temperature from 1878; and daily mean temperature from 1772</p> <p>Daily precipitation (England and Wales) based on daily weighted totals from networks within the 5 EA regions. Annual and monthly precipitation (England and Wales) from 1766 (from 1996 data have been derived from weighted averages of daily automated values from a network of stations in the five EA regions.</p> <p>Scotland series for rainfall (monthly), mean temperature and hours of sunshine all began in 1961.</p> <p>The Met. Office also provides other data sets on a commercial basis such as MORECS.</p> <p>MORECS (The Met. Office Rainfall and Evaporation Calculation System for Great Britain) is a system for calculating evaporation from the standard weather elements of temperature, sunshine, wind and humidity. The equation needs information about soil structures and the way different crops extract moisture from the soil and then transpire. This enables different crops on three different soil types to be analysed individually, so that most growing scenarios can be catered for. It gives consistent nationwide assessment of the general soil moisture status over an area. MORECS output data available for grass for over 30 years.</p>					

Statement of Quality Assurance

Defined internally

Data Storage

Stored electronically at the Met. Office on dedicated databases. The data are available either freely over the internet or on a commercial basis depending on the data set.

Location

Hadley Centre data sets are available from:

<http://www.metoffice.com/research/hadleycentre/obsdata/CET.html>

Information on MORECS data is available from:

<http://www.metoffice.com/water/morecs.html>

Contact:

Lisa Alexander

Lisa.alexander@metoffice.com

The Meteorological Office,
Room 124b, London Road, Bracknell,
Berks. RG12 2SZ

Potential for detecting climate change impacts

Low – strictly speaking the Central England temperature and England and Wales precipitation data sets are climate state variables and cannot therefore be used to detect climate change impacts.

Proforma reference	C33	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
UK Fire Statistics					
Objective of Programme					
Σ Geographical scope					
UK					
Σ Sampling Network					
Information gathered by Fire Authorities in the UK					
Dates of Monitoring Programme					
START	1991	END	In progress		
Environmental Compartment					
Air		Water		Land	3
Determinands Monitored					
Number of outdoor fires, published annually from 1991 and quarterly from 2002.					
Statement of Quality Assurance					
Based on returns provided by local authority Fire Brigades in the United Kingdom. Figures from 1994 exclude secondary fires and are based on sample data weighted to the Fire Brigade totals.					
Data Storage					
Data are stored electronically and made available to the public by the Office of the Deputy Prime Minister					
Location					
Accessible from the Web at:					
http://www.safety.odpm.gov.uk/fire/rds/					
Potential for detecting climate change impacts					
Medium – prolonged periods of good weather in summer increase the risk factors for outdoor fires (i.e. dry vegetation and increased use of outdoor spaces for leisure). The existing data set is not multi-decadel but the monitoring is ongoing. An indicator based on this information has been proposed by use in Wales (Buse <i>et al.</i> , 2001).					

Proforma reference	C34	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
UK National Air Quality Information Archive					
Objective of Programme					
Σ Geographical scope					
UK					
Σ Sampling Network					
Various networks. Over 1500 sampling sites from automatic and non-automatic networks					
Dates of Monitoring Programme					
START	1972	END	Ongoing		
Environmental Compartment					
Air	3	Water		Land	
Determinands Monitored					
Hourly automatic monitoring for CO, NO, NO ₂ , NOX, O ₃ , PM10, SO ₂ , Benzene with data transfer by telemetry. Lead and selected trace elements on weekly basis NO ₂ provided on a monthly mean, measured over 1100 urban sites (kerbside and urban background) using diffusion tubes. 165 sites measuring black smoke and SO ₂ daily Dioxins and PAHs collected over two weeks, bulked together and then chemically analysed every 3 months for PAH's and every 6 months for dioxins.					
Statement of Quality Assurance					
Not known					
Data Storage					
Data collated and stored on a dedicated database. Data are held by AEA Technology on behalf of DEFRA.					
Location					
Simple trends available from the web site at: http://www.airquality.co.uk/archive/data_and_statistics.php Contact: aqinfo@aeat.co.uk					
Potential for detecting climate change impacts					
Medium – aspects of air quality are influenced by the atmospheric temperature regime but there are many confounding factors that affect local air quality in both urban and rural areas that would need to be accounted for before detecting a climate change impact signal.					

