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Final Report

Freshwater availability and use in the United Kingdom

A review of freshwater availability and non-household (consumptive) use in the UK

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Written by: Mark Kowalski, Carmen Waylen, Sarah Clist, Sarah Wilcox, Stephen Lynn, David Garrow.

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Legacy research commissioned by the previous government.

Executive summary

1. This work was commissioned to provide WRAP (Waste and Resources Action Programme) and other stakeholders with an overview of the freshwater conservation agenda in the United Kingdom (UK). A significant element of this is an understanding of where, when and how freshwater is used across industry and commerce – this includes where water is removed from the environment and how this water is returned to the environment.

2. Although there are already a number of data sources on commercial and industrial water use in the UK, including that gathered by the Environment Agency (EA), Scottish Environment Protection Agency (SEPA), Department for Environment, Food and Rural Affairs (Defra) and water utilities, none provides the complete picture. This study draws together available evidence relating to non-household water use.

3. The study identifies those industrial and commercial sectors and regions of the UK where water use is high, where there is scope for significant reductions in water use and where environmental pressures on water use are greatest. The specific objectives of the study undertaken were to:

- Identify and collate data on industrial and commercial water use in the UK, broken down by SIC sector, to include abstraction, mains water use and water put back into the system through rivers, mains, drains etc.
- Calculate how much water is used by each commercial and industrial sector, to gain an understanding of how much each sector can contribute to reducing water use.
- Identify where there are gaps in knowledge on industrial and commercial water use, and make recommendations on how they may be filled.
- Present available water consumption data by UK region and nation and relate these findings to existing information on current and predicted freshwater scarcity.
- Identify where there are gaps in knowledge on freshwater scarcity and make recommendations on how they may be filled.
- Give a clear understanding, based on the analysis undertaken, of where activities should be focussed to reduce industrial and commercial water use.

4. A literature review on the subject of water scarcity across the UK was conducted to allow conclusions to be drawn on the basis of areas where pressure on water resources is highest. Irrespective of the indicator used to describe water stress, research indicates that action should focus initially on the Thames, Southern and Anglian EA regions. All types of observations through CAMS (Catchment Abstraction Management Strategies), WEI (Water Exploitation Index) and other water stress indicators show that much of south-east England and East Anglia is currently, and will continue to be the most water-stressed area of the UK, although there are a number of very localised areas elsewhere which are already over-abstracted. These have been identified as short term priority locations.

5. This study sought to complete a water mass balance for each region and sector in order that non-household sectors that are major consumers of water could be identified. A water use mass balance requires the information listed in Table 1. Sources of data which were available for analysis for this project at an industrial sector level, and the activities they cover are shown in bold type. It was not possible to get this level of data breakdown for all nations and/or regions of the UK.

Table 1 Water mass balance

Pre-consumer data by sector	*Post-consumer data by sector*
Direct abstraction (surface water, non-tidal)	Sewage discharges to sewers
Direct abstraction (groundwater)	**Trade effluent discharges to sewers**
Mains water supplied	Trade effluent discharges to water bodies

6. Sectoral data regarding direct abstraction were sought from the UK environmental regulators (EA, SEPA and the Northern Ireland Environment Agency, NIEA) but obtained only from the EA (for England and Wales) in the form of an extract from the National Abstraction Licensing Database (NALD). Data on the supply of mains water to non-household consumers were obtained from water utility datasets for the whole of the UK.

7. Despite limitations on the post-consumer data available, all available electronic data on trade effluent discharges to sewers were collated. Not all sewerage companies were able to provide information on the volume of water they discharge into sewers and the environmental regulators do not hold data on the volume of water that industry discharges directly into watercourses.

8. A number of gaps in the available data have been identified, and recommendations for filling these gaps suggested (**Table 2**). It is not thought that the conclusions of this study would alter with further data availability, although the confidence in numerical results would increase and further refinement of the recommendations would be possible.

Table 2 Data gaps and recommendations for filling them

Topic	Missing information	Recommendation for filling gap
Water scarcity	Indicator that considers both current and future water demands, and the needs of the environment	Currently a combination of indicators have been assessed to determine the high priority locations. This should ensure that no factors have been overlooked and that all priority locations have been identified.
Water use	Direct abstraction information (actual volumetric data) for Scotland and Northern Ireland.	Separate data improvement programmes are underway in each region, and actual volumetric data should be readily available from data sources maintained by SEPA and NIEA from 2012.
	Blank return entries in available NALD data.	Not thought to be a major issue. The EA have a standard methodology for estimating returns from these licences and a similar process has been followed for the purpose of this study.
	Mains water use data for Bournemouth and West Hampshire Water, Dee Valley Water and Cambridge Water.	Further liaison with these companies would be required to ascertain whether any information that is relevant could be used to determine water use by non-household sectors.
	Variation in the level of detail of sector information within water utility data that is used to populate the Water Resource Management Plans.	Further engagement with specific sectors would help to validate figures generated in this project and may yield additional information, such as within-sector benchmarking data from previous studies, which would assist understanding of that sector's water use.
Water discharges	Water discharged to sewers from a number of sewerage companies.	It may be appropriate to consider water-using processes for the highest priority sectors and work with sector bodies and/or trade associations to estimate the proportion of water used which is discharged to sewer and/or water courses. Large organisations may already hold sufficient information to estimate this proportion and could be contacted directly.
	Any data relating to water discharged to water courses.	

9. Water use data has been compiled separately from two major data sources:

- mains water use (public water supply), from a series of water company datasets; and
- direct abstractions from freshwater sources (excluding that abstracted for public water supply), from environmental regulatory datasets.

10. The latest year for which all major data sources were available and could be compared is 2006. Each dataset used has a slightly different classification of sectoral water use. In order to produce a coherent set of sectoral water use statistics, all dataset classification systems were aligned to the 2007 version of the Standard Industrial Classification (SIC2007). SIC2007 is a hierarchical classification system with a number of 'sections'. Each section contains a number of 'divisions', giving more detail on the type of commercial enterprise summarised by the section to which it belongs.

11. For England and Wales, data on water used from direct abstractions was sourced from the Environment Agency's National Abstraction Licensing Database (NALD). No comprehensive datasets on actual directly abstracted volumes were available for Northern Ireland or Scotland at the time of writing.

12. The initial pre-analysis steps applied to raw NALD data are detailed in Appendix B and summarised here:

- NALD secondary description categories matched to SIC2007 sections.
- For those NALD categories which remained ambiguous, the licensee name from NALD was used to identify the most appropriate SIC2007 section.
- Quality control checks (manual inspection) for (a) a random sample, and (b) the top 1% by volume.
- A more thorough manual review of selected categories where significant differences with other published statistics (e.g. Enviros Consulting, 2007) were initially observed.

13. Not all licence-holders return volumetric data annually to the Environment Agency (EA) as required. Such blank entries need to be handled appropriately to avoid gross errors in reporting. It is standard practice for the EA to estimate returns for these licenses and a process to do this has been followed for this study. The methodology followed in this study is similar, although not identical, to the EA process; our methodology allows estimation of returns by SIC section. As such, the analysis method may not exactly match that carried out in previous similar studies and hence the results may not be directly comparable to other published data.

14. Around 6.5 million megalitres (Ml), or 6.5 billion m^3, of water was directly abstracted from non-tidal sources in England and Wales in 2006. Of this total, 4.6 million Ml (about 70%) was supplied for use in the energy generation, water and waste sectors. The next largest sector supplied was agriculture, forestry and fishing (1.1 million Ml), followed by manufacturing (0.59 million Ml) and mining/quarrying (0.07 million Ml). Together, these four sectors accounted for 98% of the total volume directly abstracted. However, these figures take no account of the fact that much of this total volume of water is returned to the immediate environment following its use and is therefore still available for other uses.

15. Final use of abstracted water can therefore be classed as 'consumptive' or 'non-consumptive'. Consumptive uses of water are conventionally regarded as those in which water is evaporated, transpired, incorporated into products or crops, or consumed by humans or livestock, and hence not returned to the immediate environment whence it came. Identifying consumptive use is therefore of paramount importance when considering water conservation measures in a given sector, region or catchment. However, this conventional definition ignores the case where, for example, industrial applications have to treat their effluent before returning it to the immediate environment. Whilst the water is available for others to use in the same catchment in a short time, significant amounts of energy may have been expended to treat this water before returning it to the environment. These uses cannot, in WRc's view, be regarded as truly non-consumptive. Hence, for the purposes of this project, **non-consumptive water uses of abstracted water are those where water is returned after use to the immediate environment with little or no treatment**. These are water used for:

- fish farm/cress pond throughflow;
- hydraulic rams;
- hydroelectric power generation;
- milling and water power other than electricity generation;
- non-evaporative cooling; and
- transfers between sources.

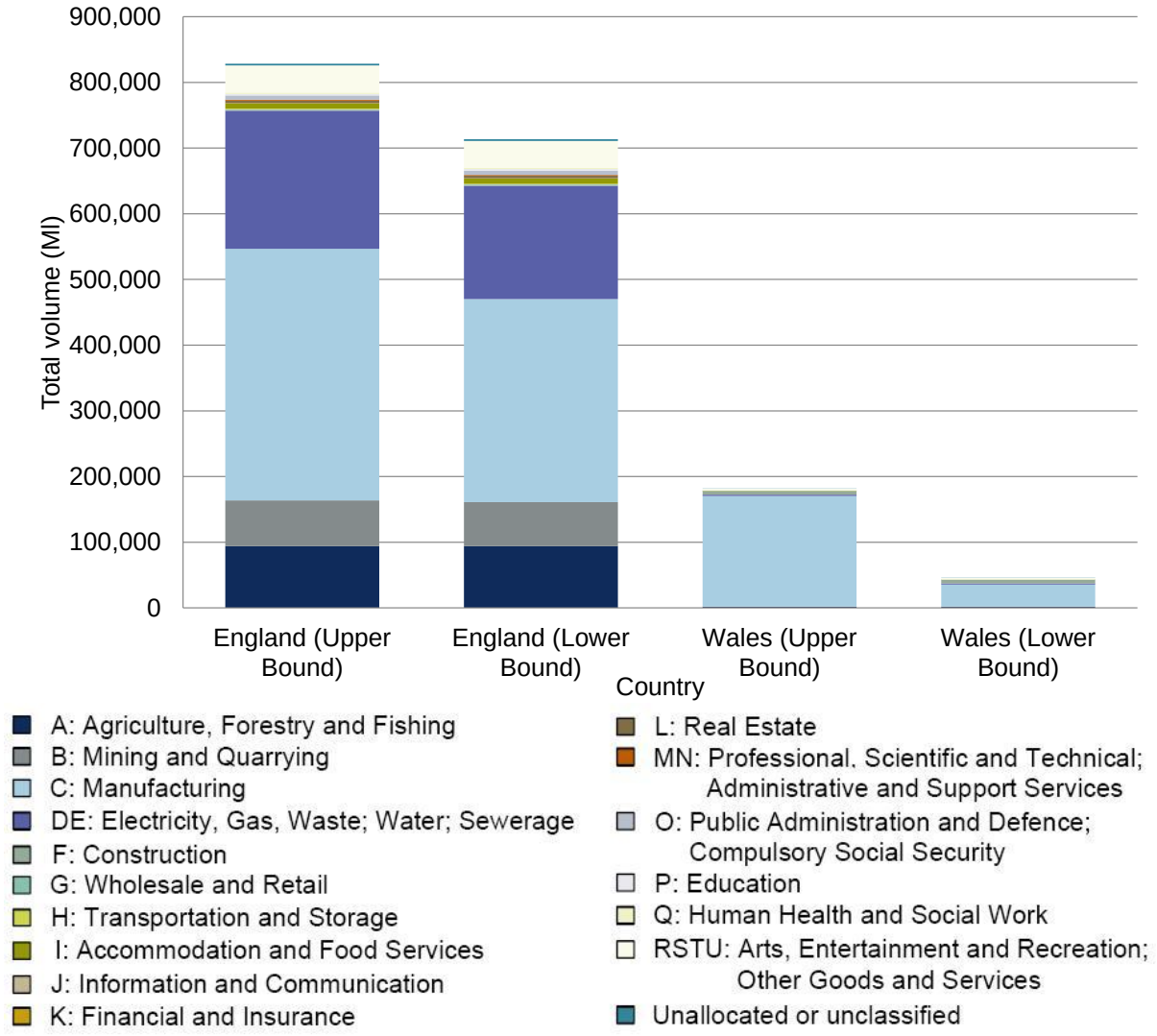
16. Consumptive uses of abstracted water are taken to be all uses excluding those listed in paragraph 15. Owing to the way that some volumetric data are reported and held in NALD, it is not always possible to apportion the volume abstracted to a single use. Hence, upper and lower bounds which will lie around the 'true' value of consumptive use are presented instead.

17. When the major non-consumptive uses listed in paragraph 15 are excluded, the total volume of water directly abstracted from all non-tidal sources in England and Wales and used for predominantly consumptive uses in 2006 was estimated to be between 0.79 million Ml and 1.01 million Ml. This represents no more than 15% of the total volume directly abstracted for both consumptive and non-consumptive uses (6.5 million Ml).

18. Taking the upper bound estimate of 1.01 million Ml (1.01 billion m^3) which is directly abstracted from non-tidal sources in England and Wales for consumptive uses by non-household sectors, an estimated 0.55 million Ml

(55%) was used by the manufacturing sector; closely followed by the energy, water and waste sectors (0.21 million Ml); then agriculture, forestry and fishing (0.10 million Ml); mining and quarrying (0.07 million Ml); and arts, entertainment, recreation and other goods and services (0.04 million Ml). Together, these five sectors account for 96% of the estimated total volume directly abstracted excluding major non-consumptive uses (Figure 1).

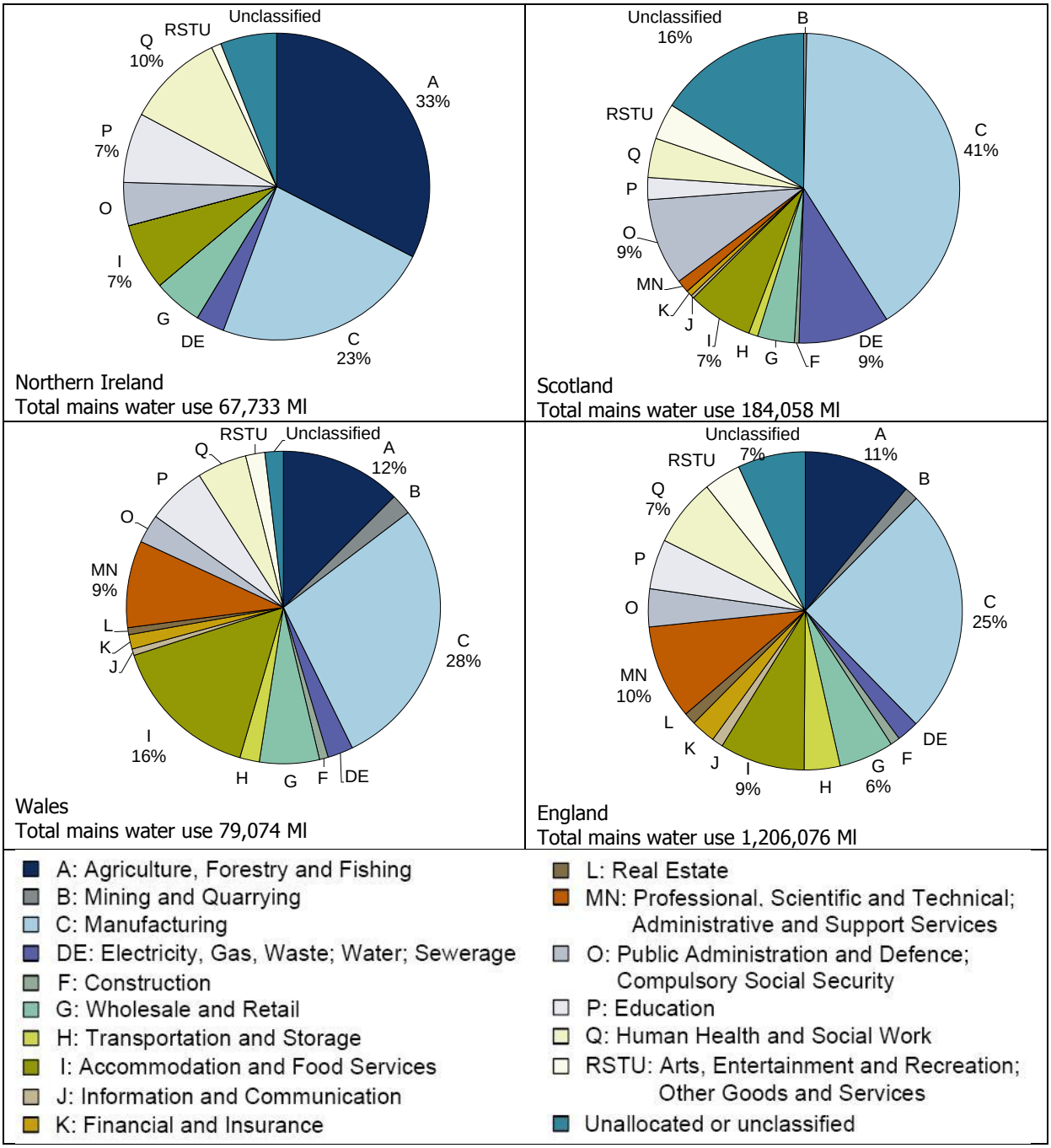
Figure 1 Estimated volume directly abstracted from non-tidal sources in England and Wales, excluding major non-consumptive uses (upper and lower bound estimates presented) and excluding that abstracted for public water supply, by SIC sector and country (Ml, 2006)



19. Mains water use data has been compiled from Table 8 of water company Water Resource Management Plans (WRMPs) for England and Wales for the year 2006/07, and from economic sectoral data provided by Scottish Water for Scotland for the same period. The UK dataset excludes three English water-only companies for which data were not available. For four English water companies, draft WRMP outputs were used as the latest available at time of writing. For Northern Ireland, a percentage breakdown by sector from Northern Ireland Water's WRMP (2008) has been applied to the 2006/07 regulatory annual return data for non-household water use to arrive at a sectoral breakdown for use in this study.

20. Mains water use by sector and country is presented in Figure 2. Of the 1.5 million Ml of water supplied to non-household consumers by water utilities in the UK in the financial year 2006/07, 0.40 million Ml (27%) was supplied to the manufacturing sector, followed by agriculture, forestry and fishing (0.16 million Ml), accommodation and food services (0.13 million Ml); professional, scientific, technical, administrative and support services (0.13 million Ml).

Figure 2 Mains water use in the UK, by country, by SIC sector (Ml, 2006/07)



21. **Table 3** presents a summary of available data on mains water use and volume directly abstracted excluding major non-consumptive uses split by SIC sector and country. A fuller presentation is provided in Appendix E.

Table 3 Mains water use by sector (Ml, 2006) and estimated volume directly abstracted from all non-tidal sources, excluding major non-consumptive uses (upper and lower bound estimates) and excluding that abstracted for public water supply, by sector and EA region (Ml, 2006)

		Mains water use (Ml, 2006/07)					Volume directly abstracted (upper bound estimate) (Ml, 2006)		Volume directly abstracted (lower bound estimate) (Ml, 2006)	
SIC2007 Section	Description	England	Wales	Scotland	NI	Total UK	England	Wales	England	Wales
A	Agriculture, Forestry and Fishing	133,789	9,735	0	22,013	165,537	94,250	1,689	94,094	1,620
B	Mining and Quarrying	17,071	1,678	605		19,354	69,488	598	66,928	486
C	Manufacturing	302,163	21,978	74,985	15,612	414,739	382,829	168,218	309,113	33,383
DE	Electricity, Gas, Waste; Water; Sewerage	27,159	2,051	17,334	2,032	48,576	210,333	1,792	172,289	1,792
F	Construction	11,842	705	866		13,412	1,470	5,496	1,470	5,496
G	Wholesale and Retail	67,899	4,811	7,016	3,502	83,227	709	6	709	6
H	Transportation and Storage	44,647	1,571	1,749		47,968	952	2	952	2
I	Accommodation and Food Services	105,618	12,158	12,446	4,762	134,984	7,959	300	7,959	300
J	Information and Communication	13,824	527	586		14,937	104		104	
K	Financial and Insurance	30,381	1,164	1,156		32,701	386		386	
L	Real Estate	14,821	565	0		15,385	3,818		3,818	
MN	Professional, Scientific and Technical; Administrative and Support Services	115,861	7,022	2,433		125,316	1,231	0	1,231	0
O	Public Administration and Defence; Compulsory Social Security	46,418	2,314	16,688	3,069	68,490	6,489	814	6,489	7
P	Education	61,064	4,778	4,236	4,971	75,048	2,407		2,407	
Q	Human Health and Social Work	83,450	3,997	7,553	6,922	101,922	2,140	10	2,140	10
RSTU	Arts, Entertainment and Recreation; Other Goods and Services	45,988	1,546	6,950	701	55,185	41,233	2,616	40,752	2,616
Unclassified	Unallocated or unclassified	84,081	1,475	29,455	4,010	119,020	2,438	0	2,438	0
	Total	**1,206,076**	**78,074**	**184,058**	**67,594**	**1,535,802**	**828,236**	**181,541**	**713,279**	**45,718**

22. The results of this analysis along with further detailed investigation of water-using processes from within NALD and information from CAMS has led to prioritisation of sectors within each identified priority region. Consideration has been given to specific uses of water within high priority catchments, focussing on consumptive uses where data allow. An extensive discussion on consumptive usage is not possible owing to the incomplete sectoral water mass balance.

23. Consumptive use in areas of water stress and where too much water is already being abstracted from the environment should be targeted in the first instance. These criteria form the basis of the short term priorities discussed below. The geographic regions, and specified industrial and commercial sectors, which should be targeted in the short term (in the next four-years) are defined using the following criteria:

- the Catchment Abstraction Management Strategy (CAMS) has identified that there is **over-abstraction** in one or more Water Resource Management Units (WRMUs) or Groundwater Management Units (GWMUs);

and

- the EA water stress methodology identified the region as **seriously water stressed**;

and

- the analysis of CAMS, NALD and other sources has highlighted **particular** industrial and commercial **sectors which are locally consumptive users**.

24. A summary of the recommended regions and sectors for priority action in the short term (next four years) is provided in Table 4.

Table 4 Short term recommendations by region and SIC sector

Government region	**Specific catchments**	**Non-household sectors to target for action**
East of England	• Cam & Ely Ouse (Cambridgeshire) • Broadland Rivers (Norfolk) • Combine Essex (Essex) • East Suffolk (Suffolk) • Upper Lee (Bedfordshire, Hertfordshire, Essex) • Colne (Hertfordshire)	• Irrigated agriculture • Food and drink industry • Other Industry – particularly chemicals
Midlands	• Grimsby, Ancholme & Louth (Lincolnshire) • Dove (Derbyshire) • Idle & Torne (Nottinghamshire) • Lower Trent & Erewash (Nottinghamshire) • Welland (Leicestershire, Rutland)	• Food and drink industry • Paper and printing industry • Irrigated agriculture • Domestic consumption in offices and schools.
London and the South East	• London (particularly South London) • Stour (Kent) • Darent & Cray (Kent)	• Irrigated agriculture • Domestic consumption in offices and schools • Paper and printing industry
South West	• Hampshire & Avon (West Hampshire, South Wiltshire) • Kennet & Pang (North Wiltshire) • Upper Thames (South Gloucestershire, West Oxfordshire)	• Irrigated agriculture • Domestic consumption in offices, schools and accommodation • Paper and printing, rubber, and chemicals industries • Food and drink industry

25. The geographic regions (and industrial and commercial sectors) which deserve attention in the medium term (in the next four to ten years) are defined using the following criteria:

EITHER

- the Catchment Abstraction Management Strategy (CAMS) has identified that there is **over-abstraction** in one or more Water Resource Management Units (WRMUs) or Groundwater Management Units (GWMUs);

and

- the EA water stress methodology identified the region as **moderately water stressed**;

OR

- CAMS has identified that one or more catchment management units are **over-licensed**; and
- the EA water stress methodology identified the region as **seriously water stressed**.

In addition it is suggested that in the East of England and South East (and London) activities are expanded from within particular catchments out to the whole region in the medium term.

26. A summary of the recommended medium term regions and sectors is provided in Table 5.

Table 5 Medium term recommendations (four to ten years) by region and sector (in addition to the short-term priorities identified in Table 4)

Government region	**Specific catchments**	**Non-household sectors to target for action**
Midlands	• Nene Catchment (Northamptonshire) • Middle Severn Catchment (Worcestershire) • Avon Catchment (Warwickshire)	• Food & drink industry • Paper & Printing industry • Irrigated agriculture • Domestic consumption in offices & schools.
South West	• Tamar/Torbay catchments (Devon)	• Irrigated agriculture • Domestic consumption in offices, schools and accommodation • Mineral extraction industry.

27. Consideration in the longer term should be given to those areas which are:

- currently described as at least moderately water stressed by the EA's water stress methodology (for reasons of current and projected household demand and population growth);
- have, and are likely to continue to have, large industries that have high volumes of consumptive water use;
- are projected to be impacted by climate change with decreases in summer rainfall, higher summer temperatures and greater frequency of droughts; and
- deemed to have no more water available at low flows according to CAMS.

28. The latest UK climate projections for the 2030s suggest that many southern counties of England and Wales and parts of the Midlands will see a decrease in daily mean summer rainfall by between 10% and 20%. These are areas which are presently at least moderately water stressed and/or have no water available. Thus, in the longer term, the conurbations and industrial areas of South Wales, much of the remainder of the Midlands and South West England will require action to tackle unsustainable water consumption.

29. It is not possible to currently say what industrial and commercial sectors might be responsible for the majority of water consumption by 2030. Current sectors in each of the long term priority areas are provided in Table 6.

Table 6 Long term (more than ten years) recommendations by region and sector (in addition to previously identified priorities for the short and medium term)

Government region	Specific catchments	Non-household sectors to target for action (based on current consumption profile)
South Wales	• Whole region	• Food & drink industry • Paper and printing industry • Mineral products industry
Midlands	• Whole region	• Food & drink industry • Paper and printing industry • Irrigated agriculture • Domestic consumption in offices & schools.
South West	• Whole region	• Irrigated agriculture • Domestic consumption in offices, schools and accommodation • Paper and printing, rubber and chemicals industries • Food & drink industry

30. There are a number of other considerations that should be made when work begins to identify water conservation methods that WRAP, the environment agencies and other stakeholders can support based on these recommendations. In particular:

- work that is already being carried out in conjunction with non-household sectors;
- the 'water hierarchy[1]' and the difference between water wastage and water use; and
- methods by which comparisons within a sector can be carried out to enable benchmarking by particular companies.

[1] *The water hierarchy is based upon a five step process (Manan et al., 2006), which should be considered in order:*

1. *source elimination;*
2. *source reduction;*
3. *direct reuse/outsourcing;*
4. *regeneration reuse; and*
5. *freshwater use.*

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Glossary of terms

Abstraction, Direct abstraction	The process of withdrawing water from a natural source. In this report, the term 'direct abstraction' is used to distinguish the process by which water is obtained from a natural source directly by an abstraction licence holder, from the use of mains water that is supplied (and originally abstracted) by water utilities.
Abstraction licence	A document issued by a UK national environmental regulator which specifies the terms under which that licence holder may abstract water from the environment. These include details of the location of the abstraction and the maximum permitted volume that may be abstracted over one or more specified time periods.
Aquifer	A water-saturated underground layer of permeable rock or unconsolidated material such as gravel, sand or silt, from which groundwater may be usefully extracted. Aquifers may be defined as 'confined' or 'unconfined': a confined aquifer is one which is overlain by impermeable material.
CAMS	The acronym for Catchment Abstraction Management Strategy. A document, published by the relevant national environmental regulator, which, *inter alia*, illustrates the water resource availability and current and likely future pressures on water resources in that particular catchment. A CAMS document often includes local commentary on major consumptive uses.
Consumptive use	See 'Non-consumptive'.
Domestic-like use	A use of water in a non-household setting similar or identical to those water-using activities carried out in a domestic setting, typically WC or urinal flushing, use of basin or kitchen taps and showering or bathing. Commercial-scale kitchens are excluded from this definition.
Embedded water	The quantity of water used to produce an item before it is purchased or otherwise obtained by consumers (i.e. excluding the use and disposal phases of a product's life-cycle).
Evaporation	The conversion of water from its liquid phase to water vapour, representing a temporary loss to those processes requiring water in its liquid form. Evaporation is considered to be a consumptive mechanism since the water is 'lost' to the atmosphere and may not return (through condensation/precipitation) to the immediate environment from where it evaporated.
Groundwater	The fraction of the total water resources available which is stored below the surface of the Earth, typically in aquifers.
Hydrology	The study of the movement, distribution, and quality of water on Earth which includes the study of all aspects of the hydrological cycle including water resources. Hydrogeology is the branch of hydrology concerned with the presence and movement of groundwater: see also *aquifer*.
Mains water	Potable water supplied by water utilities to their customers through a network of water pipes or 'mains'.

NALD	The acronym for National Abstraction Licensing Database. The definitive source of information on abstraction licence details for England and Wales, held and maintained by the Environment Agency. NALD also includes data on actual volumes abstracted by abstraction licence holders who are required to report this information. For categorising the purpose of each abstraction, NALD uses a two-level hierarchical classification system of 'primary description' and 'secondary description'. NALD defines 7 primary description categories, e.g. 'Agriculture', each of which is further disaggregated into a number of secondary description categories, e.g. 'Horticulture and Nurseries'. There are a total of 60 'secondary descriptions' defined in NALD. NALD also records the intended nature of use(s) for each abstraction licence, as a 'use description'. NALD defines 56 such use descriptions, some of which are relevant to more than one primary/secondary description, e.g. 'Process water'.
Non-consumptive use	For the purposes of this project, a use of abstracted water in which the water is returned to the immediate environment from whence it came, requiring little or no wastewater treatment. For analysis purposes, non-consumptive uses are defined as the use of directly abstracted water in: fish farm/cress pond throughflow, hydropower generation, hydraulic rams, non-evaporative cooling, and transfers between sources. Consumptive uses of abstracted water are taken to be all uses excluding those non-consumptive uses listed above. All mains water use is therefore assumed to be consumptive.
Non-household use	The use of water by all sectors excluding that used by households.
Non-tidal	In the context of this project, all surface water sources of fresh (non-saline) water.
Ofwat	The abbreviation for the Office of Water Services, the economic regulator of the water industry in England and Wales. Neighbouring bodies which carry out similar functions in their own areas are the Northern Ireland Authority for Utility Regulation (NIAUR) and the Water Industry Commission for Scotland (WICS).
Public water supply	That portion of water abstracted and treated by water utilities for the supply of potable water to its consumers, the general public.
Sewerage undertaker	The formal title of an organisation which undertakes to collect, treat and dispose of wastewater, activities are closely regulated by the industry regulators. Collection of wastewater is by means of the underground wastewater assets collectively known as the sewerage system.
SIC	The acronym for Standard Industrial Classification. A multi-level hierarchical system for classifying types of industrial and commercial activities. Analysis carried out in this project has used the uppermost two levels of the system (SIC sections and divisions) and sectoral water use is reported here at the highest level (SIC section). SIC has undergone several revisions since its inception: the latest classification method, SIC 2007, has been used in this work.
Source	In the context of this project, the point of origin of a freshwater supply, conventionally divided into two main types: non-tidal surface water sources and groundwater sources.
Surface water	The fraction of the total water resources available which resides on or near the surface of the Earth, typically in rivers or reservoirs.

Trade effluent	The name given to non-household discharges other than sewage. Trade effluent may require specialist or enhanced wastewater treatment before it is returned to the environment. Trade effluent may be treated on-site and discharged directly back to the environment or transported, by agreement with the local sewerage undertaker, through the sewerage undertaker's sewerage system to be treated at their wastewater treatment facility before discharge.
Transpiration	The evaporation of water from the leaves and stems of vegetation.
Water stress	The tension between the requirements of the environment and human activities on water resources at a given location. A number of indicators exist to quantify water stress.
Water utility	A provider of water services which may be publicly or privately owned. Water services include the treatment and distribution of potable water to consumers.
WRMP	The acronym for Water Resources Management Plan. A document created by every water utility in England and Wales for their own supply area containing information on the current and projected water supply/demand balance and any plans or proposals to safeguard water resources over the next 25 years. Water companies have a statutory duty to produce and maintain their WRMP, and consult the public and other statutory consultees (most notably the EA) on its contents. A similar process occurs in Scotland, where the document is referred to as a Water Resource Plan.

Acknowledgements

The assistance of the following contributors of data and information is gratefully acknowledged:

Anglian Water, Bristol Water, Dŵr Cymru Welsh Water. Essex & Suffolk Water, Northern Ireland Environment Agency, Northern Ireland Water, Scottish Environment Protection Agency, Scottish Water, Severn Trent Water, Southern Water, South Staffs Water, South West Water, Sutton & East Surrey, United Utilities, Veolia Water Central, Wessex Water, Yorkshire Water.

Particular thanks are extended to the Environment Agency who were represented on the Project Steering Group and provided technical support to the project.

1.0 Introduction

1.1 Project appreciation and objectives

In the UK, the water and sewerage companies are subject to three systems of regulation:

- economic;
- drinking water quality; and
- environmental.

Economic regulation is provided by Ofwat in England and Wales, who are responsible for ensuring that the water and wastewater utilities provide customers with a high quality, efficient service which is value for money. The Water Industry Commission for Scotland is responsible for this in Scotland, while in Northern Ireland it is the Northern Ireland Utility Regulator.

Drinking water quality regulators provide reassurance that water supplies are safe and of acceptable quality for consumers. This is managed by the Drinking Water Inspectorate in England and Wales, the Drinking Water Quality Regulator for Scotland and the Drinking Water Inspectorate in Northern Ireland.

Environmental regulation is provided by the Environment Agency (England and Wales), the Scottish Environment Protection Agency and the Northern Ireland Environment Agency. The environmental regulators are responsible for water resource management of surface and ground waters, such as monitoring quality and quantity, regulating discharges and abstraction and taking legal action where this is done illegally. They also have responsibilities for flood risk management and flood defence.

All three systems of regulation provide data that can be used to gain a greater appreciation of the freshwater conservation agenda. A significant element of this is an understanding of where, when and how freshwater is used across industry, commerce and homes – this includes where water is removed from the environment and how this water is returned to the environment.

Although there are already a number of data sources on commercial and industrial water use in the UK, including that gathered by the Environment Agency, Scottish Environment Protection Agency, DEFRA and water utilities, none provides the complete picture. This study will draw together available evidence relating to non-household water use.

This knowledge will allow WRAP and other stakeholders to appropriately target resources over coming years to sectors and regions where water use is high, where there is scope for significant savings to be made and where the environmental pressures on water use are greatest including seasonal influence.

The specific objectives of this work are to:

- identify and collate data on domestic and commercial water use in the UK, broken down by sector where possible, to include abstraction, mains water use and water put back into the system through rivers, mains, drains etc. Data for the most recent year available should be used;
- calculate how much water is used by each commercial and industrial sector, to gain an understanding of how much each sector can contribute to reducing water use;
- identify where there are gaps in knowledge on domestic and commercial water use, and make recommendations on how they may be filled;
- present available water consumption data by UK region and relate these findings to existing information on current and predicted freshwater scarcity;
- identify where there are gaps in knowledge on freshwater scarcity and make recommendations on how they may be filled; and
- give a clear understanding, based on the analysis undertaken, of where activities should be focussed to reduce commercial and industrial water use.

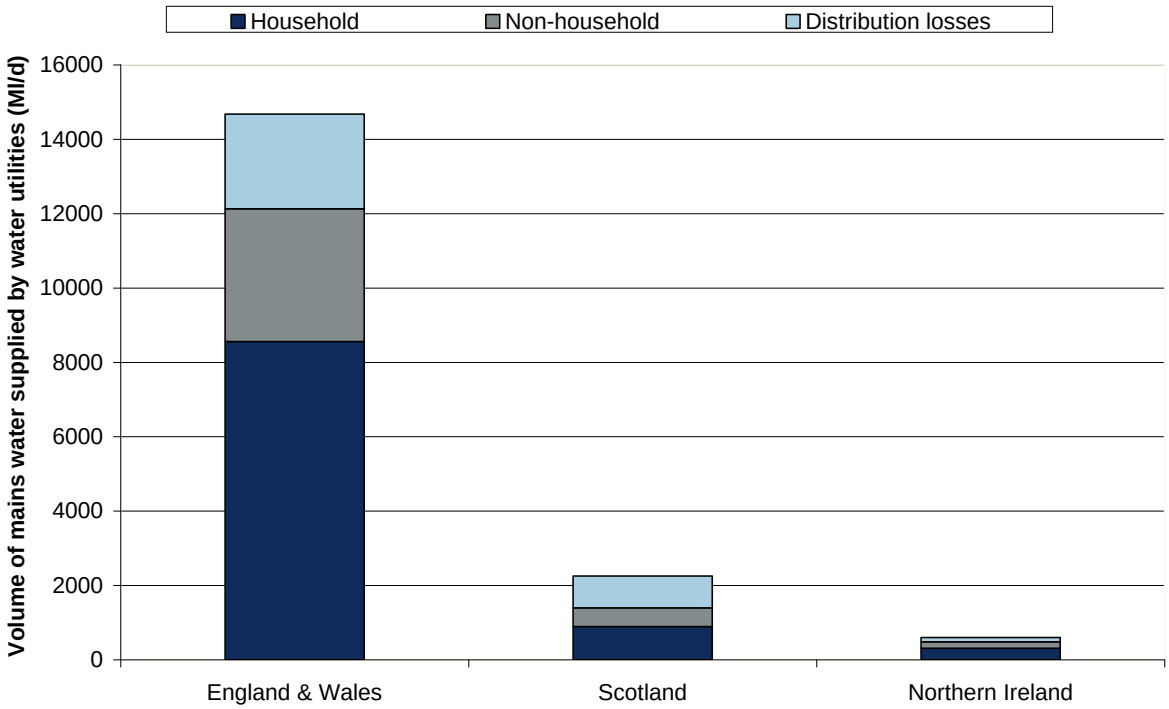
1.2 Background to water use and conservation efforts in the UK

For purpose of data availability, described further in Chapter 3, this report focuses on water use in the UK in 2006/07. Before entering into the detail of sectoral or regional water use, it is important to set non-household use of water in the context of the total volume of water used by both households and non-households in the UK. It is worth stating here that the UK picture of water use is incomplete: very few data are readily available on the volume of water that is directly abstracted from freshwater sources in Scotland and Northern Ireland as most sectors were previously unregulated prior to 2006 (2007 in Northern Ireland). Data are available from water utilities, however, on the sectoral use of use water delivered by water utilities to consumers via their networks of water pipes ('public water supply', referred to in this report as 'mains water use'). A more complete view is available for England and Wales where data on direct abstraction and mains water use are available by non-household sector.

In England and Wales, the EA records the volumes of water abstracted from groundwater and surface water sources, and the purpose of the abstraction, in its National Abstraction Licensing Database (NALD). In 2006/07, an average of around 35,000 Ml/d (12.8 million Ml in 2006/07) of freshwater was abstracted, of which approximately half was for public water supply (that portion which water utilities abstract, treat and pump to end-consumers). A further 30% was used in electricity production and the remainder for other non-household uses, including agriculture and aquaculture (EA 2008a). This report explores these non-household uses of water in more detail.

In England and Wales, mains water supplied to non-households accounts for approximately 30% of the water delivered to connected properties. This figure includes losses from customers' supply pipes but excludes losses from water company-owned assets (distribution losses). In Scotland and Northern Ireland, the figure is approximately 35%. Figure 1.1 shows the breakdown of the main components of total water supplied by water utilities across England, Wales, Scotland and Northern Ireland.

Figure 1.1 Main components of total water supplied by water utilities (from annual returns to economic regulators for reporting year 2006/07)



Household water use, the single largest component of mains water use, is the focus of many water efficiency initiatives, particularly in the more densely populated and water-stressed areas of the UK.

Waterwise is an independent UK NGO established by the UK water industry in September 2005. The NGO originally had a five-year mission of reducing per capita consumption (pcc) and promoting water efficiency. The work of Waterwise is now continuing, with a particular focus on working with UK water utilities on large scale

domestic water efficiency projects which range from water audits to domestic retrofit schemes (Waterwise 2011). Waterwise has also set up a Scottish roundtable on water efficiency supported by a new water efficiency network, 'Saving Water in Scotland' to reduce water consumption in Scotland.

Water utilities in England and Wales are required to meet water efficiency targets set by Ofwat (Ofwat 2009), the economic regulator. The headline target is an annual target to save an estimated one litre of water per property per day through water efficiency activity, during the period April 2010 to March 2015. Companies are permitted to meet these targets through a combination of household and non-household water efficiency measures. Many companies are focussing on conducting household water audits, working with social housing providers, and working with schools on educating children on water efficiency.

Information regarding improving household water efficiency is readily available to customers through water utilities, consumer bodies, DIY outlets etc. Some devices for improving efficiency in homes are also available free of charge from water companies and increasingly, where devices will save hot water, from energy companies.

The Energy Saving Trust also promotes the efficient use of water (EST [online] accessed February 2011), due to the inherent energy use implications of water use, particularly where water is heated within the home. Starting on 1 April 2008 and running to March 2011, the Carbon Emissions Reduction Target (CERT) programme requires obligated electricity and gas suppliers to achieve targets for reducing carbon emissions (by reducing greenhouse gas emissions associated with energy use) from domestic properties in Great Britain. CERT is the UK Government's main policy instrument for reducing carbon emissions from households and follows on from the earlier Energy Efficiency Commitment (EEC) programme (Ofgem 2011). Suppliers meet their targets by setting up schemes to deliver improvements in energy efficiency, e.g. distributing free, low-energy light bulbs to households. Ofgem, the UK regulator for gas and electricity markets, monitors compliance with the scheme and progress towards achievement of its target; currently two shower products are CERT approved.

Non-household water efficiency measures have also been promoted in recent years by the Envirowise programme which worked with specific sectors to put in place water reduction plans, for instance the Federation House Commitment in the food and drink sector (WRAP/ Envirowise [online] accessed February 2011). The Envirowise programme ended in April 2010; however, many of its activities including delivery of the FHC are now being managed by WRAP. In addition, other sectors have their own sustainability initiatives which include water conservation as an element, such as the Sustainable Construction Strategy (BERR – a joint Industry and UK Government Strategy) and the Food and Drink Federation Five-Fold Ambition.

In 2007/08 Northern Ireland Water employed Key Account Managers responsible for customers using more than 10,000m^3 of water per annum. NIW offer a large user tariff discount scheme (NIW [online] accessed February 2011) which is dependent on the commitment of the customer to water efficiency. This is likely to include the installation of water saving devices, recycling plants and a review of water efficiency by an independent industry expert.

Water utilities also work with non-household customers to reduce water use. The Waterwise report *Water Efficiency and the Water Companies a 2010 UK Review* (Waterwise 2010b) provides an overview of the activities carried out which include the issue of audit packs, water audits and efficiency surveys and leakage detection.

1.3 Task list

In order to meet the project objectives given in chapter 1.1, the following tasks were identified:

1. Summarise available data sources. Emphasis is given to identifying which questions they will help to answer and where there are gaps in available knowledge that cannot be filled by any given data source.
    a. Additional effort will be expended to ensure that it is possible to align data from different sources against a standard classification system for industrial and commercial activities.
    b. Additional effort will be expended to understand how some data are derived – in particular mains water consumption data in Water Resource Management Plans (WRMPs) – as this has a bearing on the robustness of the study's results.

2. Summarise water use by sector and location. The data sources identified in Task 1 will be analysed to populate three matrices containing quantities of water, consisting of:
    a. Water use across the UK split by sector, source (abstraction/mains) and method of discharge.
    b. Water use across the UK split by region, source (abstraction/mains) and method of discharge.
    c. Water use across the UK split by sector, region and nation.

3. Provide a summary of information regarding current and future freshwater stress and scarcity.

4. Provide recommendations on where future action on reducing water stress should be targeted (by region and by sector).

1.4 Scope of this report

This report is the final output of the project and provides details of all methodologies used, their results, conclusions and recommendations.

Chapter 2 contains an overview of water scarcity and stress.

Chapter 3 of this report includes information on the data sources that have been identified and contacts made in order to obtain further information. The steps by which the data have been managed and manipulated in order to report direct abstraction, mains water and trade effluent discharge volumes against SIC2007 are included in Appendix B.

Chapter 4 of this report summarises data availability and discusses the use of these data with respect to meeting the objectives of the study (see chapter 1.1) and their limitations. Where gaps in the data are identified, some pragmatic and realistic steps are recommended to elicit further information.

Chapter 5 of this report presents the results of data analysis of the sources identified in chapter 3. The results are presented both by region/country and by source, and some of the key differences between these are highlighted.

Chapter 6 of this report draws upon the observations on availability of freshwater resources in the UK (chapter 2) and the analysis of major sectoral uses in each country/region of the UK (chapter 5) to make a number of recommendations to support sustainable use of freshwater resources in the short, medium and longer term.

2.0 Water scarcity and stress

2.1 Introduction

The aim of this chapter is to examine and report a summary of the latest information on current and likely future freshwater availability in the UK. This will be used in combination with additional research detailed in subsequent chapters to identify the geographic and sectoral areas of concern requiring focus in the years ahead. *Water scarcity* and *water stress* are terms which are often used interchangeably. However, a number of variant definitions exist for each term and these are explained below.

Water scarcity describes the relationship between water demand and availability (Abrams 2000/1). There are two types of water scarcity; physical scarcity and economic scarcity. Physical scarcity occurs when the water resources available are insufficient to meet demand. Economic scarcity occurs when there is a lack of infrastructure or human capacity to keep pace with the growing demand for water (IWMI, 2006). The determination of water scarcity will vary from region to region and country to country owing to the large number of factors that affect water availability and consumption (Abrams, 2000/1).

Water scarcity is therefore a relative concept that can occur at any level of supply or demand. It may be defined as the point at which the aggregate impact of all users impinges on the supply or quality of water under prevailing institutional arrangements to the extent that the demand by all sectors, including the environment, cannot be satisfied fully (UN-Water 2007).

According to Abrams (2000/1), *water stress* is a symptomatic consequence of scarcity and relates to the amount of water available in any given area. The Environment Agency (EA) currently defines an area of water stress as an area where either the current household demand for water is a high proportion of the current effective rainfall received or future household demand for water is likely to be a high proportion of the projected effective rainfall (EA 2008c). This measure does not take into account non-household demand for water.

Water stress in the long term can lead to the deterioration of water ecosystems due to a combination of limited resources and poor water quality. In addition, water stressed areas can face a dual problem of groundwater over-abstraction leading to water table depletion and salt-water intrusion in coastal aquifers.

2.2 Indicators of water stress

There are several alternative indicators by which water stress may be estimated.

2.2.1 Falkenmark's Water Stress Indicator

According to the Water Stress Indicator developed by Falkenmark and Lindh in 1976, if removal of water from an area is greater than 20% of renewable resources, an area can be deemed to be water stressed; removal of 40% or more represents high stress (IPCC, 2001). This indicator is based on the metric that 1 million m^3 of water supplied per annum can support 2000 people in a highly developed country. Comparing the actual annual renewable resources per capita with the above metric allows an assessment of water stress based on four categories (Water Strategy Man, 2004):

- above 1,700 m^3/capita/year – shortages only occur irregularly or locally;
- between 1,700 m^3/capita/year and 1,000 m^3/capita/year – water stress occurs regularly;
- at 1,000 m^3/capita/year – water stress becomes a limitation on economic development and threatens human health;
- below 500 m^3/capita/year – water stress is a main constraint to life.

Falkenmark's Water Stress Indicator calculates the water available per person as an average with no regard to temporal or spatial scale so does not take into account seasonal or regional variation. Water quality or access to resources is not taken into account so the water could be present but not be usable (Water Strategy Man, 2004) A similar definition of water stress is used by The United Nations Water Task Force which adopts the term 'water scarcity' as an extreme form of water stress:

"an area is experiencing water stress when annual water supplies drop below 1 700 m^3 per person. When annual water supplies drop below 1 000 m^3 per person, the population faces water scarcity, and below 500 m^3 per person, absolute scarcity".

2.2.2 World Resources Institute Freshwater Scarcity Index

A Freshwater Scarcity Index has been developed by the World Resources Institute (WRI, 2003). Traditionally water scarcity or stress is measured using indicators related to the humankind's requirement for access to fresh water. This indicator, however, also incorporates the needs of the environment and its ecosystems to determine environmental water stress.

2.2.3 Water Exploitation Index

The Water Exploitation Index (WEI) identifies whether the rates of water abstraction are sustainable in terms of the amount of rainfall received. Areas with a WEI of above 20% are considered to be over-exploited.
The WEI is calculated as:

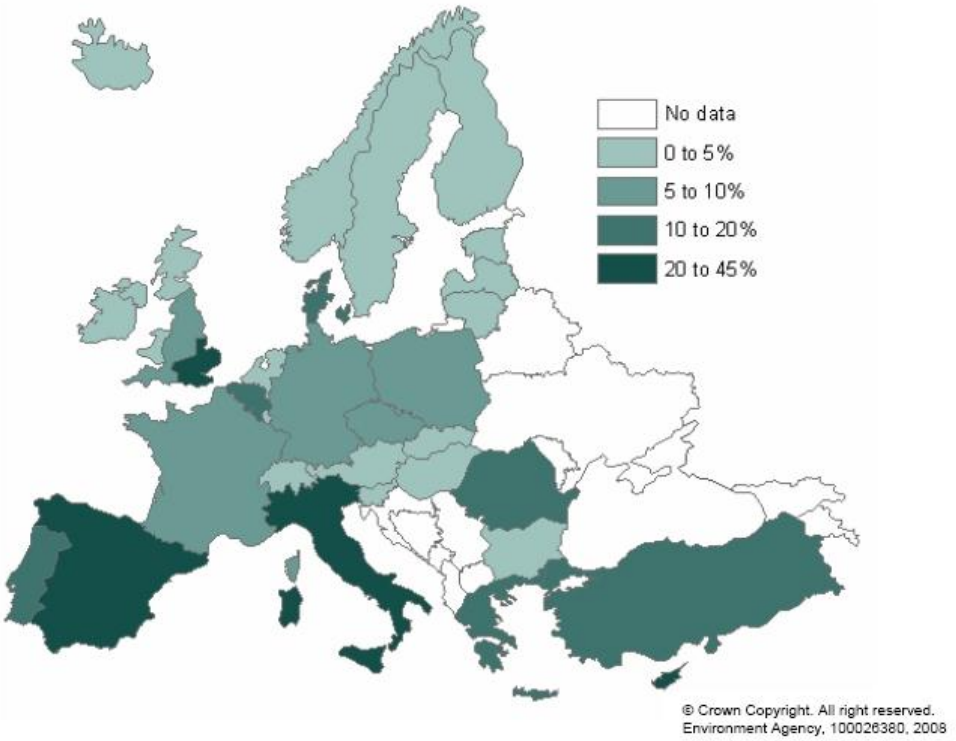
$$WEI = \frac{Mean\ annual\ total\ abstractions\ of\ freshwater}{Mean\ annual\ freshwater\ resources}$$

The value of 'mean annual freshwater resources' is derived from the mean annual precipitation minus the mean annual evapotranspiration plus the mean annual inflow to the area (Lallana & Marcuello, 2002).

The WEI does not take into account how water resources are managed, how it is stored for the future and what happens to the water following treatment (it may be deployed for environmental enhancement downstream) (Environment Agency, 2008).

Figure 2.1 shows the WEI for individual countries in Europe and broad regions in England and Wales. This map indicates that the South East of England is under the same level of water stress as countries such as Italy, Malta and Spain.

Figure 2.1 Water Exploitation Index (EA 2009)



2.2.4 Environment Agency water stressed areas

To enable future water conservation activities to be correctly targeted, in 2007 the EA produced a draft procedure to classify water stressed areas in England. This methodology focussed on household water use for the reasons given below. A consultation was released for comment and a final classification was published in 2008 (EA, 2008b).

Each area covered by a water utility was classed using a scoring system and assigned to one of three categories ('serious', 'moderate' and 'low' water stress).

The criteria used to classify each area included:

- current per capita consumption for both measured and unmeasured household water use from annual water utility return data from 2002-2005;
- forecast growth in per capita demand for water for both measured and unmeasured households from water utility Water Resource Management Plans (WRMPs);
- forecast population growth for the years 2015 and 2030 from water utility WRMPs;
- current water resource availability including rainfall data obtained from the Met Office, current population figures from water utility WRMPs and the area measurements from the Environment Agency's Geographical Information System (GIS) for each water utility area; and
- forecast resource availability for 2015 and 2030 from the same sources as current water availability along with forecast population from WRMPs.

Other criteria were considered but excluded from this EA methodology. Forecast water demand for non-household purposes was considered to be too uncertain due to its sensitivity to changes in UK economic output and regional policies. In addition, estimates presented in Water Resource Management Plans (WRMPs) at the time gave a forecast of broadly static non-household use up to 2030, suggesting that the non-household sector would not be a major contributor to future changes in water stress.

Other criteria considered for inclusion in the EA's methodology included leakage from water mains and Ofwat's *Security of Supply Index*[2]. These too were rejected as the data were deemed to be incompatible or not a direct indicator of water scarcity.