Proforma reference	C35	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Appearance of ice on lake Windermere					
Objective of Programme					
Σ Geographical scope					
Lake District, England.					
Σ Sampling Network					
Observations are made on Lake Windermere					
Dates of Monitoring Programme					
START	1936	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Number of days in the year when ice is present on Lake Windermere (in a sheltered bay on the west side of the lake).					
Statement of Quality Assurance					
Defined internally					
Data Storage					
Not known					
Location					
Contact: Institute of Freshwater Ecology, The Ferry House, Far Sawrey, Ambleside, Cumbria, LA22 0LP					
http://www.ife.ac.uk/					
Potential for detecting climate change impacts					
High – the number of ice days has shown a correlation with winter temperature. A climate change impact indicator for the UK has been proposed using these data (Cannell <i>et al.</i> , 1999, 2003).					

Proforma reference	C36	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
SAHFOS Continuous Plankton Recorder Survey					
Objective of Programme					
Σ Geographical scope					
North East Atlantic and North Sea					
Σ Sampling Network					
Continuous Plankton Recorders (CPRs) are deployed from commercial vessels travelling on routes across the North East Atlantic and North Sea.					
Dates of Monitoring Programme					
START	1931	END	In progress		
Environmental Compartment					
Air		Water	3	Land	
Determinands Monitored					
Abundance of phytoplankton and zooplankton species with data available for geographical distribution, seasonal cycles and year-to-year changes.					
Database contains results from 181,262 sampled routes with 2,135,072 taxonomic abundance entries.					
Statement of Quality Assurance					
Defined internally as rigorous quality control methods.					
Data Storage					
Data available in paper form from 1931 and from January 1946 onwards in a computerised relational database. Data is available free to users under license.					
Location					
Sir Alister Hardy Foundation for Ocean Science, The Laboratory, Citadel Hill, Plymouth, PL1 2PB					
Contact: sahfos@mail.pml.ac.uk					
Further information: www.sahfos.org					
Potential for detecting climate change impacts					
High – data generated from the CPR survey has been used to indicate changes in the North Sea and North East Atlantic surface plankton community in response to climate change (Beaugrand and Reid, 2002). A climate change impact indicator for the UK has been proposed using these data (Cannell <i>et al.</i> , 1999, 2003).					

Proforma reference	C37	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Institute of Grassland and Environmental Research (IGER) – clover flowering and rye grass ear emergence					
Objective of Programme					
Σ Geographical scope					
Aberystwyth					
Σ Sampling Network					
Long term observations at IGER's facility at Aberystwyth					
Dates of Monitoring Programme					
START	1930s	END	In progress		
Environmental Compartment					
Air		Water		Land	3
Determinands Monitored					
Date of first flowering of clover varieties (predominantly red and white).					
Date of first ear emergence of one variety (S24) of perennial rye grass.					
Statement of Quality Assurance					
Scientific research standards					
Data Storage					
Data are stored electronically but data availability is unknown					
Location					
Contact: Dr Michael Abberton, Team Leader: michael.abberton@bbsrc.ac.uk					
Further information: http://www.iger.bbsrc.ac.uk/igerweb/					
Potential for detecting climate change impacts					
High – these long term data sets appear to show earlier flowering and ear emergence dates in recent years and have been proposed as indicators of climate change impact on agriculture in Wales (Buse <i>et al</i> , 2001).					

Proforma reference	C38	DPSIR descriptor:	Impact		
Agency Internal		Agency Supported External		External	3
Title of Programme					
Office of National Statistics - Annual review of the Registrar General on deaths in England and Wales					
Objective of Programme					
Σ Geographical scope					
England and Wales					
Σ Sampling Network					
Reported incidence and circumstances of human deaths from all Health Authority areas in England and Wales					
Dates of Monitoring Programme					
START	1841	END	In progress		
Environmental Compartment					
Air	3	Water		Land	
Determinands Monitored					
Human mortality annual figures, including monthly values.					
Statement of Quality Assurance					
Unknown					
Data Storage					
Data is stored electronically and is available in spreadsheet format via the internet.					
Location					
More recent years available from web at: http://www.statistics.gov.uk/statbase/Product.asp?vlnk=620					
Contact:					
The Library Office for National Statistics 1 Drummond Gate London SW1V 2QQ					
Telephone: 01 845 601 3034					
Potential for detecting climate change impacts					
High – data on the number and causes of human deaths has been used in conjunction with data on seasonal temperature to indicate the impact of temperature extremes (cold and hot) on the human population. Measures derived from these data have been proposed as indicators of climate change impact for the UK (Cannell <i>et al.</i> , 1999, 2003) and for Wales (Buse <i>et al.</i> , 2001).					