N.B. This classification is currently under review. It is our understanding that it will be updated by Defra and the Environment Agency in due course.

2.2.5 Catchment Abstraction Management Strategies

The development of Catchment Abstraction Management Strategies (CAMS) has allowed consideration of water stress and the assessment the freshwater potentially available for abstraction. These documents are developed by the Environment Agency and cover England and Wales.

CAMS are used to identify the delicate balance between how much water is needed by the environment, how much is demanded for human consumption and how much is currently being abstracted. From this it can be deducted what (if any) water is available for further abstraction. CAMS can be used as a good indicator for areas that are under stress due to over-abstraction.

CAMS aim to protect the environment by:

- identifying a minimum flow or groundwater level below which abstraction may need to be prevented;
- preventing flow and level variability from low to high flow conditions;
- protecting habitats that are dependent upon river flows or water levels; and
- recognising that some water courses or wetlands are more sensitive than others to the impact of flow or level changes.

Water quality considerations are also taken into account in both surface and groundwater.

For the purpose of CAMS each catchment area is given a resource availability status that is based on measured river flows and ground water levels together with knowledge of human influences. A water balance assessment for each CAMS area is made based on its characterisation and ecology including river flows, groundwater recharge, abstractions, discharges, and a resource allocation for the environment or other features that require protection (EA 2008b). The status descriptions, and their meaning in terms of licence availability, are set out in Table 2.1:

[2] *For the detail of this index calculation, see Ofwat letter RD 03/02 to water utility regulatory directors at http://www.ofwat.gov.uk/sustainability/waterresources/ltr_rd0302_secsupindex.pdf*

Table 2.1 CAMS resource and licence availability

Resource availability status	Abstraction licence availability
Water available	Water is likely to be available at all flows, including low flows
No water available	No water is available for any further abstraction licensing at low flows. Water may be available at higher flows with appropriate restrictions, or through licence trading
Over-licensed	Current actual abstraction is such that no water is available at low flows. If all existing licences were used to their full allocation they could cause unacceptable environmental damage at low flows. Water could be available at higher flows, with appropriate restrictions, or through licence trading
Over-abstracted	Current actual abstraction is causing unacceptable environmental damage at low flows. Water could be available at higher flows, with appropriate restrictions.

The CAMS status of each catchment is used to inform the licensing strategy for the area. In some cases, the Restoring Sustainable Abstraction (RSA) programme might be invoked where there is evidence to suggest that unsustainable abstraction of groundwater and surface water could be contributing to environmental damage of rivers and wetlands. This programme may recommend a change to existing abstraction licences. If a voluntary agreement cannot be reached with those who abstract water in one of the affected areas, Section 52 of the Water Resources Act 1991 confers legislative powers on the Environment Agency to enable such changes to be made.

2.2.6 Summary of indicators

Table 2.2 summarises each Water Stress Indicator that is outlined in chapter 2.2 above. As shown in the table, no single indicator covers all the aspects linked to water stress. Some focus just on abstraction linked with water availability, while others take into account the needs of the environment as well as human consumption along with future pressures the UK is likely to encounter. As no indicator covers everything, when evaluating water stress each type of indicator should be considered to build up a more comprehensive picture of water stress in the UK.

Table 2.2 Summary of water stress/scarcity indicators

		Indicators				
		Falkenmark's Water Stress Indicator	**WRI Freshwater Scarcity Index**	**Water Exploitation Index**	**EA Water Stress**	**CAMS**
Causes of water stress	**Over-abstraction**	✓		✓		✓
	Low rainfall	✓	✓	✓	✓	✓
	Demand from environment		✓			✓
	Demand from households		✓		✓	✓
	Demand from non-households		✓			✓
Future pressures considered	**Forecast population**				✓	
	Forecast demand				✓	
	Forecast climate/rainfall				✓	
Water sources considered	**Surface water**					✓
	Ground water					✓

2.3 Current status of water availability and stress

2.3.1 England and Wales

In England and Wales as a whole, only about 10% of the freshwater resources are used for abstraction, as measured by the Water Exploitation Index (WEI; see 2.2.3). However, this average masks large regional variations. If the WEI for South East and Eastern England is calculated, it shows that an average of 22% of freshwater is abstracted in these areas which confirms that, under this definition, the water resources of parts of southern and eastern England are already over-exploited (Environment Agency, 2008).

In terms of the EA's methodology for defining water stressed areas (see 2.2.4), Figure 2.2 shows the most water stressed areas are in South East England, and is a result of the combination of higher population densities (now and predicted) and lower annual average rainfall amounts. Less stressed areas are in the north of England where rainfall amounts are typically higher and population density is lower. Wales was not assessed.

Figure 2.2 Map of areas of relative water stress in England (2005) (EA 2008c)

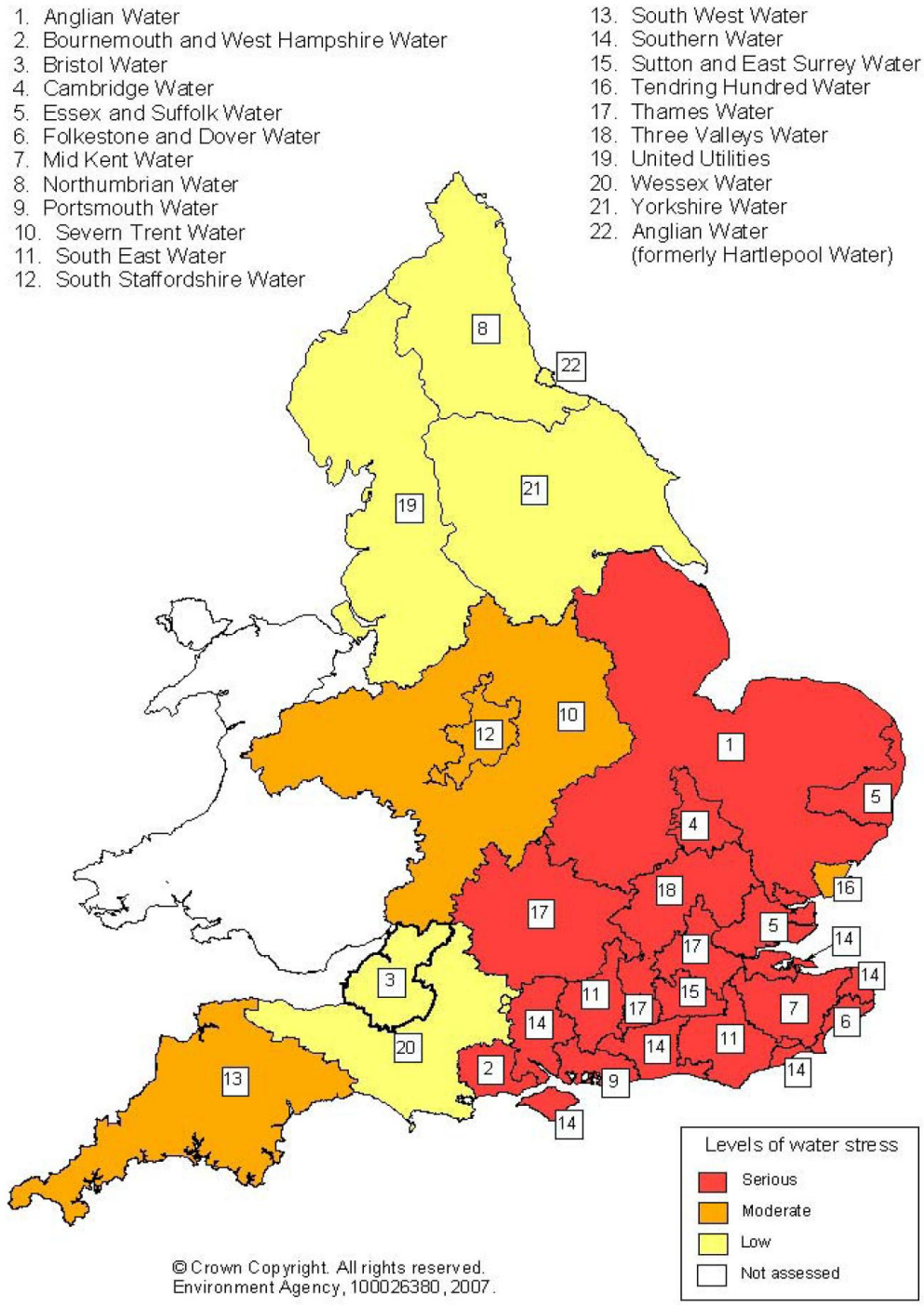


Figure **2.3** and Figure 2.4 on the following pages indicate resource availability status for units[3] of surface water and/or surface water combined with groundwater in completed CAMS, and resource availability status of units of groundwater only in completed CAMS, as of 2008 (EA 2008a).

[3] *Units are water bodies for which assessments must be completed under the Water Framework Directive.*

Figure 2.3 shows the resource availability status for surface water and/or where surface water interacts significantly with groundwater. Figure 2.4 shows the status for groundwater only that does not feature in Figure 2.3.

Figure 2.3 and Figure 2.4

Figure 2.4 show that the most over abstracted areas are in south-east England. Many other areas (coloured in yellow) show that there is little or no water available for abstraction. The blue areas, where water is available for abstraction without restriction, are mainly in north-east England and west Wales. Although there are some similarities with the Environment Agency's water stress map for England (Figure 2.2), the CAMS assessment indicates that there are many more localised issues of over-abstraction occurring across England and Wales beyond the broad areas of water stress identified by the EA water stress methodology. Yorkshire, in particular, has several catchments in a state of 'no water available' or 'over-licensed'. In addition, Worcestershire, the Hampshire Avon, the Welland and Nene, Tamar, and Dove catchments all have resource units with a status of 'over abstracted'.

Figure 2.3 Resource availability status for units of surface water and/or surface water combined with groundwater in completed CAMS, 2008 (EA, 2008a)

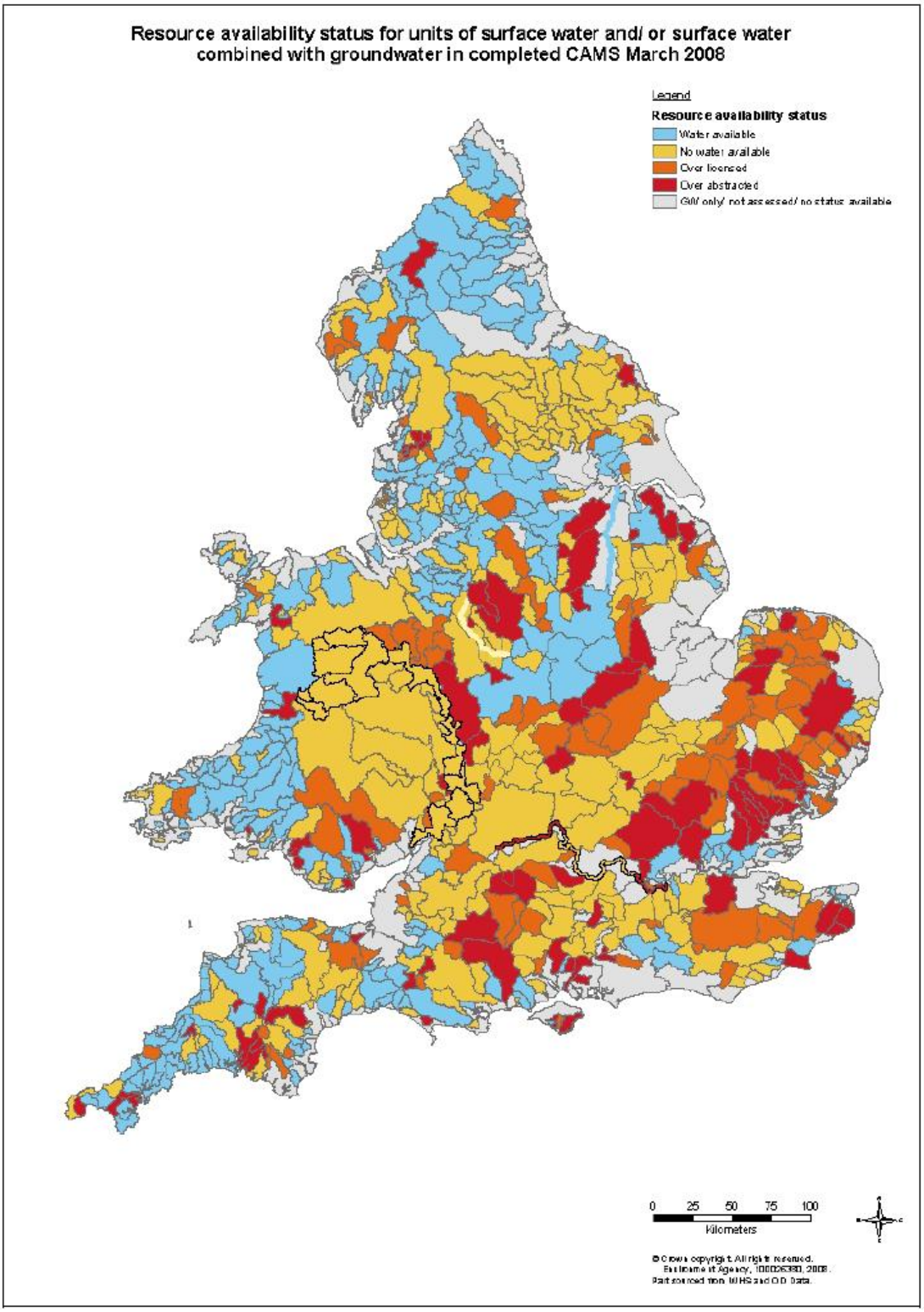
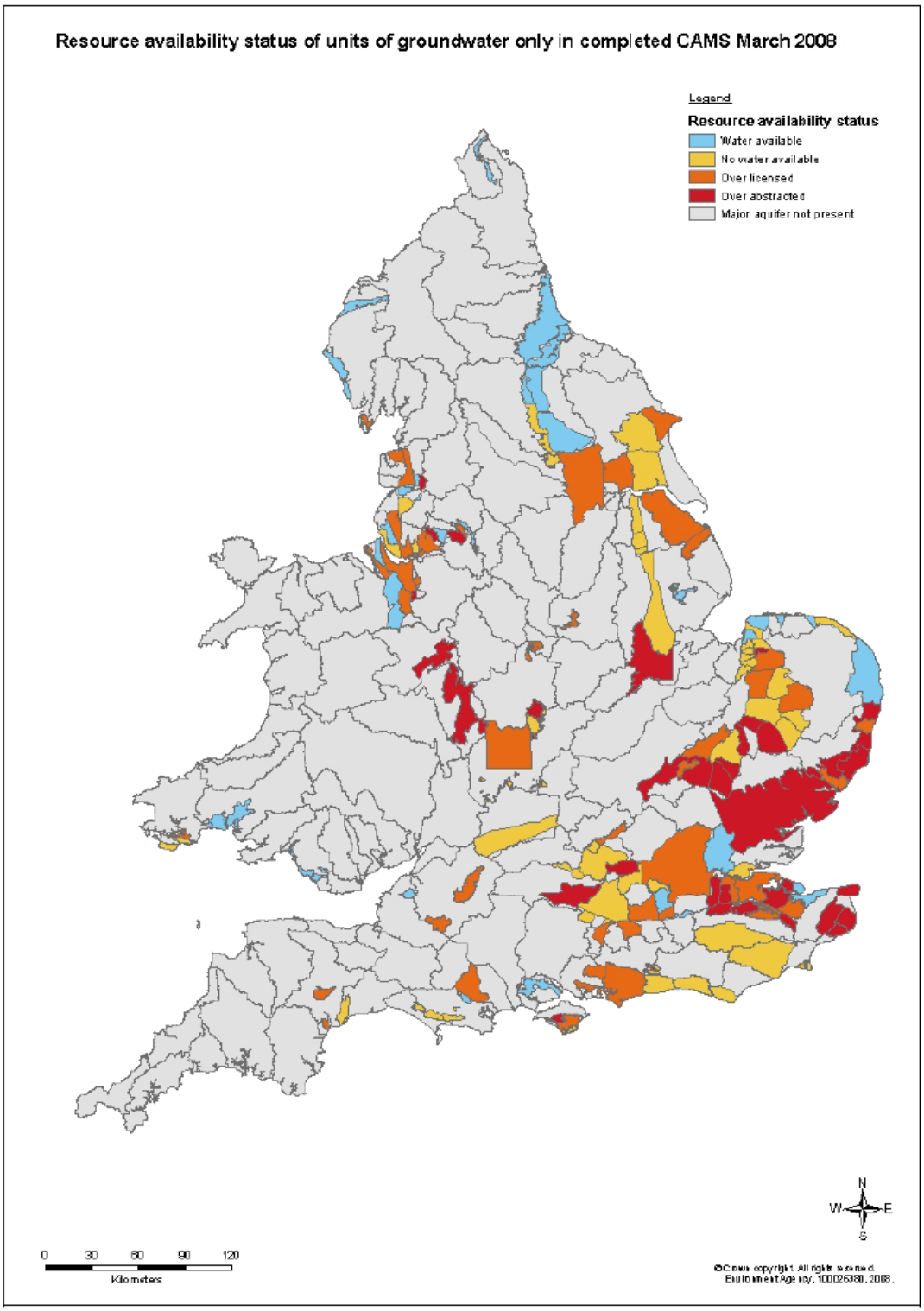


Figure 2.4 Resource availability status of units of groundwater only in completed CAMS, 2008 (EA, 2008a)



2.3.2 Scotland

Owing to mainly plentiful supplies of rainfall, issues relating to water availability are relatively rare in Scotland. Abstraction from, and impoundment of, freshwater resources in Scotland are now controlled by the Scottish Environment Protection Agency (SEPA) under the Water Environment (Controlled Activities) Regulations (Scotland) 2011. These regulations confer powers on SEPA to control the abstraction and impoundment of freshwater resources in Scotland by means of a risk-based licensing system. Such licences may be reviewed and revoked at any time.

A review of the five Catchment Management plans for Scotland (SEPA 2003a-e) revealed few stated concerns on water resource availability or over-abstraction. The Nith catchment report states that there is concern that the Dumfries and Thornhill aquifers are at risk of being over-exploited.

The River Basin Management Plans for the Scotland and Solway-Tweed river basin districts draw attention to those water bodies which are failing to meet the WFD requirement for 'good [or better] ecological status' (or 'good ecological potential' for heavily modified water bodies). In terms of those which do not meet this standard, some fail on water quantity grounds, largely due to the proximity of hydro-electric power schemes which restrict downstream flows or, for other sectors, from the threat from over-abstraction if maximum licensed volumes are taken from the water resources available (SEPA, 2009, 2011).

Increases in both household and non-household water demand are expected over the next 25 years in Scotland (Scottish Water, 2009). In addition, Scotland relies on mainly surface water sources so water resources can be affected by short term variability in climate. For example, Scottish Water applied for a drought order covering Dumfries and Galloway during July 2010; periods of low rainfall in the area throughout the Spring and early Summer severely affected reservoir levels (Scottish Water, 2010b). Long term predictions are that summer droughts will have an impact on water quality and availability for abstraction in the future (SEPA, 2007).

According to Waterwise, localised resource shortfalls could also occur in the future in south east Scotland due to rainfall variability and the structure of the distribution network (Waterwise, June 2010). Cross-border supply arrangements between Scottish Water and Northumbrian Water are theoretically possible but there is no evidence that any such arrangements are in place to mitigate shortfalls in either region.

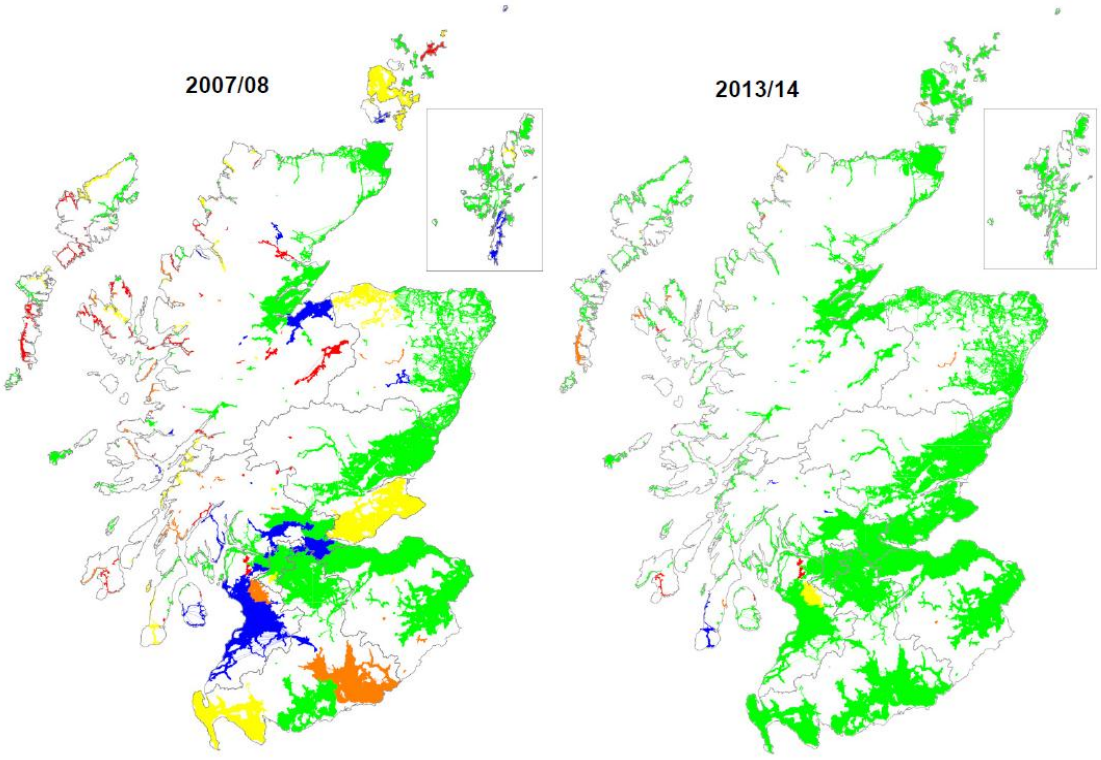
In terms of abstraction for public water supply, the latest Water Resource Plan (WRP) forecasts by Scottish Water for the supply-demand balance for each water resource zone in Scotland show little cause for concern in the short to medium term (Scottish Water 2010), with the security of supply position forecast to improve in the next few years following major investment (Figure 2.5).

2.3.3 Northern Ireland

The Abstraction and Impoundment (Northern Ireland) Regulations (2006), which came into force on 1 February 2007, confer similar powers on the Northern Ireland Environment Agency (NIEA) to those conferred on SEPA in Scotland to control abstraction and impoundment activities in Northern Ireland. As in other parts of the UK, the NIEA abstraction and impoundment licensing (AIL) team have to consider the needs of the industry, the public and the environment to make best use of available water resources without unnecessary restrictions but also safeguarding the aquatic environment and related flora and fauna. It is the responsibility of abstractors to minimise wastage and for licence holders to comply with their licence conditions and to report the volume they have abstracted on an annual basis. As in Scotland, such licences may be reviewed and revoked at any time.

Groundwater and flow monitoring is carried out so changes can be identified in future should any shortages occur. The *Summary Report of the characterisation and impact analyses required by Article 5* [of the Water Framework Directive] (NIEA 2005) indicated that were no concerns regarding water stress in Northern Ireland. NIEA, however, are paying close attention to abstraction from the Belfast Lagan Valley sandstone aquifer, a vital resource for some large abstractions (including that for public water supply). Abstracted volume can exceed 20% of the recharge potential (NIEA 2011b), and thus, in terms of the Water Exploitation Index (see chapter 2.2) this aquifer may be considered to be 'over-exploited'.

Figure 2.5 Supply demand balance deficits in Scotland during critical period for 2007/8 (actual) and 2013/14 (forecast). (Scottish Water, 2010)



Key on Map	Deficit Bandings	2007/08			2013/14 (Predicted)		
		No. of WRZs	Population ('000s)	% of SW's Population	No. of WRZs	Population ('000s)	% of SW's Population
	In Surplus	98	3487	70	197	5012	98.7
	>0 to -10%	20	806	16	4	8	0.2
	>-10% to -25%	29	538	11	9	44	0.9
	>-25% to -50%	32	109	2	10	3	0.1
	>-50%	51	44	1	10	10	0.2
	Totals	**230**	**4984**	**100%**	**230**	**5077**	**100%**

2.4 Projected future status of water availability and stress

Water is becoming a scarce resource: in many parts of the UK there is less water available per person than there is in some Mediterranean countries due to high population density (Defra, 2008).

An increasing population, increasing demand, lifestyle change along with climate change will all contribute to determining the amount of water available in the future (Abro, 2010; EA,2009a).

Climate change is expected to exacerbate decreasing water availability and water stress is expected to become more widespread. The Intergovernmental Panel on Climate Change (IPCC) states that climate change will lead to "changes in all components of the freshwater system" and concludes that "water and its availability and quality will be the main pressures on, and issues for, societies and the environment under climate change" (Bates et al, 2008).

The differences in research at global and local levels in the predicted changes in water use and availability show that there is a need for looking at climate change impacts at a local level (Downing et al, 2003). There are significant differences across the UK in the amount of water available for use shown by the WEI and the CAMS studies.

The latest UK Climate Projections (UKCP09) suggest that the UK is likely to experience:

- generally warmer summers and milder winters;
- wetter winters and a higher frequency of intense rainfall events all year round;
- an increase in severe weather events and climatic variability; and
- increased frequency of drought and flooding events.

When considering the effects of climate change, the impacts on the entire water cycle must be considered, from the availability and use of water resources, how water is returned to the environment after use, and the environmental requirements to maintain existing habitats.

The nature of these effects will vary across the UK. Changes in rainfall frequency and distribution will affect river flow, water levels and groundwater replenishment. Rain does not always fall at the right time or in the right place to meet demand. By 2050, river flows in winter are, on average, projected to increase by 10-15%. However, during the summer and early autumn months, some areas could see river flows drop by 50-80%, meaning that demand for water would not be met at these times of year. This would result in an overall total annual decrease in river flows of up to 15% compared to current values. Rivers that rely on groundwater storage are more vulnerable in the early summer whereas groundwater supplies, particularly in sandstone areas, will be lower in the autumn due to lower replenishment rates. By 2025 groundwater levels are also projected to be generally lower (EA, 2009a).

The anticipated increase in flooding events is likely to exacerbate undesirable effects of increased erosion from enhanced runoff and soil sediment deposition in downstream water bodies, with attendant environmental water quality problems. An increase in the amount of debris washing into water courses from previously dry uncompacted soils (together with potentially higher pesticide loads) may require improved or enhanced water treatment processes to maintain drinking water standards (EA, 2009a).

Groundwater supplies will also be affected: almost half of groundwater used to meet public demand is blended with other water sources due to decreasing quality resulting from diffuse pollution. Land use change will also have an effect on supply and quality of water (EA, 2009a).

Population growth and changing household size will be another factor. It is expected that across the UK the population will increase from around 61 million in 2008 to over 70 million by 2033 (ONS, 2010a). Much of the population increase is expected in areas which are already suffering or anticipated to suffer water stress (EA, 2008a). In England, two-thirds of new households are expected to be single occupant homes by 2031 (CLG, 2009). Single occupant homes use more water per capita than larger households.

Population growth in turn will lead to economic growth as we demand more services. The increase in demand for basic commodities such as food will lead to increased demand for water from both the agriculture and manufacturing sectors, placing greater pressure on our water resources. Water industry forecasts suggest total water demand will rise steadily over the next 10 years: by 2020, water demand is forecast to be 5% greater than in 2008/9 (EA, 2009a).

In addition, an ageing water supply and sewerage infrastructure may not be able to cope with changes to the demand and distribution of water and collection of wastewater, nor be sufficiently resilient to withstand extreme weather events.

2.5 Mitigation of water stress

In order to alleviate current water stress and mitigate the undesirable effects anticipated in the future, organisations including the Environment Agency, Ofwat, Defra, Water Companies, and the department for Communities and Local Government would need to work together to bring about change. Mitigation options include: (e.g. Wilby and Dessai, 2010; EA, 2009a):

- the improvement of infrastructure resilience to extreme weather events;
- changes to the metering policy of water utilities, leading to a step-change in domestic meter penetration;
- the consideration and adoption of water neutrality[4] principles in sensitive areas;

[4] *Water Neutrality is a relatively new concept; the Government and Environment Agency define Water Neutrality as* 'where total water use after development does not exceed total water use before development" *(EA, 2009b).*

- further leakage control and a reassessment of the sustainable economic level of leakage;
- the introduction of further incentives to encourage water efficiency and further market transformation to water-efficient products;
- the identification of water efficiency standards for non-household buildings; and
- the introduction of time limits in place of permanent abstraction licences.

2.6 Conclusions

Irrespective of the indicator used to describe water stress, research indicates that the work relating to freshwater availability should focus initially in the Thames, Southern and Anglian regions. Appendix J presents a map which indicates EA regions and Government Office (Euro) regions, both of which are used in this study.

All types of observations through CAMS, WEI and other water stress indicators show that much of south east England and East Anglia is currently, and will continue to be the most water stressed area, although there are a number of very localised areas elsewhere which are already over-abstracted.

Regions which deserve a 'watching brief' for action in the medium term include South West England, South Wales and the Midlands regions. The CAMS surface water stress map (Figure 2.3) shows that across much of the south Midlands, and in parts of east and north Wales, Cumbria, North Yorkshire and south-west England, there is no more water available for abstraction at low flows and restrictions would be required at higher flows. Whilst not currently over-abstracted, these regions have different pressures which make them vulnerable to intermittent increases in water stress, given the appropriate conditions. Conditions which increase vulnerability to water stress in these areas include:

- impermeable geology of an area, resulting in a reliance on surface water sources (and hence sufficient effective rainfall) to avoid water supply restrictions. The vast majority of Wales and much of south-west England rely on surface water sources due to the presence of metamorphic rather than sedimentary rocks (British Geological Survey);
- a meteorological drought (like those experienced during spring and early summer 2010 in parts of south-west Scotland and Cumbria); and
- increased transient population in these areas, e.g. from tourism.

Sectoral use of water has previously been analysed by Envirowise, ONS and in this study. The findings of this study are presented in chapters 4 and 5 plus supporting appendices. A brief review of the findings from the other studies is presented in Appendix H.

Suggested priorities for WRAP and other stakeholders on a sectoral basis can be found in chapter 6 of this report.

3.0 Data sources

3.1 Introduction

This chapter explains the methods by which volumetric data on the following aspects of the water cycle were gathered:

- water abstracted directly from water bodies (excluding tidal waters) by non-household sectors, excluding that abstracted by water utilities for public water supply;
- water supplied by water utilities to consumers through a network of water mains (mains water use);
- discharges to sewers; and
- discharges direct to water bodies.

Further detail on data requests for these is given in Appendix A, while manipulation of these data is explained in detail in Appendix B. For information, the data tables that underpin this report are available on request from WRAP, subject to terms and conditions of use.

Data were primarily sought for the financial year 2006/07 to align with data made available from water utility Water Resource Management Plan (WRMP) baseline estimates which are typically for 2006/07.

The latest revision of the Standard Industry Classification System produced by the Office of National Statistics in 2007 (SIC2007) was used to compile a consistent set of volumetric data by industrial sector code (ONS, 2009a). Not all data sources use SIC so alignment of native data source sectoral classification systems to SIC2007 was necessary. Where earlier versions of SIC sectoral classification were available, a mapping exercise carried out by ONS was used to update the SIC codes to SIC2007 (ONS, 2009b). Appendix B contains further information on the mapping exercise and methodologies used to align different data sources to SIC2007.

SIC2007 comprises numerous levels of complexity of industrial classification: for the purposes of this project, only the top two coding levels were considered ('section' e.g. construction and 'division' e.g. civil engineering). SIC2007 comprises 88 divisions (numbered between 1 and 99) across 21 sections (labelled A to U). More information on the structure of SIC can be found in Appendix C.

Comment is also provided on the quantity of water used by households. This is not the focus of this study, however, and is therefore provided only for reference.

3.2 Direct abstraction

England and Wales

The Environment Agency (EA) holds a record of abstraction licences, actual and authorised volumes abstracted from the environment in England and Wales by source type (tidal, groundwater, surface water). An abstraction licence is required for abstractions over 20 m^3/day. There are approximately 21,500 current abstraction licences in England and Wales, of which approximately 14,000 relate to direct abstraction (excluding that by water companies for public water supply) from non-tidal sources. Under the Water Act 2003, abstraction of 20 m^3/day or less became exempt from the requirement to hold a licence as of 1 April 2005. As a result 22,673 licences were deregulated, mainly for agricultural or private water supply purposes. Limited data relating to these deregulated licences exists. Only 1189 such licence holders provided return data in the last year before deregulation with the total abstracted volume of approximately 2.74 Ml/d.

Volumetric data are reported by licence holders to the EA mandatorily under The Water Resources (Abstraction and Impounding) Regulations 2006 and are held in the National Abstraction Licensing Database (NALD). A data request was submitted to the Environment Agency's abstraction licensing team by WRc in consultation with the Project Steering Group. Details of the request can be found in Appendix A.

Direct abstraction by households accounts for less than 0.5% of the total volume abstracted[5] (ONS, 2010b) and therefore has not been explored in any further detail.

Scotland

[5] *As a proportion of the volume abstracted by licence holders. The requirement to hold an abstraction licence is now subject to a minimum abstraction rate (the licensing threshold), typically 20m^3/day. Hence those who abstract less are no longer required to hold a licence: many households fall into this latter category.*

The principal legislation governing abstraction activities in Scotland is the Water Environment (Controlled Activities) (Scotland) Regulations 2011 ('CAR 2011') which came into force on 31 March 2011. This replaced the Water Environment (Controlled Activities) (Scotland) Regulations 2005 (as amended) or 'CAR 2005' which originally came into force on 1 April 2006.

This legislation confers powers on SEPA to regulate and monitor abstraction activities in Scotland, including the power to review and revoke an abstraction licence at any time. CAR is a risk-based approach to control: those wishing to abstract less than $10m^3$/day need not contact SEPA but must comply with the appropriate 'General Binding Rules'. Those wishing to abstract between 10 and 50 m^3/day must register their activities with SEPA but do not need to make an annual return. Those abstracting more than 50 m^3/day and up to 2000 m^3/day must apply for a 'simple licence'. Larger abstractors must apply for a 'complex licence' (SEPA 2008).

The conditions of each licence specify the necessary monitoring and reporting arrangements but most licence holders are expected to make an annual data return (based on calendar years) which includes abstraction volume. These annual returns are currently submitted by e-mail or by post to local SEPA offices or SEPA HQ, then manually collated. A database of licensed volumes per licence already exists. Work is nearing completion on an online portal for licence holders to submit their annual data returns electronically. This portal is expected to become 'live' in 2011 in time for the bulk of the 2011 annual data returns which are expected by January 2012. The new portal will link to SEPA's existing Compliance Assessment Scheme and Licensing Database such that breaches of licence conditions and unexpected null returns may be identified (SEPA 2011).

The CAR requires licence holders to specify the sector and purpose of their abstraction as one of fourteen categories, viz.

1. Agriculture (other than irrigation);
2. Agriculture (irrigation – mobile plant);
3. Agriculture (irrigation – fixed);
4. Drinking water supply (public);
5. Drinking water supply (private);
6. Environmental service;
7. Fish production;
8. Golf course;
9. Hydropower;
10. Industrial or commercial (process water);
11. Industrial of commercial (evaporative cooling);
12. Industrial or commercial (non-evaporative cooling);
13. Navigation (including canals); and
14. Mining and quarrying.

Data on historical actual abstracted volumes are not readily available electronically, hence sectoral analysis for Scotland has not been possible[6]. Whilst it is the case that the largest authorised volumes are in the agriculture, fish farming/aquaculture, electricity generation and manufacturing sectors, much of this water abstracted will be for non-consumptive uses (e.g. hydropower and fish farm throughflows). SEPA has undertaken to improve access to these data by employing a data team to digitise annual returns data (including actual quantities abstracted) for the years 2008, 2009 and 2010. Data prior to 2008 is believed to be less complete and hence will not be digitised. By 2012, therefore, SEPA should have licensed (authorised maximum) and actual abstraction volumes for all major licence holders in Scotland, for at last four years.

Northern Ireland

Legislation to control abstraction from freshwater resources now exists in Northern Ireland by means of the Water Abstraction and Impoundment (Licensing) Regulations (Northern Ireland) 2006 (in force from 1 February 2007). The regulations apply a risk-based approach to controlling abstraction with tighter controls for larger abstractions. As in England and Wales, those wishing to abstract 20 m^3/day or more must hold an abstraction licence, and those wishing to abstract at least 200 m^3/day may additionally be required to submit an

[6] Moran et al (2007) describes an alternative method for estimating sectoral use in Scotland. Indices of activity levels in each sector - in this case 'gross value added' (GVA) - are multiplied by fixed coefficients of water use (ML/day/£M GVA) to obtain an estimate of water use by sector in ML/day. In the absence of water use coefficients specific to Scotland, relevant values were obtained from the REWARD (Regional and Welsh Appraisal of Resource Productivity and Development 2004) environmental dataset and multiplied by GVA sectoral estimates for Scotland calculated by the Fraser of Allander Institute (FAI).

environmental assessment to the Department of Environment (Northern Ireland) under the Water Resources (Environmental Impact Assessment) Regulations (Northern Ireland) 2005 (NIEA 2011a). As in Scotland, abstraction licences may be reviewed and revoked by NIEA at any time.

According to the Water Management Unit (WMU) at NIEA, owing to the relatively short time in which the regulations have been in force and the historical absence of measuring equipment at many abstraction points, only very recent and limited actual volumetric abstraction data exist for some large abstractions. However, at time of writing, the WMU are stepping up their activity to ensure that all licence holders complete an annual data return by February 2012, focussing on large abstractions (e.g. those for public water supply and the drinks industry) in the first instance. Hence the quantity and quality of electronic data on actual abstractions available for analysis will improve from 2012 as reporting becomes a routine process for all abstraction licence holders (NIEA 2011b).

3.3 Mains water use

Data for mains water use in England and Wales were extracted from the data tables that accompany each Water Resource Management Plan (WRMP)[7]. Table WRP8 includes non-household consumption data and is divided by economic sector (though not always SIC). Three water-only companies did not populate Table WRP8 in their WRMP. At time of writing three other water utilities were subject to public inquires on their plans and one had not published their final plan. All but two companies included baseline data for 2006-07; for the two companies without data for this period, data for 2007-08 were used instead.

Similar data for Northern Ireland were sourced from Northern Ireland Water. The WRMP for NIW includes a sectoral breakdown, in percentage terms, of non-household water use. These percentages were applied to the 2006/07 annual return data of non-household water use to arrive at a volumetric estimate for each sector. (It should be noted that the sectoral breakdown in the WRMP was produced in 2008 but is believed to be sufficiently stable to be applied to data from the previous year.)

Similar data for Scotland were sought directly from Scottish Water who provided data for 2006/07.

There are a variety of methodologies employed by water utilities in deriving the baseline data so enquiries were made with appropriate contacts in each utility to better understand how the information is held and how the sectoral codes were applied. Conversations were held with contacts in 14 water utilities. All companies indicated that the baseline data were generally derived using a 'bottom-up' method, as the majority of their non-household customers are metered. One water utility did not include un-metered consumption but all others included estimated data for un-metered customers.

In general, the baseline data are accurate as they are mainly derived from metered customers[8]. However, some caution should be exercised when comparing sectors, as there are limitations in how economic sectors are assigned to customers and how they were mapped to the coding used in Table WRP8 of the WRMPs.

The storing of sector classification data in the customer billing database varies from utility to utility. Two companies employed consultants to assign their customers to the correct SIC codes and these were used to produce their WRP8 tables. The others hold some economic information against at least the majority of their customers. The classifications vary from utility to utility, with some using up-to-date SIC coding, others using older SIC codes, and the remainder using their own classification that they feel best represents the differences in use between different types of activity. Representatives from two companies mentioned that using SIC may not be the most appropriate way to look at different customers. One expressed a personal opinion that the data are limited as it is not "core water utility information" and this may have implications for accuracy, adding that there are not significant general differences between the sectors and water use between individual companies in the same sector can vary enormously. Another contact felt that the way SIC codes are assigned may not accurately reflect the activity of the customer, for example if a holding company operates in more than one sector, so the water utility has kept to their own classification as they believe it better reflects differences in use.

[7] *Each water company in England and Wales is required by the Water Industry Act 1991 s37A (as amended by the Water Act 2003) to prepare and maintain a WRMP. The Water Resources Management Plan Regulations 2007 prescribe how water utilities should prepare and publish such a plan. Plans are reviewed every 5 years by the EA. A similar requirement exists in Scotland between SEPA and Scottish Water.*

[8] *There is no legal requirement that non-households should be metered, however it is advised by Ofwat and is mentioned as a requirement in the Water Company charging schemes that non-household customers should be metered.*

3.4 Trade effluent discharge to sewer

Consents to discharge trade effluent to public sewers are granted by the UK's 12 sewerage undertakers following an application process initiated by the trade wishing to discharge. It is the responsibility of the trade to alert the undertaker if any of a number of prescribed processes or substances[9] apply to their discharge. If this is the case, the undertaker must refer the application to the relevant environmental regulator to set additional conditions before the consent to discharge may be authorised.

Trade effluent managers and officers were contacted by WRc to obtain volumes discharged by sector. The email describing the query is included in Appendix A. Where required, this email contact was followed up by a number of telephone conversations to further clarify the request and to facilitate data transmission to WRc.

The information is not readily available and each sewerage undertaker has its own process to deal with a trade effluent discharge application and its own classification for trade effluent origin.

Data were received from seven sewerage undertakers who provided details of trade effluent discharge and the type of activity from which the effluent arises. The undertakers that provided data are: Anglian Water, Northern Ireland Water, Northumbrian Water, Scottish Water, Southern Water, South West Water and Yorkshire Water. The spatial coverage of this data can be seen in Figure 3.1. Not all discharges are monitored and some datasets were based on volumes estimated for billing purposes.

Figure 3.1 UK coverage of trade effluent discharge to sewers data obtained from sewerage companies, by region

The periods for which trade effluent discharge data are available also varies within the group of companies who responded (Table 3.1). From the data presented to WRc and from annual return data reported to Ofwat, it is clear that there is significant inter-annual variation in the trade effluent volume discharged to sewers. In order to prevent bias from the use of a single year's data, a simple average of all available full-year data has been taken for each sewerage undertaker. As a quality control check, total volumes of trade effluent as reported to WRc were compared to the data supplied to the appropriate regulator by each sewerage undertaker in their annual return.

[9] *The list of prescribed processes and substances is given in the Trade Effluent (Prescribed Processes and Substances) Regulations 1989 (amended 1990).*

Table 3.1 Summary of trade effluent discharge to sewers data

Sewerage undertaker	Year(s) from 2006 for which data were provided	Time-span used in analysis	Proportion of mean annual return figure[1]
Anglian Water	2007 to 2010	Total of four years	70.98%
Northern Ireland Water	2009	Single calendar year	51.16%
Northumbrian Water	2006 to 2009	Four calendar years	51.94%[2]
Scottish Water	Not specified	Single year	85.49%
Southern Water	2006/07 to 2008/09	Three financial years	61.02%
South West Water	2007 to 2010[3]	Three calendar years[3]	99.48%
Yorkshire Water	2006 to 2009	Average of four years	92.02%

Notes on Table 3.1:

[1] Based on an arithmetic mean of three years of annual returns data ('June Return' in England and Wales).

[2] Northumbrian Water identified the difference between the data provided and the June Return value as emanating from a trade effluent discharge direct to a wastewater treatment works from a manufacturing facility. This difference was, therefore, ascribed to the manufacturing sector.

[3] 2010 is an incomplete year. The data for this year were excluded from the calculation of an average value.

A preliminary analysis of the annual returns for England and Wales indicated that the five English sewerage undertakers represented in our sample account for about one third (33.5%) of the trade effluent volume discharged to sewers in England and Wales. However, for a variety of reasons which are explained briefly in chapter 5.5, the data received by WRc from these five sewerage undertakers is equivalent to a lesser figure: 25% of the total volume of trade effluent reported to Ofwat from all the sewerage undertakers in England and Wales. Of this, approximately 11% could not be assigned to a non-household sector, therefore the final analysis by sector reported in chapter 5.5 reflects just 22% of the total trade effluent volume reported in all annual returns to Ofwat.

In light of these shortcomings, the analysis of data pertaining to trade effluent volumes discharged to sewer must be treated with caution.

3.5 Trade effluent discharge direct to water course

Trade effluent discharges direct to water courses are controlled by the relevant environmental regulator.

WRc contacted the Environment Agency Water Quality Policy and National Surface Water Quality Technical Services teams. The availability of effluent flow data for industrial sectors that discharge direct to water bodies (non-tidal) was requested. Following a number of telephone calls, it was ascertained that volumetric information was not readily available. Whilst collected locally, it is not recorded centrally and systematically and therefore not available without significant additional effort beyond the time constraints of this project.

Details of the response to our request from one EA region are given in Appendix A.

At WRc's request, the availability of data of this nature covering England and Wales was also investigated by the EA representative on the Project Steering Group. This investigation confirmed WRc's findings.

From telephone conversations with representatives from the Water Management Unit at NIEA and the freedom of information (FOI) team and other colleagues at SEPA, little volumetric data are currently readily available: much of these data, where held, are recorded locally on paper records.

No analysis was therefore possible for this component of the water cycle.

4.0 Data availability

4.1 Introduction

Available data described in chapter 3 have been summarised in one matrix split by SIC2007. The matrix, presented in chapter 4.2, includes information on available National Abstraction Licensing Database (NALD) and mains water use data; the geographical availability of data; and on water that is discharged to sewers and/or water courses. The matrix is not designed to be used in isolation, rather it provides a convenient summary of data availability and refers to other chapters of this report where necessary.

Finally, this chapter provides a summary, in chapter 4.3, of the relevance of the available data to the project and discusses the gaps and limitations in data. It makes some recommendations for filling important gaps to better inform understanding on non-household water use.

4.2 Data availability matrix

The availability matrix can be found in Table 4.1 over the following pages and represents the availability of volumetric data pertaining to abstraction, mains water use and trade effluent discharges at time of writing.

Detailed information on the manipulation of data to produce this matrix can be found in Appendix B. The structure of the SIC2007 categorisation used for this project is described in Appendix C. Further information on the alignment of NALD information with SIC2007 can be found in Appendix D.

Table 4.1 Data Availability Matrix

SIC 2007 Section and Code	Agriculture, Forestry and Fishing	Mining and quarrying
	A	B
Directly abstracted water	NALD Secondary categories 'aquaculture fish', 'aquaculture plant', 'business parks', 'food & drink', 'forestry', 'general agriculture', 'golf courses', 'horticulture and nurseries', 'industrial/commercial/energy/public services', 'mineral products', 'orchards', 'other industrial/commercial/public services', 'private non-industrial', and 'schools and colleges' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.	NALD secondary categories 'aquaculture fish', 'business parks', 'construction', 'extractive', 'golf courses', 'general Agriculture', 'mineral products' and 'other industrial/commercial/public services' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in the Appendix B.
National and Regional coverage	By EA Region. No data held electonically for Scotland or Northern Ireland, and hence no data available for this study.	
Mains water	For 19 Water Companies this could be taken directly from WRMP. For Bristol and Northumbrian Water this has been apportioned from broader category as described in Appendix B. Scottish Water had no agricultural use categories. Similar data obtained from Northern Ireland WRMP, a percentage for sectoral use has been applied to 2006/07 annual return for non-household water use to arrive at a volumetric estimate.	For 14 Water Companies this could be taken directly from WRMP or other data provided (Scottish). For others it has had to be calculated based on various apportionment methods described in the full report. Choldeton Water and Northern Ireland Water have no consumption in this category.
National and Regional coverage	Split by Water Utility boundary. Information available for all Water Companies other than Cambridge Water, Dee Valley Water and Bournemouth and West Hampshire Water.	
Water discharged to water courses	Currently no information available	
National and Regional coverage	No information available for England and Wales from Environment Agency. A data request under 'freedom of information' has been made to SEPA for information regarding Scottish discharges but no information received. Information has been received from NIEA for Northern Ireland regarding maximum permissible discharge volumes.	
Water discharged to sewers	Present in all datasets except NI and Scotland. Taken directly from Anglian Water data. For other companies industrial categories have been manually mapped to SIC (methodology included within Appendix B).	Category not present in any dataset except Scotland and Southern Water, although there are 'other' discharge categories which it has not been possible to separate out.
National and Regional coverage	Data received from Anglian Water, Northern Ireland Water, Northumbrian Water, Yorkshire Water, Scottish Water, Southern Water and South West Water only. It has not been possible to align all data to SIC as detailed in the main report.	

SIC 2007 Section and Code	Manufacturing	Electricity, gas, steam and air conditioning supply
	C	D
Directly abstracted water	NALD secondary categories 'aquaculture fish', 'breweries/wine', 'chemicals', 'construction', 'dairies', 'extractive', 'food & drink', 'general agriculture', 'golf courses', 'industrial/commercial/energy/public services', 'machinery and electronics', 'metal', 'mineral products', 'other industrial/commercial/public services', 'paper and printing', 'petrochemicals', 'rubber', 'slaughtering', 'sports grounds/facilities', and 'textiles and leather' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.	NALD secondary categories 'electricity', 'industrial/commercial/energy/public services', 'mechanical non electrical', and 'other industrial/commercial/public services' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.
National and Regional coverage	By EA Region. No data held electonically for Scotland or Northern Ireland, and hence no data available for this study.	
Mains water	For 18 Water Companies this could be taken directly from WRMP or other data provided (Scottish), although usually doesn't include sub-category C.30 (manufacture of transport). For others it has had to be calculated based on various apportionment methods described in Appendix B. Similar data obtained from Northern Ireland WRMP, a percentage for sectoral use has been applied to 2006/07 annual return for non-household water use to arrive at a volumetric estimate.	For 13 Water Companies, within the WRMP categories D and E are combined together. Other companies were apportioned using alternative methods described in the full report. Cholderton Water has no consumption in this category. Similar data obtained from Northern Ireland WRMP, a percentage for sectoral use has been applied to 2006/07 annual return for non-household water use to arrive at a volumetric estimate.
National and Regional coverage	Split by Water Utility boundary. Information available for all Water Companies other than Cambridge Water, Dee Valley Water and Bournemouth and West Hampshire Water.	
Water discharged to water courses	Currently no information available	
Regional split	No information available for England and Wales from Environment Agency. A data request under 'freedom of information' has been made to SEPA for information regarding Scottish discharges but no information received. Information has been received from NIEA for Northern Ireland regarding maximum permissible discharge volumes.	
Water discharged to sewers	Present in all 7 datasets. Taken directly from Anglian Water data. For other companies industrial categories have been manually mapped to SIC (methodology included in Appendix B).	Present in Scottish Water and South West Water dataset. Industrial categories have been manually mapped to SIC (methodology included in Appendix B).
National and Regional coverage	Data received from Anglian Water, Northern Ireland Water, Northumbrian Water, Yorkshire Water, Scottish Water, Southern Water and South West Water only. It has not been possible to align all data to SIC as detailed in the main report.	

SIC 2007 Section and Code	Water supply, sewerage, waste management and remediation activities	Construction
	E	F
Directly abstracted water	NALD secondary categories 'construction', 'general agriculture', 'industrial/commercial/energy/public services', 'mineral products', 'other industrial/commercial/public services', 'private non-industrial', 'private water undertaking', and 'refuse and recycling' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.	NALD secondary categories 'construction', 'general agriculture', 'industrial/commercial/energy/public services', 'mineral products', and 'other industrial/commercial/public services' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.
National and Regional coverage	By EA Region. No data held electonically for Scotland or Northern Ireland, and hence no data available for this study.	
Mains water	For 13 Water Companies, within the WRMP categories D and E are combined together. Other companies were apportioned using alternative methods described in the full report. Cholderton Water has no consumption in this category. Similar data obtained from Northern Ireland WRMP, a percentage for sectoral use has been applied to 2006/07 annual return for non-household water use to arrive at a volumetric estimate.	For 17 Companies this has been taken directly from WRMP or other data provided (Scottish). One company includes some elements of Category 'M' but this has not been possible to separate out. For two companies we have apportioned use from a combined category. Cholderton Water and Northern Ireland Water have no consumption in this category.
National and Regional coverage	Split by Water Utility boundary. Information available for all Water Companies other than Cambridge Water, Dee Valley Water and Bournemouth and West Hampshire Water.	
Water discharged to water courses	Currently no information available	
National and Regional coverage	No information available for England and Wales from Environment Agency. A data request under 'freedom of information' has been made to SEPA for information regarding Scottish discharges but no information received. Information has been received from NIEA for Northern Ireland regarding maximum permissible discharge volumes.	
Water discharged to sewers	Present in all data sets except Northumbrian Water. Taken directly from Anglian Water data. For other companies industrial categories have been manually mapped to SIC (methodology included in Appendix B).	Present in Scottish Water and Anglian Water dataset. Scottish Water industrial categories have been manually mapped to SIC (methodology included within Appendix B). Taken directly from Anglian Water data.
National and Regional coverage	Data received from Anglian Water, Northern Ireland Water, Northumbrian Water, Yorkshire Water, Scottish Water, Southern Water and South West Water only. It has not been possible to align all data to SIC as detailed in the main report.	

SIC 2007 Section and Code	Wholesale and retail trade; repair of motor vehicles and motorcycles	Transportation and storage
	G	H
Directly abstracted water	NALD secondary categories 'general agriculture', 'holiday sites, camp sites & tourist attractions', 'horticulture and nurseries', 'industrial/commercial/energy/public services', 'mineral products', 'other industrial/commercial/public services' and 'retail' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in the Appendix B.	NALD secondary categories 'business parks', 'navigation', 'other industrial/commercial/public services' and 'transport' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.
National and Regional coverage	By EA Region. No data held electonically for Scotland or Northern Ireland, and hence no data available for this study.	
Mains water	For 17 Companies this has been taken directly from WRMP or other data provided (Scottish). For South Staffs Water the category 'Sundry Supplies - trade data' has been mapped to SIC G. For Bristol Water and Northumbrian Water data has been apportioned from a broader category using employment figures. For Wessex Water the most appropriate method of apportionment from a broader category covering SIC G and R,S,T,U is considered to be based on the proportion of consumption in these categories in other Companies. Similar data obtained from Northern Ireland WRMP, a percentage for sectoral use has been applied to 2006/07 annual return for non-household water use to arrive at a volumetric estimate.	For 13 Companies this could be taken directly from WRMP or other data provided (Scottish) although it has not been able to separate out SIC C30 from from the slightly broader category 'Transportation and manufacture of transport equipment' defined in the WRMP template. For Bristol Water and Northumbrian Water data has been apportioned from a broader category using employment figures. Northern Ireland Water has no consumption in this category.
National and Regional coverage	Split by Water Utility boundary. Information available for all Water Companies other than Cambridge Water, Dee Valley Water and Bournemouth and West Hampshire Water.	
Water discharged to water courses	Currently no information available	
National and Regional coverage	No information available for England and Wales from Environment Agency. A data request under 'freedom of information' has been made to SEPA for information regarding Scottish discharges but no information received. Information has been received from NIEA for Northern Ireland regarding maximum permissible discharge volumes.	
Water discharged to sewers	Present in all datasets. Taken directly from Anglian Water data. For other companies industrial categories have been manually mapped to SIC (methodology included within Appendix B).	Present in NI, Scottish Water and Anglian Water dataset. Scottish Water industrial categories have been manually mapped to SIC (methodology included within Appendix B). Taken directly from Anglian Water data.
National and Regional coverage	Data received from Anglian Water, Northern Ireland Water, Northumbrian Water, Yorkshire Water, Scottish Water, Southern Water and South West Water only. It has not been possible to align all data to SIC as detailed in the main report.	

SIC 2007 Section and Code	Accommodation and food service activities	Information and communication
	I	J
Directly abstracted water	NALD secondary categories 'holiday sites, camp sites & tourist attractions', 'hotels, public houses and conference centres', 'industrial/commercial/energy/public services', and 'other industrial/commercial/public services' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.	NALD secondary categories 'industrial/commercial/energy/public services' and 'other industrial/commercial/public services' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.
National and Regional coverage	By EA Region. No data held electonically for Scotland or Northern Ireland, and hence no data available for this study.	
Mains water	For 18 Companies this could be taken directly from the WRMP or other data provided (Scottish) . For Bristol Water and Northumbrian Water data has been apportioned from a broader category using employment figures. Taken directly from Wessex Water WRMP. Similar data obtained from Northern Ireland WRMP, a percentage for sectoral use has been applied to 2006/07 annual return for non-household water use to arrive at a volumetric estimate.	For 15 Companies this has been apportioned from a broader category using employment figures. For Scottish Water this could be calculated from data provided. Northern Ireland Water has no consumption in this category.
National and Regional coverage	Split by Water Utility boundary. Information available for all Water Companies other than Cambridge Water, Dee Valley Water and Bournemouth and West Hampshire Water.	
Water discharged to water courses	Currently no information available	
National and Regional coverage	No information available for England and Wales from Environment Agency. A data request under 'freedom of information' has been made to SEPA for information regarding Scottish discharges but no information received. Information has been received from NIEA for Northern Ireland regarding maximum permissible discharge volumes.	
Water discharged to sewers	Category not present in any dataset, although there are 'other' discharge categories which it has not been possible to separate out.	Present in Anglian Water dataset. Taken directly from Anglian Water data.
National and Regional coverage	Data received from Anglian Water, Northern Ireland Water, Northumbrian Water, Yorkshire Water, Scottish Water, Southern Water and South West Water only. It has not been possible to align all data to SIC as detailed in the main report.	

SIC 2007 Section and Code	Financial and insurance activities	Real estate activities
	K	L
Directly abstracted water	NALD secondary categories 'business parks', 'industrial/commerical/energy/public services' and 'other industrial/commercial/public services' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.	NALD secondary categories 'business parks', 'construction', 'general agriculture', 'holiday sites, camp sites & tourist attractions', 'hotels, public houses and conference centres', 'industrial/commercial/energy/public services' and 'other industrial/commercial/public services' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.
National and Regional coverage	By EA Region. No data held electonically for Scotland or Northern Ireland, and hence no data available for this study.	
Mains water	For 15 Companies this has been apportioned from a broader category using employment figures. For Scottish Water this could be calculated from data provided. Northern Ireland Water has no consumption in this category.	For 15 Companies this has been apportioned from a broader category using employment figures. Scottish Water had no consumption in this category. Northern Ireland Water has no consumption in this category.
National and Regional coverage	Split by Water Utility boundary. Information available for all Water Companies other than Cambridge Water, Dee Valley Water and Bournemouth and West Hampshire Water.	
Water discharged to water courses	Currently no information available	
National and Regional coverage	No information available for England and Wales from Environment Agency. A data request under 'freedom of information' has been made to SEPA for information regarding Scottish discharges but no information received. Information has been received from NIEA for Northern Ireland regarding maximum permissible discharge volumes.	
Water discharged to sewers	Category not present in any dataset, although there are 'other' discharge categories which it has not been possible to separate out.	Category not present in any dataset, although there are 'other' discharge categories which it has not been possible to separate out.
National and Regional coverage	Data received from Anglian Water, Northern Ireland Water, Northumbrian Water, Yorkshire Water, Scottish Water, Southern Water and South West Water only. It has not been possible to align all data to SIC as detailed in the main report.	

SIC 2007 Section and Code	Professional, scientific and technical activities	Administrative and support service activities
	M	N
Directly abstracted water	NALD secondary categories 'business parks', 'industrial/commercial/energy/public services', 'mineral products', 'other industrial/commercial/public services', 'private non-industrial' and 'research non-univeristy/college' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.	NALD secondary category 'other industrial/commercial/public services' contributes to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.
National and Regional coverage	By EA Region. No data held electonically for Scotland or Northern Ireland, and hence no data available for this study.	
Mains water	For 15 Companies this has been apportioned from a broader category using employment figures. For Welsh Water this also includes data from a category entitled 'Enginering (Electrical, Mechanical and Instrument)' in their WRMP. For Scottish Water this could be calculated from data provided. Northern Ireland Water has no consumption in this category.	For 13 Companies this has been apportioned from a broader category using employment figures. For 2 Companies this could be taken directly from the WRMP or other data provided (Scottish). Northern Ireland Water has no consumption in this category.
National and Regional coverage	Split by Water Utility boundary. Information available for all Water Companies other than Cambridge Water, Dee Valley Water and Bournemouth and West Hampshire Water.	
Water discharged to water courses	Currently no information available	
National and Regional coverage	No information available for England and Wales from Environment Agency. A data request under 'freedom of information' has been made to SEPA for information regarding Scottish discharges but no information received. Information has been received from NIEA for Northern Ireland regarding maximum permissible discharge volumes.	
Water discharged to sewers	Present in all datasets except NI. Taken directly from Anglian Water data. For other companies industrial categories have been manually mapped to SIC (methodology included within Appendix B).	Present in all data sets except NI & Northumbrian Water. Taken directly from Anglian Water data. For other companies industrial categories have been manually mapped to SIC (methodology included within Appendix B).
National and Regional coverage	Data received from Anglian Water, Northern Ireland Water, Northumbrian Water, Yorkshire Water, Scottish Water, Southern Water and South West Water only. It has not been possible to align all data to SIC as detailed in the main report.	

SIC 2007 Section and Code	Public administration and defence etc.	Education
	O	P
Directly abstracted water	NALD secondary categories 'golf courses', 'hotels, public houses and conference centres', 'holiday sites, camp sites & tourist attractions', 'industrial/commercial/energy/public services', 'municipal grounds', 'other industrial/commercial/public services' and 'public administration' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.	NALD secondary categories 'general agriculture', 'hotels, public houses and conference centres', 'industrial/commercial/energy/public services', 'mineral products' and 'schools and colleges' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.
National and Regional coverage	By EA Region. No data held electonically for Scotland or Northern Ireland, and hence no data available for this study.	
Mains water	For 13 Companies this has been apportioned from a broader category using employment figures. For SWW this could be taken directly from the WRMP. For Wessex Water this has been apportioned from a broader category covering SIC O, P and Q using proportions from other companies. For Scottish Water this could be calculated using data provided. Similar data obtained from Northern Ireland WRMP, a percentage for sectoral use has been applied to 2006/07 annual return for non-household water use to arrive at a volumetric estimate.	For 15 Companies this has been apportioned from a broader category using employment figures. For two companies this could be taken directly from the WRMP. For Wessex Water this has been apportioned from a broader category covering SIC O, P and Q using proportions from other companies. For Scottish Water this could be calculated using data provided. Similar data obtained from Northern Ireland WRMP, a percentage for sectoral use has been applied to 2006/07 annual return for non-household water use to arrive at a volumetric estimate.
National and Regional coverage	Split by Water Utility boundary. Information available for all Water Companies other than Cambridge Water, Dee Valley Water and Bournemouth and West Hampshire Water.	
Water discharged to water courses	Currently no information available	
National and Regional coverage	No information available for England and Wales from Environment Agency. A data request under 'freedom of information' has been made to SEPA for information regarding Scottish discharges but no information received. Information has been received from NIEA for Northern Ireland regarding maximum permissible discharge volumes.	
Water discharged to sewers	Category not present in any dataset, although there are 'other' discharge categories which it has not been possible to separate out.	Present in Anglian Water dataset. Taken directly from Anglian Water data.
National and Regional coverage	Data received from Anglian Water, Northern Ireland Water, Northumbrian Water, Yorkshire Water, Scottish Water, Southern Water and South West Water only. It has not been possible to align all data to SIC as detailed in the main report.	

SIC 2007 Section and Code	Human health and social work activities	Arts, entertainment and recreation
	Q	R
Directly abstracted water	NALD secondary categories 'hospitals' and 'other industrial/commercial/public services' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.	NALD secondary categories 'business parks', 'chemicals', 'construction', 'electricity', 'extractive', 'general agriculture', 'golf courses', 'holiday sites, camp sites & tourist attractions', 'hotels, public houses and conference centres', 'industrial/commerical/energy/public services', 'machinery and electronics', 'mechanical non electrical', 'metal', 'mineral products', 'municipal grounds', 'navigation', 'other industrial/commercial/public services', 'petrochemicals', 'private non-industrial', 'racecourses', 'research non-university / college', 'rubber', 'sports grounds/facilities' and 'zoos/kennels/stables' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.
National and Regional coverage	By EA Region. No data held electonically for Scotland or Northern Ireland, and hence no data available for this study.	
Mains water	For 15 Companies this has been apportioned from a broader category using employment figures. For two companies this could be taken directly from the WRMP. For Wessex Water this has been apportioned from a broader category covering SIC O, P and Q using proportions from other companies. For Scottish Water this could be calculated using data provided. Similar data obtained from Northern Ireland WRMP, a percentage for sectoral use has been applied to 2006/07 annual return for non-household water use to arrive at a volumetric estimate.	Categories R,S,T and U are combined and it is not possible to realistically separate these for 16 companies. For South Staffs Water information is taken from Category 'sport and recreation' defined in their WRMP. For Wessex Water the most appropriate method of apportionment from a broader category covering SIC G and R,S,T,U is considered to be based on the proportion of consumption in these categories in other Companies. For Scottish Water this could be calculated using data provided. Similar data obtained from Northern Ireland WRMP, a percentage for sectoral use has been applied to 2006/07 annual return for non-household water use to arrive at a volumetric estimate.
National and Regional coverage	Split by Water Utility boundary. Information available for all Water Companies other than Cambridge Water, Dee Valley Water and Bournemouth and West Hampshire Water.	
Water discharged to water courses	Currently no information available	
National and Regional coverage	No information available for England and Wales from Environment Agency. A data request under 'freedom of information' has been made to SEPA for information regarding Scottish discharges but no information received. Information has been received from NIEA for Northern Ireland regarding maximum permissible discharge volumes.	
Water discharged to sewers	Present in NI, Scottish Water and Yorkshire Water dataset. Industrial categories have been manually mapped to SIC (methodology included within Appendix B).	Present in all datasets. Taken directly from Anglian Water data. For other companies industrial categories have been manually mapped to SIC (methodology included within Appendix B).
National and Regional coverage	Data received from Anglian Water, Northern Ireland Water, Northumbrian Water, Yorkshire Water, Scottish Water, Southern Water and South West Water only. It has not been possible to align all data to SIC as detailed in the main report.	

SIC 2007 Section and Code	Other service activities	Activities of households as employers etc.
	S	T
Directly abstracted water	NALD secondary categories 'holiday sites, camp sites & tourist attractions', 'industrial/commerical/energy/public services', 'laundry', 'other industrial/commercial/public services' and 'private non-industrial' all contribute to this category. This has been determined through detailed mapping of SIC to NALD at the SIC 'group' level, and some manual reclassification of NALD data described in Appendix B.	No NALD data within this category
National and Regional coverage	By EA Region. No data held electonically for Scotland or Northern Ireland, and hence no data available for this study.	Not applicable
Mains water	Categories R,S,T and U are combined and it is not possible to realistically separate these for 16 companies. For South Staffs Water information is taken from Category 'laundry' defined in their WRMP. For Wessex Water the most appropriate method of apportionment from a broader category covering SIC G and R,S,T,U is considered to be based on the proportion of consumption in these categories in other Companies. For Scottish Water this could be calculated using data provided. Similar data obtained from Northern Ireland WRMP, a percentage for sectoral use has been applied to 2006/07 annual return for non-household water use to arrive at a volumetric estimate.	Categories R,S,T and U are combined and it is not possible to realistically separate these for 16 companies. For Wessex Water the most appropriate method of apportionment from a broader category covering SIC G and R,S,T,U is considered to be based on the proportion of consumption in these categories in other Companies. For Scottish Water this could be calculated using data provided. Similar data obtained from Northern Ireland WRMP, a percentage for sectoral use has been applied to 2006/07 annual return for non-household water use to arrive at a volumetric estimate.
National and Regional coverage	Split by Water Utility boundary. Information available for all Water Companies other than Cambridge Water, Dee Valley Water and Bournemouth and West Hampshire Water.	
Water discharged to water courses	Currently no information available	
National and Regional coverage	No information available for England and Wales from Environment Agency. A data request under 'freedom of information' has been made to SEPA for information regarding Scottish discharges but no information received. Information has been received from NIEA for Northern Ireland regarding maximum permissible discharge volumes.	
Water discharged to sewers	Present in all data sets except Anglian Water. Industrial categories have been manually mapped to SIC (methodology included within Appendix B).	Present in Anglian Water dataset. Taken directly from Anglian Water data.
National and Regional coverage	Data received from Anglian Water, Northern Ireland Water, Northumbrian Water, Yorkshire Water, Scottish Water, Southern Water and South West Water only. It has not been possible to align all data to SIC as detailed in the main report.	

SIC 2007 Section and Code	Activities of extraterritorial organizations and bodies	
	U	
Directly abstracted water	No NALD data within this category	
National and Regional coverage	Not applicable	
Mains water	Categories R,S,T and U are combined and it is not possible to realistically separate these for 16 companies. For Wessex Water the most appropriate method of apportionment from a broader category covering SIC G and R,S,T,U is considered to be based on the proportion of consumption in these categories in other Companies. For Scottish Water this could be calculated using data provided. Similar data obtained from Northern Ireland WRMP, a percentage for sectoral use has been applied to 2006/07 annual return for non-household water use to arrive at a volumetric estimate.	
National and Regional coverage	Split by Water Utility boundary. Information available for all Water Companies other than Cambridge Water, Dee Valley Water and Bournemouth and West Hampshire Water.	
Water discharged to water courses	Currently no information available	
National and Regional coverage	No information available for England and Wales from Environment Agency. A data request under 'freedom of information' has been made to SEPA for information regarding Scottish discharges but no information received. Information has been received from NIEA for Northern Ireland regarding maximum permissible discharge volumes.	
Water discharged to sewers	Category not present in any dataset, although there are 'other' discharge categories which it has not been possible to separate out.	
National and Regional coverage	Data received from Anglian Water, Northern Ireland Water, Northumbrian Water, Yorkshire Water, Scottish Water, Southern Water and South West Water only. It has not been possible to align all data to SIC as detailed in the main report.	

4.3 Discussion and conclusions relating to data availability

4.3.1 The use of SIC2007

The use of SIC2007 as a means to classify different types of non-household use allows information to be compared from a variety of sources. However, its use does require the translation of data from other classifications and this has entailed some extensive data manipulation in some cases and the use of assumptions (listed in chapter 3).

Although the act of aligning data sources to SIC2007 has been completed, it is sensible when considering the purpose of the project – namely to give WRAP and other stakeholders a clear understanding of where it should focus its activities on reducing commercial and industrial water use – to consider if groups of SIC2007 (such as R, S, T and U) will have similar uses of water and therefore to consider them as one group of uses. For instance, all office based sectors will have very similar types of use – primarily domestic for urinals, WC flushing and hand washing, and therefore could usefully be considered as one category.

4.3.2 Gaps in available data

Direct abstraction

At time of writing, actual volumetric abstraction data were not available centrally and electronically for Northern Ireland or Scotland (see chapter 3). Electronic data improvement projects are underway in each of these areas such that analysis similar to that carried out using NALD data may be conducted in the years ahead.

NALD data (covering England and Wales) has a number of blank returns entries – indicating the data has not been received by the Environment Agency (EA). It is standard for the EA to estimate the returns for these licences, and a process to do this has also been followed for the purpose of this project, as detailed in chapter 3. A similar[10] methodology to that used by the EA has been followed for this study and is described in Appendix B. This allows the estimation of returns by SIC section.

Mains water use

No data were available for Bournemouth and West Hampshire Water, Dee Valley Water or Cambridge Water. For Thames Water, Portsmouth Water and South East Water, only figures from the draft Water Resource Management Plans (WRMPs) were available, however representatives at each utility in this position stated that little change was expected in the figures used for this study between draft and final Plans.

Detailed discussions with water utilities indicate that it is common practice to estimate water use within different sectors using economic analysis. Whilst the majority of water utilities approached held some form of record of the non-household sector of their customers on the billing system, in the majority of cases, the sectors used were broad and required economic disaggregation to allow the WRMP Table 8 to be populated. One utility held no sector-related information within the billing system, and several had incomplete information on their customers. This is a weakness in the data, as there is likely to be a high level of uncertainty associated with estimated data within the WRMP Table 8.

Trade effluent discharged to sewers

There is currently limited sectoral information on trade effluent volumes discharged to sewers. Data were available from Anglian Water, Northumbrian Water, Yorkshire Water, Scottish Water, Southern Water and South West Water. Some information was also received from Northern Ireland Water for the year 2009. It has not been possible to assign all of the data provided to SIC2007 categories.

Trade effluent discharged to water courses

There are currently no data available from any region (EA, SEPA or NIEA) on volumes of water discharged directly to water courses. For the EA, Regional Data, Public Register and Pollution Prevention and Control (PPC) teams were contacted.

Under PPC, permit holders are obliged to record flow data, but not send it all in to the EA. The EA require only maximum values, for example, every few months. Permit holders are required to store the more detailed flow data (e.g. 15 minute values or longer durations) and send it to the EA only if it is requested, but it is not routine to send any flow data in on a set frequency.

[10] The methodology is similar but will not necessarily produce identical results. Differences will remain due to the way in which information is stored in NALD whereby single licences have multiple uses and therefore SIC2007 sectors assigned to them.

Similarly, for discharge consents granted to private and industrial discharges, the consent holder is required to hold records of flow readings, but not submit this data to the EA. It is understood that the EA will generally only request such data if a problem were to occur downstream of the discharge.

From telephone conversations with representatives from the Water Management Unit at NIEA and the Freedom of Information (FOI) team and other colleagues at SEPA, little volumetric data are currently readily available: much of these data, where held, are recorded locally on paper records.

4.3.3 Recommendations for filling data gaps

Suggestions for how gaps in water use data and discharge data might be filled are presented here. It should be noted however that any additional data found from additional suggested sources will not have been collected via a consistent process; therefore care would have to be taken if it is used in conjunction with any national data sets such as NALD or Water Resource Management Plans.

The data available for use in this study provides a major step forward in bringing together disparate data to draw conclusions on which areas (geographic and sectoral) deserve greater attention in respect of water efficiency and conservation by WRAP and other stakeholders. Further assessment would be required to inform the potential for water conservation measures and their implementation by conducting sector-specific research.

Gaps in water use data

Whilst there are no major gaps in terms of missing information for any particular sector, once the sectors with highest apparent water use have been ascertained it would be prudent to confirm estimates of volumes through engagement with the relevant sectors. This could be through trade associations or other sector-specific initiatives to obtain key performance indicator (KPI) information, for example.

In addition, it would be instructive to look at benchmark data available from previous studies by industry (e.g. the data underpinning the WRAP/ Envirowise online water benchmarking tool (Envirowise, 2011)).

Gaps in discharge data

There are significant gaps in information regarding discharges, particularly those direct to the environment. It may therefore be appropriate to consider water-using processes for the highest priority sectors (those that appear to use the highest volumes of water) and work with sector bodies / trade associations to see if an estimate of proportion discharged to sewer and/or water course can be identified. Organisations may already have access to this information and could be contacted directly, perhaps starting with those which discharge significant volumes to sensitive catchments.

5.0 Sectoral and regional water use data analysis

5.1 Introduction

This chapter of the report presents the results of the data collation and manipulation exercise described in chapter 4. Results are presented initially split between direct abstraction and mains water, and then are combined together to represent total water consumption across the UK.

The data analysis undertaken was completed to meet WRAP's objectives (Chapter 1.1) and thus is not intended to replace or be compared directly to other published data. Whilst every effort has been made to replicate analysis of NALD conducted for previous studies, differences in categorisation methods and assumptions made remain. The analysis of direct abstraction data deliberately excludes figures for direct abstraction for public water supply as information on the sectoral use of public water supply was sought from water utilities instead.

The data are split by region to allow comparison with the review of current understanding on water availability and stress described in chapter 2.

For the purpose of analysing water abstracted from the environment, data were available by EA region, whereas mains water consumption data were available by water utility area. Work was therefore carried out to align all reported data to EA region.

Any use of abstracted water may be regarded as 'consumptive' or 'non-consumptive'. Consumptive water uses are conventionally defined as those where water is evaporated, transpired, incorporated into products or crops, or consumed by humans or livestock. When considering water conservation measures it is prudent to consider consumptive uses, as these are where water is not being returned to the immediate environment. However, it is also sensible to consider uses where significant treatment is required to return effluent to a suitable water quality for return to the environment, particularly where such treatment processes are energy (and hence carbon) intensive. It is WRc's view that processes which return water to the immediate environment in a short period of time (and hence may be conventionally regarded as non-consumptive) cannot be regarded as truly non-consumptive if significant wastewater treatment is required before the water can be safely discharged. Hence, for the purposes of this project, **non-consumptive uses of abstracted water are those where water is returned after use to the immediate environment with little or no treatment**. These are water used for:

- fish farm/cress pond throughflow;
- hydraulic rams;
- hydroelectric power generation;
- milling and water power other than electricity generation;
- non-evaporative cooling; and
- transfers between sources.

Throughout this report, **consumptive uses of abstracted water are therefore taken to be all uses excluding those listed above**[11]**.** Throughout the chapter, details of quality control through comparison of this study with other available data sources are described including a commentary of how our analysis has been affected by these checks, and why differences are seen between the results presented here and elsewhere.

It is not possible from the data available to ascertain what proportion of mains water is used for non-consumptive purposes. It is logical to assume if a non-household user were discharging large volumes of water to the environment after use, that it would be less expensive for them to extract the water directly from the environment locally than use mains water for this purpose. Large volumes of (formerly) mains water discharged to the environment following a non-consumptive use is not only an expensive (and arguably wasteful) use of resources but may also cause problems in the local environment. Following this argument and applying a similar definition to that used for directly abstracted water leads to the conclusion that the vast majority of mains water must be used consumptively as it is unlikely to be returned to the immediate environment whence it came. Hence, unlike the estimates derived for volumes directly abstracted, no upper and lower bound estimates are created for main water use.

[11] *This is a similar definition to that used in the SEPA Water Environment Charging Scheme Guidance (SEPA, 2010), which defines three levels of 'consumptiveness'. The above uses (excepting 'milling and water power') are included in the 'non-consumptive' category in SEPA's charging scheme guidance, which defines 'non-consumptive' uses as those in which at least 95% of the water abstracted is returned to the immediate environment from which it was abstracted.*

5.2 Direct abstraction

5.2.1 Direct abstraction data

An assessment of the total volume directly abstracted from all non-tidal sources excluding non-consumptive uses is presented in Table 5.1 and Table 5.2 by region and nation[12].

A further assessment in relation to non-tidal surface water only and groundwater only is presented in Appendix F. An assessment of the total volume directly abstracted including major non-consumptive uses from all non-tidal sources, non-tidal surface water sources only and groundwater sources only is presented in Appendix G.

Table 5.1 shows for each EA region and nation, the total volume directly abstracted with respect to the upper bound from all non-tidal sources in England and Wales in 2006 by each industrial or commercial sector (i.e. excluding that abstracted for public water supply). Table 5.2 shows the same data with respect to the lower bound for the total volume directly abstracted. Theses total volumes of directly abstracted water from all non-tidal sources include estimates for the null returns in the NALD information. The estimation methodology is described in Appendix B.

[12] *Note that no data are currently readily available on actual volumes abstracted for Scotland and Northern Ireland from abstraction licensing information held by SEPA and NIEA respectively. Moran et al (2007) presents a sectoral analysis for Scotland using economic indicators and estimates of water use per GVA for each sector. This analysis is incompatible with that carried out in this project but indicates that, apart from electricity generation (mainly hydropower) and fish-farming/aquaculture, the largest non-household water users in Scotland are electrical and instrument engineering; manufacturing of chemicals and fibres; food, drink and tobacco; and manufacturing of metals and metal products. Moran et al (2007) also reports an estimate of the proportion of water use in selected sectors which is directly abstracted. However, no quantitative information on the proportion of abstracted water which is used for non-consumptive uses is available.*

Table 5.1 Estimated volume directly abstracted in England and Wales from all non-tidal sources, excluding major non-consumptive uses (upper bound estimate) and excluding that abstracted for public water supply, by sector and EA region (Ml, 2006)

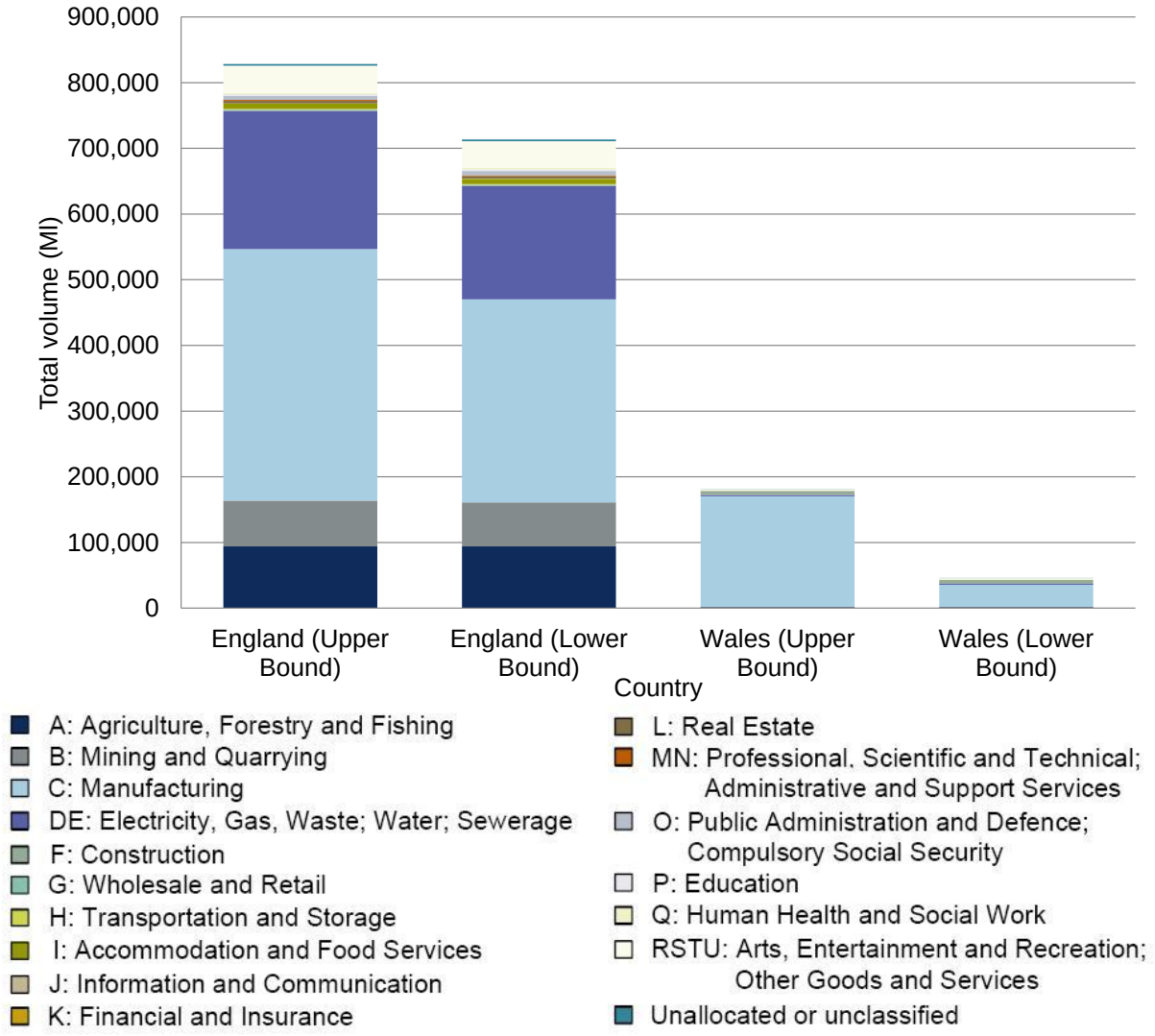
SIC2007 Section	Description	Anglian	Yorkshire and NE	North West	South West	Southern	Midlands	Thames	Wales	England Total	Wales Total	Grand Total	*Rank*
A	Agriculture, Forestry and Fishing	48,893	9,390	1,565	6,043	6,839	18,604	2,917	1,689	94,250	1,689	**95,938**	*3*
B	Mining and Quarrying	7,991	7,711	14,398	7,340	2,129	19,262	10,658	598	69,488	598	**70,086**	*4*
C	Manufacturing	27,214	38,939	189,871	12,869	31,239	77,305	5,391	168,218	382,829	168,218	**551,047**	*1*
DE	Electricity, Gas, Waste; Water; Sewerage	4,817	76,330	13,813	571	63	74,316	40,423	1,792	210,333	1,792	**212,125**	*2*
F	Construction	287	124	40	1	920	29	70	5,496	1,470	5,496	**6,967**	*8*
G	Wholesale and Retail	101	39	122	15	0	21	411	6	709	6	**715**	*15*
H	Transportation and Storage		164	10	0	316	4	456	2	952	2	**953**	*14*
I	Accommodation and Food Services	124	90	6,824	544	1	15	362	300	7,959	300	**8,259**	*6*
J	Information and Communication		1			27		76		104		**104**	*17*
K	Financial and Insurance	70		0	229		37	49		386		**386**	*16*
L	Real Estate	103	259	2,547	27	62	32	788		3,818		**3,818**	*9*
MN	Professional, Scientific and Technical; Administrative and Support Services	375	72	53	0	0	45	686	0	1,231	0	**1,231**	*13*
O	Public Administration and Defence; Compulsory Social Security	44	2	1,030	5,149	5	23	236	814	6,489	814	**7,303**	*7*
P	Education	51	110	1,020	982	20	105	119		2,407		**2,407**	*11*
Q	Human Health and Social Work		85	289	128	112	577	949	10	2,140	10	**2,150**	*12*
RSTU	Arts, Entertainment and Recreation; Other Goods and Services	5,357	2,161	3,007	5,561	933	14,379	9,836	2,616	41,233	2,616	**43,849**	*5*
Unclassified	Unallocated or unclassified	62	212	880	1,036	2	226	20	0	2,438	0	**2,438**	*10*
	Total	**95,489**	**135,688**	**235,469**	**40,495**	**42,668**	**204,980**	**73,447**	**181,541**	**828,236**	**181,541**	**1,009,777**	
	Rank	*5*	*4*	*1*	*8*	*7*	*2*	*6*	*3*				

Table 5.2 Estimated volume directly abstracted in England and Wales from all non-tidal sources, excluding major non-consumptive uses (lower bound estimate) and excluding that abstracted for public water supply, by sector and EA region (Ml, 2006)

SIC2007 Section	Description	Anglian	Yorkshire and NE	North West	South West	Southern	Midlands	Thames	Wales	England Total	Wales Total	Grand Total	*Rank*
A	Agriculture, Forestry and Fishing	48,778	9,390	1,555	6,043	6,839	18,573	2,917	1,620	94,094	1,620	**95,714**	*3*
B	Mining and Quarrying	7,991	7,711	12,927	7,340	2,045	18,258	10,658	486	66,928	486	**67,414**	*4*
C	Manufacturing	22,988	38,939	188,041	10,368	31,239	12,242	5,296	33,383	309,113	33,383	**342,496**	*1*
DE	Electricity, Gas, Waste; Water; Sewerage	4,817	76,330	8,823	571	63	41,262	40,423	1,792	172,289	1,792	**174,081**	*2*
F	Construction	287	124	40	1	920	29	70	5,496	1,470	5,496	**6,967**	*7*
G	Wholesale and Retail	101	39	122	15	0	21	411	6	709	6	**715**	*15*
H	Transportation and Storage		164	10	0	316	4	456	2	952	2	**953**	*14*
I	Accommodation and Food Services	124	90	6,824	544	1	15	362	300	7,959	300	**8,259**	*6*
J	Information and Communication		1			27		76		104		**104**	*17*
K	Financial and Insurance	70		0	229		37	49		386		**386**	*16*
L	Real Estate	103	259	2,547	27	62	32	788		3,818		**3,818**	*9*
MN	Professional, Scientific and Technical; Administrative and Support Services	375	72	53	0	0	45	686	0	1,231	0	**1,231**	*13*
O	Public Administration and Defence; Compulsory Social Security	44	2	1,030	5,149	5	23	236	7	6,489	7	**6,496**	*8*
P	Education	51	110	1,020	982	20	105	119		2,407		**2,407**	*11*
Q	Human Health and Social Work		85	289	128	112	577	949	10	2,140	10	**2,150**	*12*
RSTU	Arts, Entertainment and Recreation; Other Goods and Services	5,328	2,161	3,007	5,379	933	14,108	9,836	2,616	40,752	2,616	**43,368**	*5*
Unclassified	Unallocated or unclassified	62	212	880	1,036	2	226	20	0	2,438	0	**2,438**	*10*
	Total	**91,120**	**135,688**	**227,167**	**37,812**	**42,583**	**105,557**	**73,352**	**45,718**	**713,279**	**45,718**	**758,997**	
	Rank	*4*	*2*	*1*	*8*	*7*	*3*	*5*	*6*				

5.2.2 Sectoral assessment of abstraction data

Figure 5.1 Estimated volume directly abstracted from non-tidal sources in England and Wales, excluding major non-consumptive uses (upper and lower bound estimates presented) and excluding that abstracted for public water supply, by sector and country (Ml, 2006)



In England, the total volume directly abstracted for consumptive uses in 2006 is estimated to be between 713,279 Ml and 828,236 Ml (Figure 5.1). The 'Manufacturing' sector was the largest direct abstractor in England in 2006, representing over 40% of the total volume directly abstracted. The second largest sector in England was 'Electricity, Gas, Waste; Water; Sewerage', accounting for over one-fifth of the total volume directly abstracted for consumptive uses. Other significant sectors are 'Agriculture, Forestry and Fishing' and 'Mining and Quarrying'. In total, the four largest sectoral abstractors are responsible for abstracting approximately 90% of the total volume directly abstracted in England for consumptive uses.

In Wales, the total volume directly abstracted for consumptive uses in 2006 was less than one-fifth of that abstracted in England. Note that there is significant uncertainty in the 'true' value of consumptive use, particularly in the manufacturing sector which dominates the abstraction for consumptive uses in Wales. Using the upper and lower bound estimating approach described in detail in Appendix B, the volume directly abstracted is estimated to be between 45,718 Ml and 181,541 Ml. With the exception of manufacturing, other important sectors in Wales in relation to volumes directly abstracted from freshwater resources include the 'Construction' and 'Arts, Entertainment and Recreation; Other Goods and Services' sectors.

Taking England and Wales as a whole, the 'Manufacturing' and 'Electricity, Gas, Waste; Water; Sewerage' sectors were the largest sectors, accounting for approximately 75% of the total volume directly abstracted for

consumptive uses. Other significant sectors were 'Agriculture, Forestry and Fishing' and 'Mining and Quarrying' which together accounted for over a further 15% of the total volume directly abstracted for consumptive uses in 2006.

Figure 5.2 Estimated volume directly abstracted from non-tidal sources in England and Wales, excluding major non-consumptive uses (upper and lower bound estimates presented) and excluding that abstracted for public water supply, by sector and EA region (Ml, 2006)

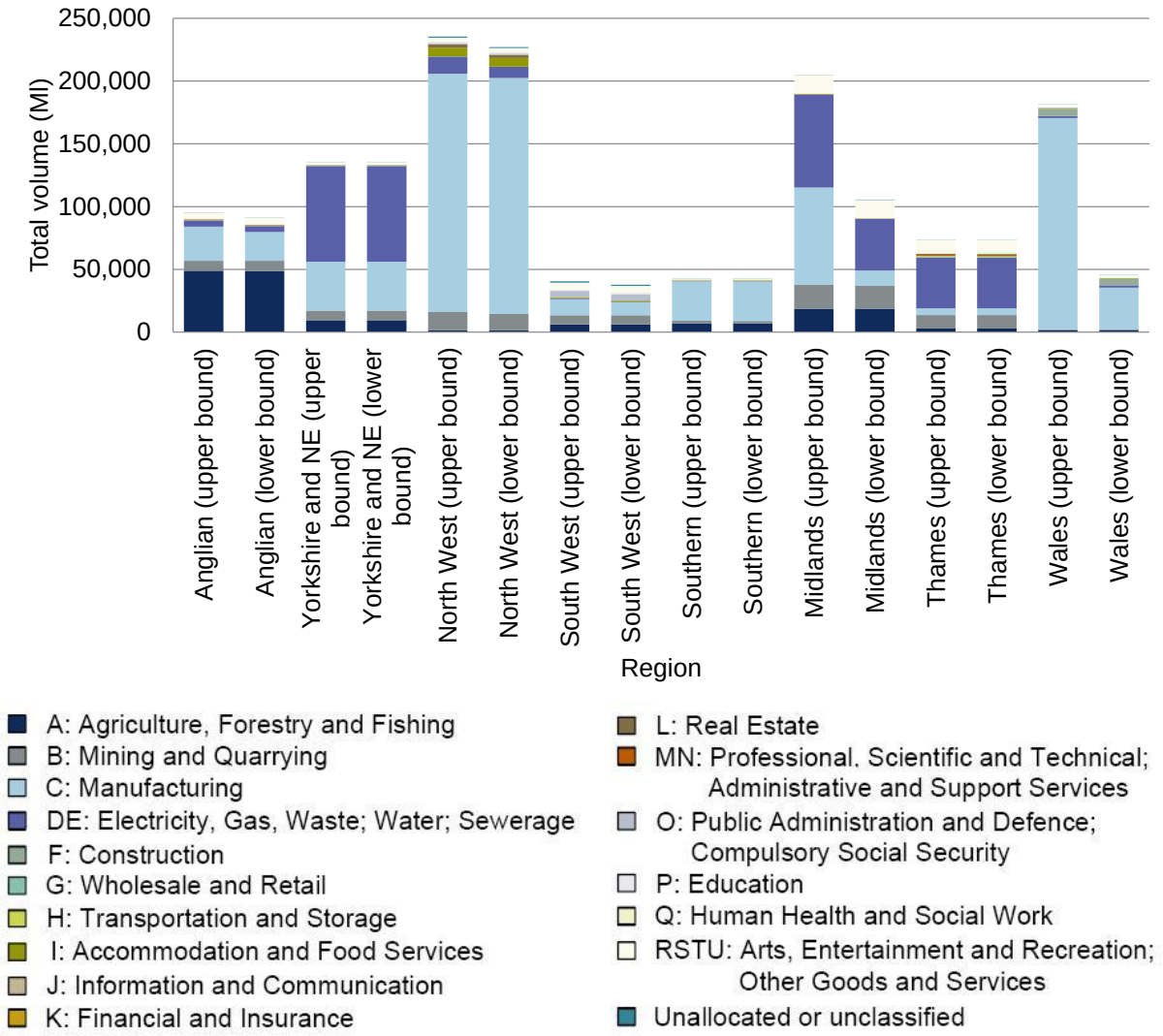


Figure 5.2 highlights the regional variation in total and sectoral volumes abstracted for consumptive uses. The North West was the region with the largest volume abstracted directly from the environment with an estimate of between 227,167 and 235,469 Ml for 2006. The most significant sector within this region is the manufacturing sector that accounts for over 80% of the total.

Different sectors are more or less important in each region. For example, Figure 5.2 shows that 'Manufacturing' is a major consumptive user of directly abstracted water in North West England whereas the 'Agriculture, Forestry and Fishing' sector is the major direct abstractor in the Anglian region.

5.3 Mains water use

5.3.1 Mains water data

Table 5.3 shows mains water use for each region within the UK for the baseline year, usually 2006/07[13], by each non-household sector. In Scotland, the baseline used in the Water Resource Plan (Scottish Water, 2009) is 2007/08 but Scottish Water were able to provide data to WRc for 2006/07 to enable the best comparison with data from WRP8 tables for water utilities in England and Wales.

Total use was 1,535,941 Ml of which 1,284,143 Ml (84%) was used in England and Wales. The latter figure compares favourably[14] to the 1,304,875 Ml delivered to non-households in England and Wales reported in Ofwat's Security of Supply 2006-07 report (Ofwat, 2007b).

[13] The Environment Agency guidelines for water resource planning (Environment Agency, 2008d) state that the baseline year for all tables and forecasts should be 2006/2007. However, Essex and Suffolk Water and South West Water do not have data for 2006/07 in Table WRP8 so 2007/08 data have been used instead.

[14] The discrepancy between the figure reported by Ofwat and the aggregated figure from all Water Resource Management Plans is less than 2%.

Table 5.3 Mains water use in the regions and nations of the UK, by sector (Ml, 2006/07)

SIC2007 Section	Description	Anglian	Yorkshire and NE	North West	South West	Southern	Midlands	Thames	Wales	Scotland	Northern Ireland	England Total	Wales Total	Scotland Total	Northern Ireland Total	UK Total	*Rank*
A	Agriculture, Forestry and Fishing	22,808	20,595	13,653	20,042	30,991	17,023	8,677	9,735	0	22,013	133,789	9,735	0	22,013	**165,536**	*2*
B	Mining and Quarrying	570	12,365	350	984	779	1,647	375	1,678	605		17,071	1,678	605	0	**19,354**	*14*
C	Manufacturing	37,843	110,718	56,132	15,962	9,692	37,821	33,996	21,978	74,985	15,612	302,163	21,978	74,985	15,612	**414,739**	*1*
DE	Electricity, Gas, Waste; Water; Sewerage	4,539	2,406	4,192	7,112	2,126	2,435	4,349	2,051	17,334	2,032	27,159	2,051	17,334	2,032	**48,576**	*11*
F	Construction	1,353	2,915	1,209	672	1,315	2,263	2,117	705	866		11,842	705	866	0	**13,412**	*17*
G	Wholesale and Retail	12,024	10,250	10,156	7,857	4,713	8,397	14,500	4,811	7,016	3,502	67,899	4,811	7,016	3,502	**83,227**	*7*
H	Transportation and Storage	6,315	2,227	6,115	1,874	6,323	7,050	14,743	1,571	1,749		44,647	1,571	1,749	0	**47,968**	*12*
I	Accommodation and Food Services	13,118	8,782	18,395	10,941	8,422	10,342	35,618	12,158	12,446	4,762	105,618	12,158	12,446	4,762	**134,984**	*3*
J	Information and Communication	1,974	1,773	1,676	523	813	1,156	5,910	527	586		13,824	527	586	0	**14,937**	*16*
K	Financial and Insurance	4,362	3,918	3,704	1,156	1,623	2,556	13,062	1,164	1,156		30,381	1,164	1,156	0	**32,701**	*13*
L	Real Estate	2,115	1,899	1,796	560	880	1,239	6,332	565	0		14,821	565	0	0	**15,385**	*15*
MN	Professional, Scientific and Technical; Administrative and Support Services	16,529	14,844	14,033	4,404	6,876	9,684	49,491	7,022	2,433		115,861	7,022	2,433	0	**125,316**	*4*
O	Public Administration and Defence; Compulsory Social Security	6,046	5,179	5,133	5,815	2,601	3,542	18,103	2,314	16,688	3,069	46,418	2,314	16,688	3,069	**68,489**	*9*
P	Education	7,627	6,221	8,304	6,295	4,734	9,845	18,039	4,778	4,236	4,971	61,064	4,778	4,236	4,971	**75,049**	*8*
Q	Human Health and Social Work	10,532	8,605	11,467	8,742	6,756	12,436	24,910	3,997	7,553	6,922	83,450	3,997	7,553	6,922	**101,922**	*6*
RSTU	Arts, Entertainment and Recreation; Other Goods and Services	5,793	5,202	4,918	3,733	4,627	4,368	17,345	1,546	6,950	840	45,988	1,546	6,950	840	**55,324**	*10*
Unclassified	Unallocated or unclassified	0	28,791	0	0	20,550	33,838	902	1,475	29,455	4,010	84,081	1,475	29,455	4,010	**119,020**	*5*
	Total	**153,549**	**246,689**	**161,233**	**96,674**	**113,820**	**165,643**	**268,469**	**78,074**	**184,058**	**67,733**	**1,206,076**	**78,074**	**184,058**	**67,733**	**1,535,941**	
	Rank	*6*	*2*	*5*	*8*	*7*	*4*	*1*	*9*	*3*	*10*						

5.3.2 Sectoral assessment of UK mains water use

As might be expected, the total volume of mains water used in England per annum vastly outstrips that used in other regions/countries of the UK (Figure 5.3). The manufacturing, agriculture, and accommodation and food services sectors stand out as major users in England and Wales, whilst manufacturing and public administration/defence feature prominently in Scotland (as does a significant proportion which remains 'Unclassified'). The agriculture, forestry, fishing and manufacturing sectors predominate in Northern Ireland. The professional services sector is also a significant user of mains water in England.

Figure 5.3 Estimated total mains water use in the UK regions and nations, by sector (Ml, 2006/07)

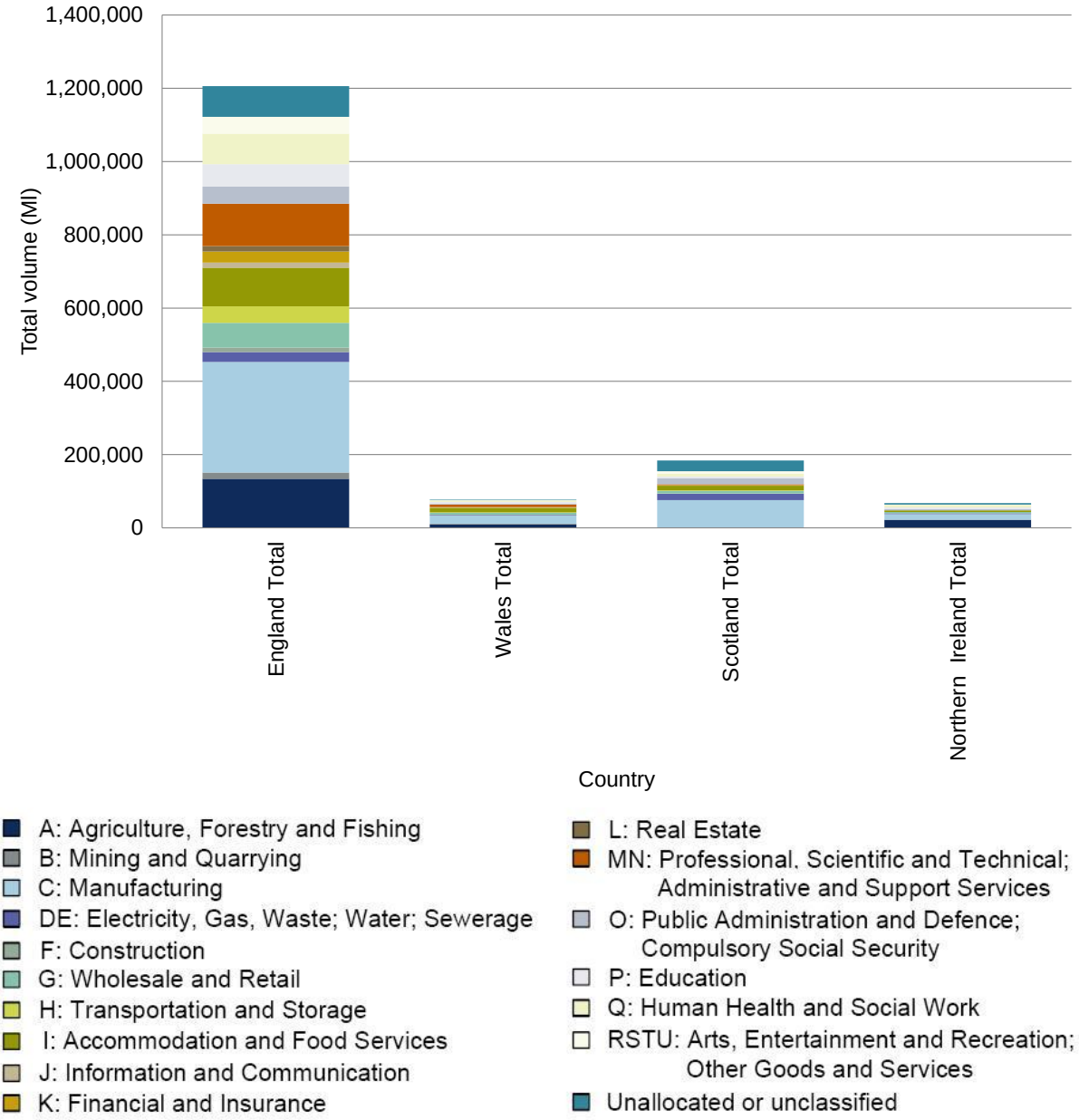
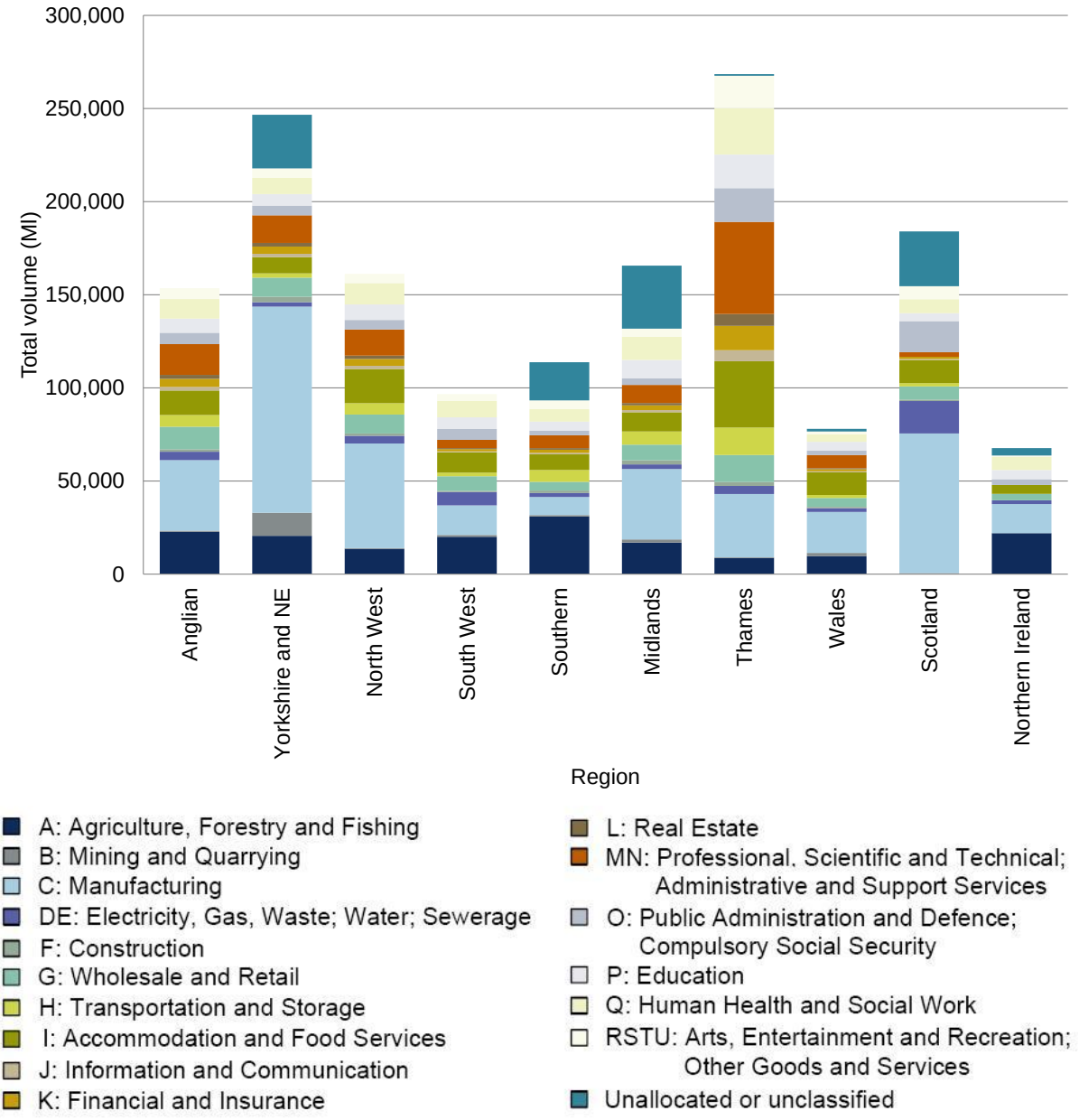


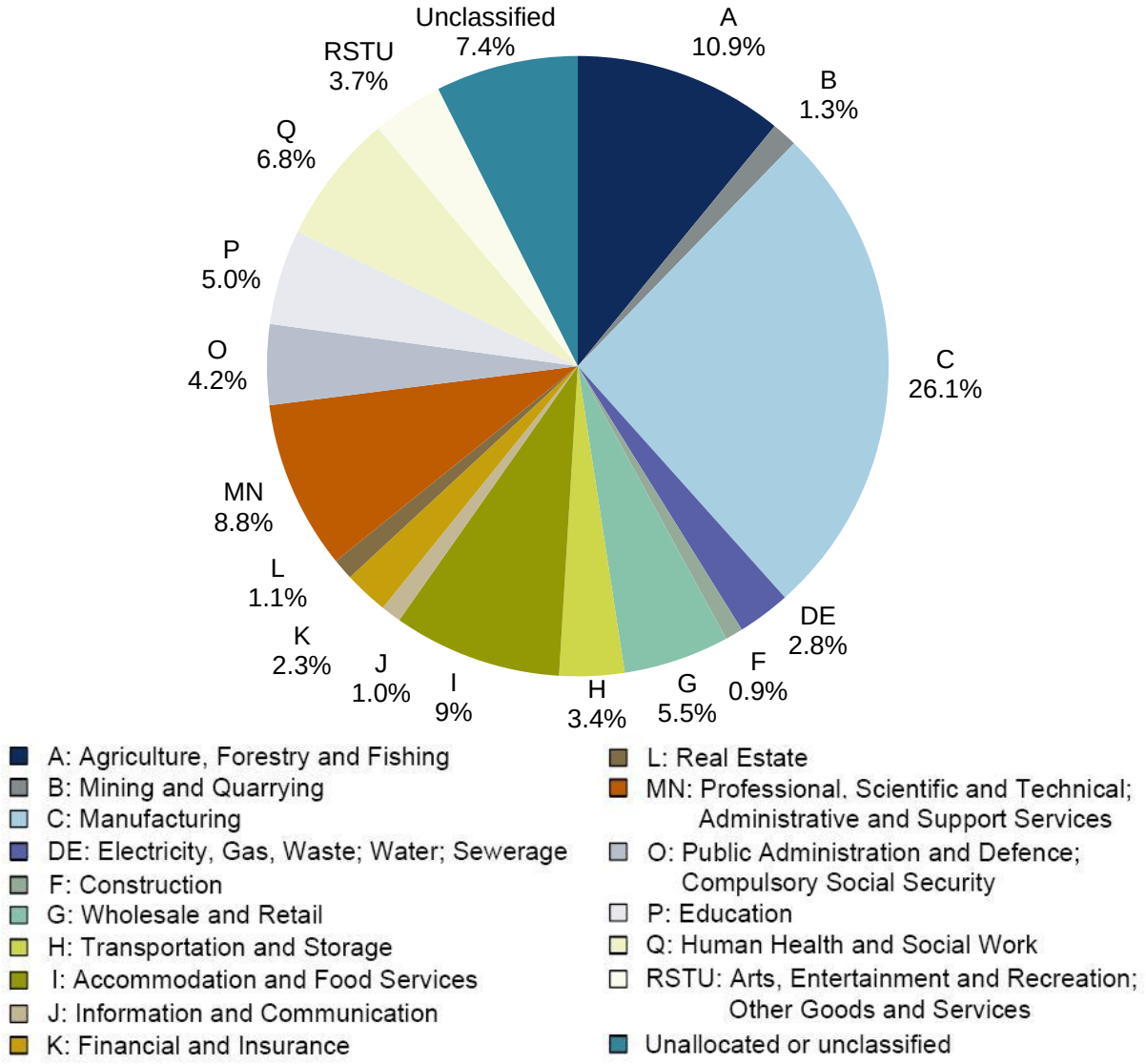
Figure 5.4 presents a regional breakdown of mains water use by sector, highlighting that significant differences exist in the nature of mains water use in different regions of the UK.

Figure 5.4 Estimated total mains water use in the regions and nations of the UK (Ml, 2006/07)



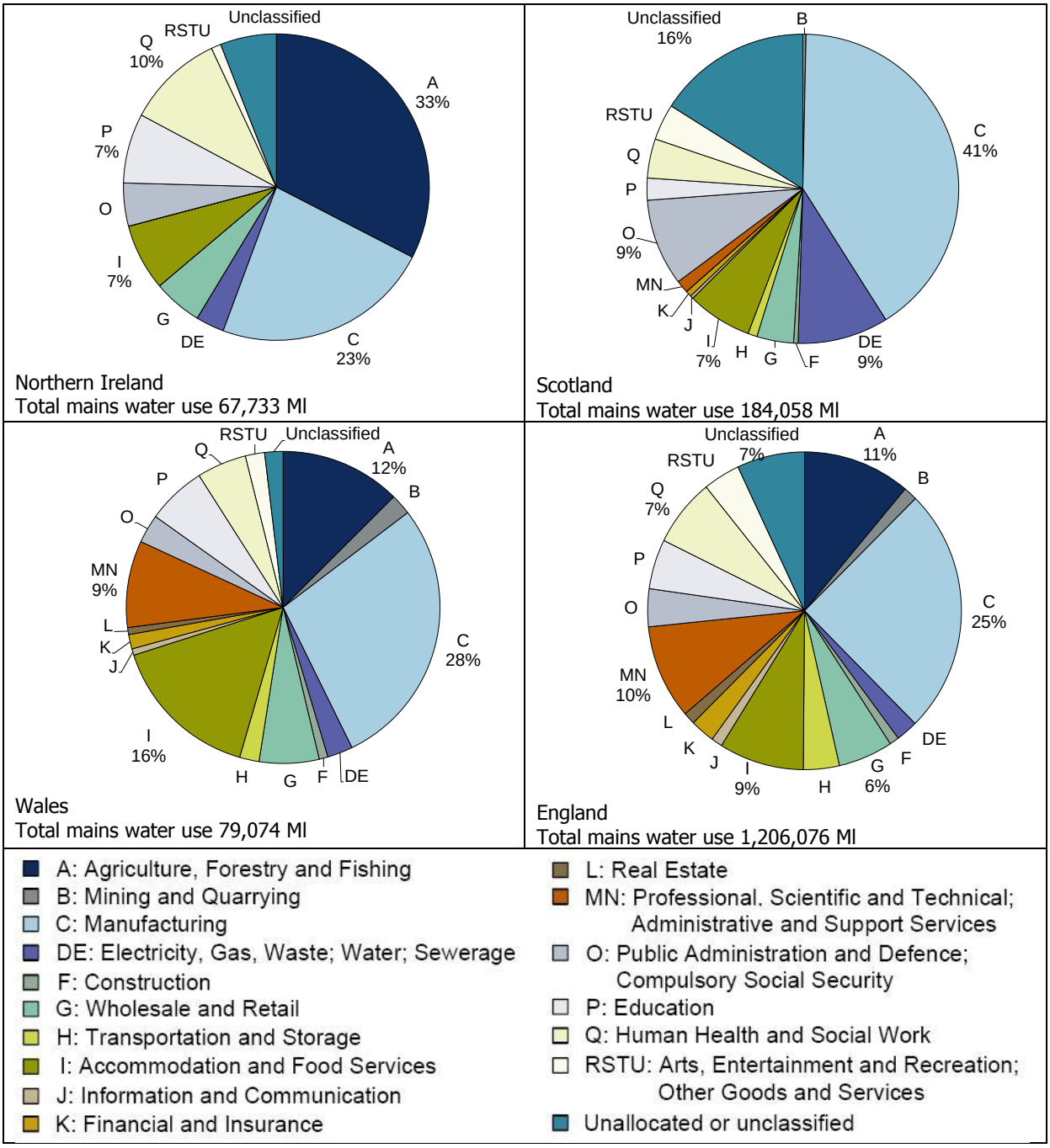
In terms of the UK as a whole, mains water use was greatest in the 'Manufacturing' sector (SIC section C) (Figure 5.5), accounting for 27% of all non-household use (399,127 Ml). The next largest was 'Agriculture, Forestry and Fishing' (SIC section A) at just under 10% of the total.

Figure 5.5 Proportion of total mains water use in UK, by sector (2006/07)



Regional differences in water use by different sectors are illustrated in Figure 5.6.

Figure 5.6 Mains water use by region and sector (2006/07)



'Manufacturing' was the largest single user of mains water in three nations, with the exception being Northern Ireland where 'Agriculture, Forestry and Fishing' is the largest sector. In Yorkshire and the North East region and in Scotland, manufacturing accounted for over 40% of all non-household water use. However, in the South West and Southern regions, the largest single sector was 'Agriculture, Forestry and Fishing', accounting for 21% and 27% of total non-household use respectively, with 'Manufacturing' representing the second-largest sector.

There is no evidence in the figures supplied by Scottish Water to suggest that any mains water is used to supply water for agricultural purposes. This apparent anomaly was discussed with contacts at Scottish Water who, at time of writing, were unable to provide any additional information either way. It is therefore presumed that the agriculture sector is able to abstract sufficient water directly from the environment without the need to top up using mains water. In England and Wales, mains water use for 'Agriculture, Forestry and Fishing' was smallest in the Thames region (3%) and highest in the Anglian region (15%).

In the Thames region, the largest user of mains water was professional and administration activities, accounting for over 18% of total non-household use and a greater proportion than in any other region. This is not surprising since London and the Thames Valley are located in this region and these areas are traditionally the base for many service sector businesses. 'Manufacturing' was the second largest sector in the Thames region, accounting for 13% of mains water use. Mains water use by the financial and insurance sector was greater in the Thames region (5%) than in any other region.

Mains water use for the 'Mining and Quarrying' sector was generally low and has dropped following the decline of coal mining activity in recent decades. The greatest proportion of use in this sector was found in Yorkshire and the North East (5%) and in Wales (2%).

Use in the 'Electricity, Gas, Waste, Water and Sewerage' sectors were also generally low, reflecting the trend to directly abstract an increasing volume of water for cooling purposes for power generation, for example, from tidal waters. Notable exceptions were Scotland and the South West; however, data reported for this sector by Wessex Water included bulk supplies to other water utilities. It was not possible to separate use for bulk supplies from other uses in this sector and this inflated the relative importance of this sector in the South West. In Scotland, use in this sector was the second largest after manufacturing.

Consumption by the 'Accommodation and Food services' sector was proportionally highest in Wales (16%) and relatively high in the North West and South West, accounting for just over 11% of total non-household use in each of these regions. Use by this sector was lowest in Yorkshire and the North East (4%).

5.4 Total water use (direct abstraction plus mains water)

This section combines the results from chapter 5.2 (directly abstracted water) with that of chapter 5.3 (mains water consumption) to produce overall statistics by sector and region which is indicative of total freshwater use (**excluding** non-consumptive uses) in 2006/7.

A summary of this data for England and Wales only is presented in Table 5.4. Scotland and Northern Ireland are excluded from this analysis as only data on mains water consumption were available for these areas at time of writing.

Table 5.4 Estimated total water use in England and Wales (volume directly abstracted from non-tidal sources, excluding major non-consumptive uses and (upper and lower bound estimates) excluding that abstracted for public water supply combined with total mains water use), by sector and country (Ml, 2006,07)

		Upper Bound				Lower Bound			
SIC2007 Section	Description	England	Wales	Grand Total	*Rank*	England	Wales	Grand Total	*Rank*
A	Agriculture, Forestry and Fishing	228,038	11,423	**239,462**	*3*	227,883	11,355	**239,238**	*2*
B	Mining and Quarrying	86,558	2,276	**88,834**	*8*	83,999	2,163	**86,162**	*9*
C	Manufacturing	684,992	190,197	**875,189**	*1*	611,276	55,361	**666,637**	*1*
DE	Electricity, Gas, Waste; Water; Sewerage	237,492	3,843	**241,335**	*2*	199,448	3,843	**203,291**	*3*
F	Construction	13,313	6,201	**19,513**	*15*	13,313	6,201	**19,513**	*15*
G	Wholesale and Retail	68,608	4,816	**73,424**	*10*	68,608	4,816	**73,424**	*10*
H	Transportation and Storage	45,599	1,573	**47,172**	*13*	45,599	1,573	**47,172**	*13*
I	Accommodation and Food Services	113,577	12,458	**126,035**	*4*	113,577	12,458	**126,035**	*4*
J	Information and Communication	13,928	527	**14,455**	*17*	13,928	527	**14,455**	*17*
K	Financial and Insurance	30,766	1,164	**31,931**	*14*	30,766	1,164	**31,931**	*14*
L	Real Estate	18,639	565	**19,204**	*16*	18,639	565	**19,204**	*16*
MN	Professional, Scientific and Technical; Administrative and Support Services	117,093	7,022	**124,114**	*5*	117,093	7,022	**124,114**	*5*
O	Public Administration and Defence; Compulsory Social Security	52,907	3,128	**56,035**	*12*	52,907	2,321	**55,228**	*12*
P	Education	63,471	4,778	**68,249**	*11*	63,471	4,778	**68,249**	*11*
Q	Human Health and Social Work	85,590	4,007	**89,597**	*7*	85,590	4,007	**89,597**	*7*
RSTU	Arts, Entertainment and Recreation; Other Goods and Services	87,221	4,162	**91,383**	*6*	86,740	4,162	**90,902**	*6*
Unclassified	Unallocated or unclassified	86,519	1,475	**87,994**	*9*	86,519	1,475	**87,994**	*8*
	Total	**2,034,311**	**259,614**	**2,293,926**		**1,919,355**	**123,792**	**2,043,147**	

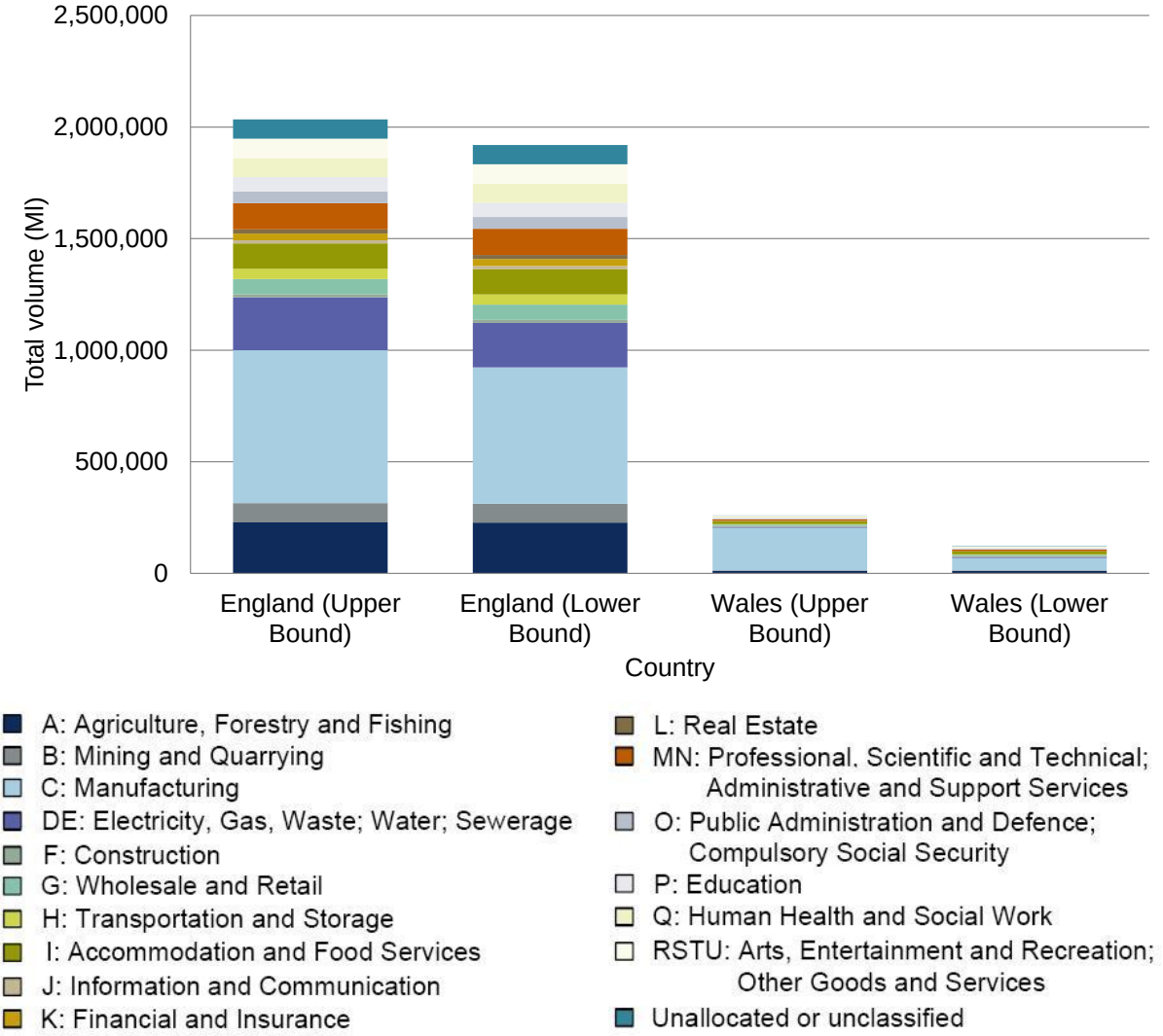
When volumes directly abstracted for consumptive uses and mains water use are combined, 'Manufacturing' is clearly the largest water using sector for England and Wales as a whole. From Table 5.4, it is evident that the top five water-using sectors in England and Wales as a whole are:

- manufacturing;
- electricity, gas, waste, water and sewerage;
- agriculture, forestry and fishing;
- accommodation and food services; and
- professional, scientific and technical, administrative and support services.

The above statistics are presented graphically in Figure 5.7 below.

This information is considered further in drawing together conclusions and recommendations for priorities in chapter 6 where greater focus is given to the ways in which water is used in addition to the SIC sectoral classification.

Figure 5.7 Estimated total water use in England and Wales (volume directly abstracted from non-tidal sources, excluding major non-consumptive uses (upper and lower bound estimates) and excluding that abstracted for public water supply combined with total mains water use), by sector and country (Ml, 2006,07)



5.5 Trade effluent discharges to sewer

5.5.1 Trade effluent discharge to sewer data

Table 5.5 presents the volume discharged to sewers by region by sector in a 'typical' year[15]. No data were available for water utilities in the North West, Thames, Wales and Midlands regions.

In addition, data from Wessex Water were not available for the South West region. Analysis of annual data returns provided to Ofwat by companies in the South West region (South West Water and Wessex Water) indicates that South West Water accounts for only around 26% of the total volume of trade effluent discharged in this region. Therefore, this region is greatly under-represented in Table 5.5.

A number of the sectors have no reported trade effluent discharges to sewers. These include: 'Accommodation and Food Services' (SIC section I), 'Financial and Insurance' (SIC section K), 'Real Estate' (SIC section L) and 'Public Administration and Defence; Compulsory Social Security' (SIC section O). This may reflect either a genuinely negligible level of discharge from these sectors, or, more probably, that the true discharge value for these sectors is embedded in the 'Unclassified' category and cannot be disaggregated.

[15] *Data for all available full reporting years were time-averaged to give a 'typical' annual volume. This was done since the volumes discharged by individual sectors often show strong inter-annual variation. See also chapter 3.4.*

Table 5.5 Volume of trade effluent discharged to sewers in the United Kingdom by sector and region/nation (Ml, time-average of all data available for the period 2006-2010)

SIC2007 Section	Description	Anglian	Yorkshire and North East	South West	Southern	Scotland	Northern Ireland	Total	Rank
A	Agriculture, Forestry and Fishing	56	347	124	31	0	0	558	**10**
B	Mining and Quarrying	0	0	0	39	61	0	100	**11**
C	Manufacturing	11,242	35,890	1,545	1,931	16,891	4,784	72,284	**1**
DE	Electricity, Gas, Waste; Water; Sewerage	30	826	273	390	626	403	2,548	**7**
F	Construction	325	0	0	0	514	0	839	**9**
G	Wholesale and Retail	1	694	157	311	1,865	61	3,089	**6**
H	Transportation and Storage	1,044	0	0	0	3	24	1,070	**8**
I	Accommodation and Food Services	0	0	0	0	0	0	0	**14**
J	Information and Communication	21	0	0	0	0	0	21	**13**
K	Financial and Insurance	0	0	0	0	0	0	0	**14**
L	Real Estate	0	0	0	0	0	0	0	**14**
MN	Professional, Scientific and Technical; Administrative and Support Services	303	1,053	159	322	2,362	0	4,198	**5**
O	Public Administration and Defence; Compulsory Social Security	0	0	0	0	0	0	0	**14**
P	Education	34	0	0	0	0	0	34	**12**
Q	Human Health and Social Work	0	1	0	0	4,415	439	4,855	**4**
RSTU	Arts, Entertainment and Recreation; Other Goods and Services	1,736	1,072	332	2,099	956	146	6,341	**3**
Unclassified	Unallocated or unclassified	3,284	1,692	138	253	6,299	0	11,666	**2**
	Total	**18,074**	**41,574**	**2,728**	**5,376**	**33,991**	**5,858**	**107,602**	

Note on Table 5.5:

[1] Data was only available from one of the sewerage undertakers (South West Water) in the EA South West region. South West Water gives consent to around 26% of the total volume discharged in the South West region.

5.6 Trade effluent discharges to water courses

No data are currently available on trade effluent discharges direct to water courses.

6.0 Conclusions and Recommendations

6.1 Introduction

This chapter presents conclusions and recommendations by nation, region and by sector as far as the data collected and analysed in this project will permit.

The evidence used to draw together these conclusions and recommendations varies in quality: it is asserted that local CAMS information, for example, on consumptive sectors is good quality evidence based on local knowledge. Other data are of limited value for quantitative analysis but is nonetheless used to support quantitative data or add context.

A water use mass balance requires the information listed below. Data which were available for analysis by sector for this project is shown in bold type (Table 6.1):

Table 6.1 Water mass balance (data available shown in bold)

Pre-consumer data by sector	*Post-consumer data by sector*
Direct abstraction (surface water, non-tidal)	Sewage discharges to sewers
Direct abstraction (groundwater)	**Trade effluent discharges to sewers**
Mains water consumption	Trade effluent discharges to water bodies

Whilst the picture on the availability and supply of freshwater is relatively clear for England and Wales (data for Scotland and Northern Ireland are limited), volumetric data on water returned to the environment from non-household sectors are incomplete.

In addition to trade effluent discharges to sewers, sewage discharges make up a significant proportion of the water balance. Figures available from sewerage undertakers do not provide sufficient detail to ascribe sewage effluent volumes to each sector, but do provide estimates of the total volume discharged as sewage from non-household properties. Sewage discharges are generally from domestic-like water uses including urinal and WC flushing, and the use of basin and kitchen taps. This means they are likely to be correlated, at least in part, to numbers of employees. Sectoral estimates of volumes of sewage returned can therefore be made using the Labour Market Survey workforce numbers by sector for each Government Office Region.

Using figures provided in water utility annual returns and total workforce numbers by region, it is estimated that each employee produces an average of 56 litres of wastewater per day. An independent 'bottom-up' estimate using previous work carried out by WRc for Defra's Market Transformation Programme (MTP, 2008) suggests that the majority of this volume (typically 40-50 l/day) may be attributable to domestic-like uses such as WC/urinal flushing and hand washing. The value of this estimate will vary depending upon the percentage of male and female employees in a given workplace and certain assumptions on the efficiency and use frequency of WCs, urinals and wash basin taps.

This is still only a partial picture since no data are available for trade effluent discharges to water bodies.

It is clear that attention should be focussed on the consumptive industries in areas of water stress and where too much water is already being abstracted from the environment. These criteria form the basis of the short term priorities discussed below. Any extensive discussion on consumptive usage is severely hindered by an incomplete sectoral water mass balance. It is, however, still possible to draw conclusions and recommendations for consideration in the short term (0-4 years), medium term (4-10 years), and longer term (10 years+). These should be read with an appreciation of the above caveats and limitations.

6.2 Conclusions and recommendations for the short term

6.2.1 Criteria

The geographic regions, and specified non-household sectors, which deserve attention in the short term (in the next four years) are defined using the following criteria:

- the Catchment Abstraction Management Strategy (CAMS) has identified that there is over-abstraction in one or more Water Resource Management Units (WRMUs) or Groundwater Management Units (GWMUs) (red shaded areas of Figure 2.3 and 2.4); **and**

- the EA water stress methodology identified the region as seriously water stressed (red shaded areas of Figure 2.2); **and**
- the analysis of CAMS, NALD and other sources has highlighted particular non-household sectors which are locally consumptive users.

It is prudent to consider why these areas are in a state of water stress and over-abstraction. Whilst the physical volume of abstraction evidently plays a role it is also useful to consider the geology of the area, and any other factors that might affect the availability of water.

6.2.2 Eastern England

Within this region six high priority zones have been identified[16].

These are the:

- Cam and Ely Ouse Catchment (Cambridgeshire);
- Broadland Rivers Catchment (Norfolk);
- Combined Essex Catchment (Essex);
- East Suffolk Catchment (Suffolk);
- Upper Lee Catchment (Bedfordshire/Hertfordshire/Essex); and
- Colne Catchment (Hertfordshire).

There is significant over-abstraction of groundwater in Essex and East Suffolk. In these regions the Eiocene divide denotes the presence of London Clay overlying the chalk aquifer beneath. This confines the chalk and restricts groundwater flow into and out of the aquifer. Across Norfolk the majority of abstractions are from the chalk aquifer that underlies the region. Across the Upper Lee catchment the hydrology is primarily influenced by unconfined chalk, which, to the south east of the catchment, is overlain by London Clay and Reading Beds. Within this catchment the majority of abstraction is from groundwater. The Colne catchment is underlain by the most significant chalk aquifer in Southern England. To the south of the region it is overlain by London clay; however, the remainder is unconfined.

The CAMS for the above catchments indicate that groundwater abstractions are mainly used for mains water supply and spray irrigation for agricultural purposes.

The independent analysis of total water use carried out in this study confirms that the agricultural sector is the primary user of water in the Anglian region (34% of total non-household use or 96,725 Ml per annum), with manufacturing also significant (26% of total non-household use).

Detail within the NALD database shows that in the Anglian region up to two-thirds of all of the agricultural abstractions are used for irrigated agriculture including crops such as potatoes, sugar beet, salad vegetables and soft fruits. Irrigated agriculture is considered a consumptive use of water, and therefore any actions that can be taken to reduce this usage would be beneficial – for instance, irrigating during the evening to reduce evapotranspiration, or developing and farming more drought-resistant crop varieties.

In addition to irrigated agriculture, there is also substantial abstraction of water for aquaculture indicated in the NALD database. This accounts for approximately one-third of the SIC A abstractions within the Anglian Region. This use is considered to be largely non-consumptive as the water is primarily throughflow.

Analysis of NALD data indicates that the two largest types of manufacturing found within the Anglian region are of food and drink (this is likely to be associated with the preparation, processing and retailing of crops grown), and chemicals. These two industries account for 50% of the total volume directly abstracted for manufacturing. Various uses are associated with these two industries including processes that are likely to be non-consumptive (e.g. non-evaporative cooling) and others which are certainly consumptive (water bottling). It has not been possible to calculate accurately the proportion of the abstracted water used for these different processes.

[16] *There are also very small Water Resource Management Units described as over-abstracted within North Norfolk Catchment and the North West Norfolk Catchment. Because the proportion of these catchments in the over-abstracted state is smaller, however, the focus is directed to the six priority areas listed.*

Trade effluent volumes to sewers from manufacturing in the Anglian Region are approximately 15% of the total water volume used by the sector. In addition, it is possible to estimate a volume of water that is used for domestic purposes by employees of the manufacturing sector. Assuming that each of 237,000 employees discharges 56 litres per day of sewage from domestic uses in the workplace (mainly WC flushing and hand washing), the manufacturing sector in the East of England region would discharge around 13 Ml/d from such uses. Taken together with trade effluent discharged to sewers, this rather crude assessment indicates that, of the 200 Ml/d supplied to the sector, just 44 Ml/d, or 22% is returned to the environment (excluding direct discharges which are, as yet, unknown). As stated above, values are not available for trade effluent discharges direct to water courses, although it is likely that water used for cooling or washing might be returned direct to these.

In summary, the focus for activities in this region should be to:

- promote water-efficient practices in irrigated agriculture;
- continue work with the food and drink industry; and
- investigate ways to support other manufacturing industries, particularly chemicals, to improve water efficiency.

6.2.3 Midlands

High priority catchments were identified to be in the East Midlands and they are:

- Grimsby, Ancholme & Louth (Lincolnshire);
- Dove (Derbyshire);
- Idle & Torne (Nottinghamshire);
- Lower Trent & Erewash (Nottinghamshire); and
- Welland (Leicestershire/Rutland).

Geology plays a key part in determining the water available in each of the above catchments. A large proportion of the water in the East Midlands is sourced from sandstone and limestone aquifers, although sandstone aquifers are preferred since groundwater availability from the limestone aquifers can be extremely variable.

The CAMS for the above catchments indicate that abstracted water is used primarily for mains water supply, with a small proportion being used for commercial and industrial uses such as irrigated agriculture and horticulture, mining and quarrying. Heavy industry is present in the catchment but in decline, much of which can be attributed to the decline in coal mining. The dominant land use is now for agricultural purposes, though even this sector has seen land use change from pasture to arable (mainly cereals) production which has led to an increase in spray irrigation. This land use change is reflected in the increase in the number of related processing industries, further increasing the pressure on water supplies available within this mainly groundwater-dependent region. In the West Midlands, the majority of agricultural land is dedicated to livestock grazing rather than arable but large volumes of water are still consumed.

In contrast, quarrying is a prominent industry in the Peak District: sand, gravel, limestone and gypsum are all extracted here. There is also manufacturing of textiles, paper and food in this area.

Our independent analysis of total water consumption in the Midlands region indicates that approximately 80% of non-household water use is for electricity, gas, waste, water and sewerage. It is estimated that at least 70% of this water is used for non-consumptive purposes (hydroelectricity generation, non-evaporative cooling etc.) and therefore can be considered of little relevance to this study. The remaining volume is used for process water, evaporative cooling, boiler feeds etc.

Of the remaining volume consumed, 38% is used for manufacturing and 13% for agriculture, forestry and fishing. There is also a reasonable proportion of water consumed in mining and quarrying (uses such as mineral washing and dust suppression) and in the arts, entertainment and recreation sectors.

70% of the water supplied to the manufacturing sector in this region is supplied to the chemicals industry. However, it is apparent from NALD that one very large licence holder abstracts the majority of the 70% used in the chemicals industry and that this water is used for a combination of non-evaporative cooling (non-consumptive) and process water (assumed consumptive). It is therefore likely that a significant proportion of the water use in this sector is non-consumptive.

Food and drink and paper and printing are the next largest users of water in the manufacturing sector in this region. Within the food and drink sector there are non-consumptive processes (non-evaporative cooling) which account for between 50% and 80% of the total volume abstracted for this sector. Within the paper and printing sector, approximately 50% is also considered non-consumptive use (transfer between sources). With consumptive use in the manufacturing sector in mind, the relative importance of food and drink and paper and printing is elevated from a total of 15% of all water use to up to 50% of all **consumptive** use in the manufacturing sector.

The mining and quarrying sector accounts for over 6% of total water use when SIC categories D and E (energy generation, water and waste industries) are excluded. Of this, the dominant use of water is for mineral washing. This activity is understood, from reviews of CAMS, to be generally non-consumptive.

The arts, entertainment and recreation sector accounts for almost 11% of total water use in the Midlands (when SIC D/E is excluded). Again, upon more detailed inspection of the uses of (directly abstracted) water, it is apparent that over 50% of the use is from non-evaporative cooling at one licence, with a significant proportion of the remainder being throughflow of ponds and lakes (again, non-consumptive).

Whilst large abstractors, these non-consumptive uses may be regarded as low priority areas. As these uses are removed from the analysis, the impact of the sectors that are primarily office-based becomes more significant.

The total annual water use in SIC categories I (accommodation and food services), J (information and communication), K (Financial and Insurance), O (public administration and defence; compulsory social security) and P (Education) was 28,105 Ml in 2006, or 9% of all water use in the Midlands when SIC categories D and E are excluded. Of this volume, it is estimated that almost all is consumptive, with a significant proportion for domestic-like uses such as WC flushing, urinals, hand washing and drinking water.

The focus for activities in this region should be to:

- work with manufacturing sectors, particularly food and drink and paper and printing to identify water-efficient practices;
- promote water-efficient practices in irrigated agriculture; and
- work with major office-based companies and the education sector where opportunities for improving efficiency of domestic water-using devices (WCs, urinals, taps etc.) are likely to exist.

6.2.4 London and South East England

Three catchments have been identified as high priority zones in the South East, namely:

- London (particularly South London) ;
- Stour (Kent); and
- Darent and Cray (Kent).

These catchments vary enormously in their land use characteristics and therefore have different priorities for action. These regions cannot be separated within our analysis as a result of the way that abstraction information is collected (by EA region).

Across the Stour catchment, the geology primarily consists of chalk and Lower Greensand with a stretch of clay in the upper catchment. The CAMS indicates that agriculture is the dominant land use within the Stour CAMS area, with only limited industrial use of water. In the north east of the catchment there is high demand of water for irrigated agriculture required for crops such as potatoes, soft fruits and salad vegetables. In the south west of the catchment the land use is primarily grassland for grazing sheep, and arable crops such as oil seed rape and wheat due to the well-drained soils that overlie chalk.

Across the London CAMS area, chalk is designated a major aquifer and is confined by impermeable London Clay across most of the catchment, except the North Downs to the south of the CAMS area. In the London region there is very little agricultural use, with the majority of water abstracted (92% according to CAMS) being for mains water supply.

Both the Cray and Darent river systems are heavily reliant on groundwater from the underlying Chalk and Lower Greensand. CAMS tells us that historically there have been problems with over-abstraction and drought which led to some stretches of the Darent drying up completely.

Our independent analysis shows that in the South East region (roughly aligned to the Southern and including Thames EA regions for this element of analysis in order that the urban conurbation of London is included) approximately 11% of total water use, or 22% of consumptive water use is likely to be used for domestic-like purposes i.e. by SIC categories I (accommodation and food services), J (information and communication), K (financial and insurance), O (public administration and defence; compulsory social security) and P (education). These uses would include WC flushing, urinals, hand washing and kitchen tap use.

Across the EA southern region, the single largest water-using sector is agriculture (78% of total water use) however a significant proportion of the uses are non-consumptive. It is estimated that approximately 25% of total consumptive water uses (by volume) in the southern region are for agriculture (and primarily irrigated agriculture).

A further 26% of consumptive water use (by volume) in the EA southern region are by the manufacturing sector. The NALD indicates that the manufacturing sector of most significance in this region is the paper and printing industry – accounting for 80% of all manufacturing consumption for uses such as process water and boiler feed. The details of the use of water described as 'process water' is not known; therefore, it is not possible to say whether or not this is a consumptive or non-consumptive water use.

The focus for activities in this region should be to:

- promote water-efficient practices in irrigated agriculture;
- work with major office-based companies and the education sector where opportunities for improving efficiency of domestic water-using devices (WCs, urinals, taps etc.) are likely to exist; and
- identify processes used within the paper and printing industry to ascertain if they are largely consumptive or non-consumptive. Further work as appropriate to improve the efficiency of any consumptive processes identified.

6.2.5 South West England

Three high priority catchments were identified in this area, namely:

- Hampshire Avon catchment (West Hampshire/South Wiltshire);
- Kennet and Pang catchment (North Wiltshire); and
- Upper Thames catchment (South Gloucestershire/West Oxfordshire).

The geology of this area is mainly chalk, along with Upper Greensand, Purbeck and Portland limestone with a small amount of clay. The water level of the chalk aquifers in the area has an impact on the available river flow within the catchment. Most of the water used comes from groundwater sources in the Kennet and Pang catchment (91%), whereas in the Hampshire and Avon catchment, a greater proportion of surface water is abstracted.

According to the CAMS, the major abstractions across the three catchments are for mains water supply, with fisheries being the next largest consumer, although this is largely a non-consumptive activity which is therefore of less relevance for this study. However, the Hampshire and Avon CAMS does highlight that large volumes of water are returned to the catchment at different locations to the point of abstraction causing locally deprived reaches.

The CAMS indicate that the next largest consumers are agricultural activities (which are in the same SIC section as fisheries): this includes arable farming and irrigation along with water provision for stables of which there are a large number in this area. There is also a small demand for water for industrial use (manufacturing, mineral extraction and washing) along with abstraction to maintain watercress beds.

Our independent analysis of total water consumption in the South West EA region indicates that the agricultural sector (including aquaculture) is the single largest water user. The sector uses approximately 50% of all water supplied to the region, or approximately 20% of the total volume attributable to consumptive uses. Over 90% of the total water use in SIC section A in the South West region is for aquaculture purposes, and almost all of this is for (non-consumptive) fish farm throughflow.

SIC section D (electricity, gas, waste, water and sewerage) is the second largest water using sector when total water use is considered. However, when non-consumptive uses are excluded, this sector is responsible for only 7% of water use (by volume).

The manufacturing sector is the largest consumptive water-using sector by volume. The NALD indicates that the largest types of manufacturing in the South West are food and drink, paper and printing, rubber and chemicals. It is not possible to accurately calculate the consumptive volume of water used by these industries although it is clear that not all use is consumptive. Uses include non-evaporative cooling, process water, evaporative cooling and vegetable washing (food and drink industry).

Taken together, the next important consumptive water-using sectors in the South West are education (SIC section P) and those which are largely office-based, i.e. accommodation and food services (SIC section I), information and communication (J), financial and insurance (K), and public administration and defence; compulsory social security (O). This is likely to be particularly evident in the summer months when tourist numbers swell the local population significantly. The above sectors collectively account for approximately 23% of the total volume supplied to consumptive uses.

The focus for work in this region should be to:

- promote water-efficient practices in irrigated agriculture;
- work with major office-based companies and the education sector where opportunities for improving efficiency of domestic water-using devices (WCs, urinals, taps etc.) are likely to exist;
- identify the processes used within the paper and printing, rubber and chemicals industries to ascertain if they are largely consumptive or non-consumptive and carry out further work as appropriate to improve the efficiency of any consumptive processes identified; and
- work with the food and drink industry to improve water-efficient practices.

6.3 Conclusions and recommendations for the medium term

6.3.1 Criteria

The geographic regions (and non-household sectors therein) which deserve attention in the medium term (in the next decade, but beyond the short-term priorities) are defined using the following criteria:

EITHER

The Catchment Abstraction Management Strategy (CAMS) has identified that there is **over-abstraction** in one or more Water Resource Management Units (WRMUs) or Groundwater Management Units (GWMUs) (red shaded areas of Figure 2.3 and 2.4);
and
The EA water stress methodology identified the region as **moderately water stressed** (amber shaded areas of Figure 2.2)

OR

CAMS has identified that one or more catchment management units are **over-licensed** (amber shaded areas of Figure 2.3/2.4)
and
the EA water stress methodology identified the region as **seriously water stressed** (red shaded areas of Figure 2.2).

In addition it is suggested that activities proposed for specific catchments in the East of England and South East (and London) are extended to the entire region in the medium term.

N.B. The priorities identified for the short term should continue to be the primary focus for attention for as long as is necessary: the catchments and priorities identified below are **in addition** to those identified as short term priorities.

6.3.2 Midlands

- Nene Catchment (Northamptonshire);
- Middle Severn catchment (Worcestershire); and
- Avon catchment (Warwickshire).

The Nene catchment runs from Northamptonshire up to the Norfolk Broads, so has two very distinctive ecosystems. The river first runs through built-up areas such as Northampton and Wellingborough and then heads north through the Norfolk fens. The water abstracted from the Nene catchment is mainly from surface water,

there is no groundwater abstraction for water supply in this area but there are some small aquifers which contribute to local river water levels and can be used locally for small scale water supply.

CAMS indicate that agricultural practices are one of the smallest users of water but widely distributed and largely consumptive; industrial abstractions such as quarries and breweries use a larger volume of water but are concentrated in or near large conurbations and are only partially consumptive. The consumptive nature of agricultural use over a large area may impinge upon water availability for other purposes.

The Worcestershire Middle Severn catchment and Warwickshire Avon catchment are predominantly rural. CAMS indicate that around 90% of the total volume abstracted is for public water supply. Agricultural use accounts for some of the water used in these catchments due to irrigation.

These two catchments are made up of sandstone and limestone aquifers. The sandstone aquifers are capable of supporting large abstractions so are important to the water supply of this area. The groundwater is heavily abstracted (92% of the total volume abstraction is from groundwater sources) with most abstractions for long-standing licences in Worcestershire. New groundwater extraction licences have not been issued for a considerable time in this area which increases pressure on supplies from surface water sources.

Our independent analysis of the Midlands region supports the CAMS for these areas, indicating that agricultural uses are generally small but still significant in terms of the total volume of all consumptive uses. Therefore, the priority areas for focus in the medium term across these areas remain the same as for the short term, viz.:

- work with manufacturing sectors, particularly food and drink and paper and printing to identify water-efficient practices;
- promote water-efficient practices in irrigated agriculture; and
- work with major office-based companies and the education sector where opportunities for improving efficiency of domestic water-using devices (WCs, urinals, taps etc.) are likely to exist.

6.3.3 South West England

The medium term priority zone in the South West has been identified as the:

- Tamar/Torbay catchments (Devon)

These are largely rural catchments, with two major urban areas (Torbay / Plymouth). There are several rivers in the area which are currently over-abstracted; these include the Rivers Tavy, Meavy, Plym and Yelm. There is no groundwater within the Tamar catchment due to the geology of the area, so all abstractions are from surface water sources.

CAMS indicate that the largest volume of abstractions are made for mains water supplies. The mineral extraction industry is the biggest industrial abstractor (for uses such as mineral washing). There are also small-scale abstractions for agricultural use which is the dominant land use in the area.

Our independent analysis of the South West region indicates, as for the short term actions, that agriculture, paper and printing, rubber and chemicals industry, domestic-like uses associated with offices, schools and accommodation and the food and drink industry are the most significant priority sectors within the region. Therefore, CAMS allows us to make more specific recommendations specifically for this catchment in the medium term:

- work with major office-based companies and the education sector where opportunities for improving efficiency of domestic water-using devices (WCs, urinals, taps etc.) are likely to exist;
- work with the mineral extraction industry to identify water-efficient practices; and
- promote water-efficient practices in irrigated agriculture.

6.4 Conclusions and recommendations for the longer term

6.4.1 Criteria

Consideration in the longer term should be given to those areas which are:

- currently described as at least **moderately water stressed** by the EA's water stress methodology (for reasons of current and projected household demand and population growth); **and**
- deemed to have **no more water available at low flows** according to CAMS; **and**

- have, and are likely to continue to have, large water-consumptive industries; **and**
- are projected to be impacted by climate change with decreases in summer rainfall, higher summer temperatures and greater frequency of droughts.

The latest UK climate projections for the 2030s suggest that many southern counties of England and Wales and parts of the Midlands will see a decrease in daily mean summer rainfall by between 10% and 20% (central estimate[17], Figure 6.1). These are areas which are presently at least moderately water stressed and/or have no water available.

Thus, in the longer term, the conurbations and industrial areas of South Wales, much of the remainder of the Midlands and South West England will require action to tackle unsustainable water consumption.

It is not possible to say what non-household sectors might be responsible for the majority of water consumption by 2030. The sectors that *currently* account for the largest volume of water consumption in the Midlands and South West England (areas already discussed in the short and medium terms actions), are:

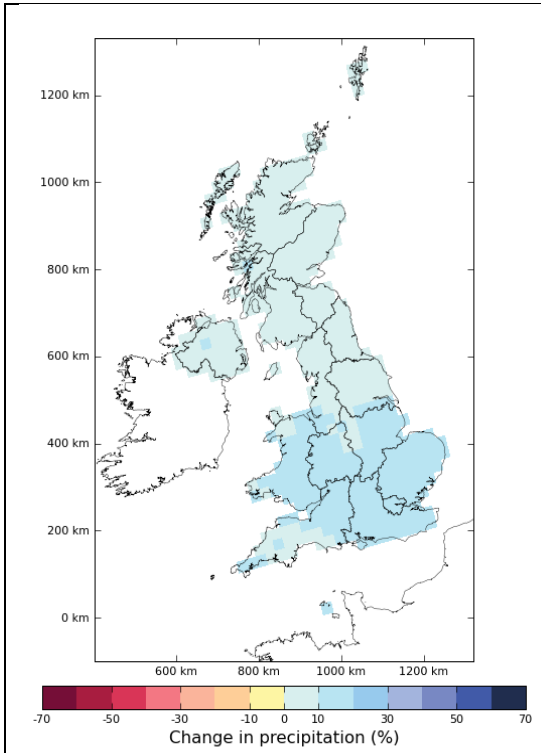
- manufacturing, particularly food and drink, and paper and printing;
- irrigated agriculture; and
- office-based and education sectors.

Longer term action is required for South Wales, where our analysis indicates that manufacturing is by far the largest single non-household sector in terms of the total volume of water used for non-consumptive use. Specifically, the following subsectors are important for longer-term consideration in Wales:

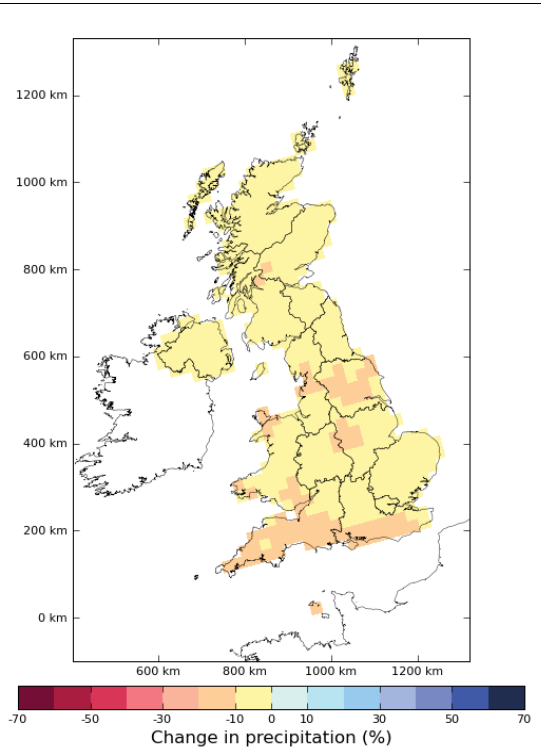
- paper and printing;
- mineral products ; and
- food and drink.

[17] *There is inherent uncertainty in these projections with a small probability that rainfall will on average* increase *in summer. However, based on the best available climate modelling at the UK's disposal, this outcome remains very unlikely.*

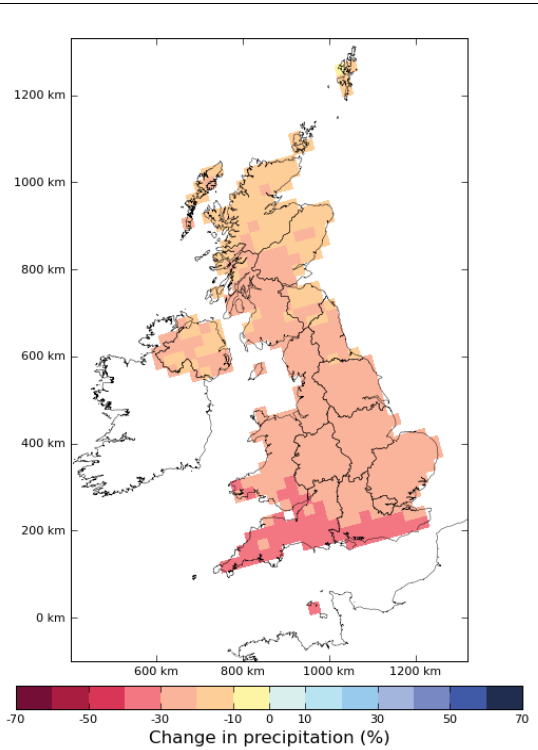
Figure 6.1 Projected percentage change in summer mean daily rainfall by the 2030s (from UKCP09)



90%-ile of change in summer mean daily rainfall in 2030s



50%-ile of percentage change in summer mean daily rainfall in 2030s



10%-ile of change in summer mean daily rainfall in 2030s

6.5 Discussion and recommendations

The aim of this project was to determine where effort should be focussed in future to help conserve the UK's valuable water resources. Data from a variety of sources were assessed to aid the identification of these priority areas, and in the course of the research a number of data gaps were identified that, if filled, would strengthen the validity of the results presented. It is important to note that the conclusions that have been drawn are unlikely to be altered significantly by the addition of such data. Additional data would, however, allow a greater depth of analysis and provide a methodology with fewer subjective elements that would allow progress to be measured in the future. The major gaps in data, and recommendations on how to fill these may be filled are provided in Table 6.2.

Table 6.2 Data gaps and recommendations for filling them

Topic	Missing information	Recommendation for filling gap
Water scarcity	Indicator that considers both current and future water demands, and the needs of the environment	Currently a combination of indicators have been assessed to determine the high priority locations. This should ensure that no factors have been overlooked and that all priority locations have been identified.
Water use	Direct abstraction information (actual volumetric data) for Scotland and Northern Ireland.	Separate data improvement programmes are underway in each region, and actual volumetric data will be available from databases held by SEPA and NIEA from 2012.
	Blank return entries in available NALD data.	Not thought to be a major issue. The EA have a standard methodology for estimating returns from these licences and a similar process has been followed for the purpose of this study.
	Mains water use data for Northern Ireland.	It was not possible to obtain data for the purposes of this study and it has not been possible to confirm, at time of writing, if these data exist.
	Mains water use data for Bournemouth and West Hampshire Water, Dee Valley Water and Cambridge Water.	Further liaison with these companies would be required to ascertain whether any information that is relevant could be used to determine water use by non-household sectors.
	Variation in the level of detail of sector information within water utility data that is used to populate the Water Resource Management Plans.	Further engagement with specific sectors would help to validate figures generated in this project and may yield additional information, such as within-sector benchmarking data from previous studies, which would assist understanding of that sector's water use.
Water discharges	Water discharged to sewers from a number of sewerage companies.	It might be appropriate to consider water-using processes for the highest priority sectors and work with sector bodies and/or trade associations to see if an estimate of the proportion discharged to sewer and/or water course can be identified. For large organisations it might be possible to contact them directly to obtain this information.
	Any data relating to water discharged to water courses.	

The analysis carried out on National Abstraction Licensing Database information, Water Resource Management Plan information and Catchment Abstraction Management Strategy documents has allowed WRc to ascertain those sectors that are likely to be responsible for the most significant consumptive uses of water in the regions identified as priorities in the short, medium and longer term. These recommendations are summarised in Table 6.3, Table 6.4 and Table 6.5 respectively.

Table 6.3 Areas and sectors recommended for consideration in the short term (next four years)

Region	Specific catchments	Non-household sectors
Eastern England	• Cam & Ely Ouse (Cambridgeshire) • Broadland Rivers (Norfolk) • Combine Essex (Essex) • East Suffolk (Suffolk) • Upper Lee (Bedfordshire, Hertfordshire, Essex) • Colne (Hertfordshire)	• Irrigated agriculture • Food and drink industry • Other Industry – particularly chemicals
Midlands	• Grimsby, Ancholme & Louth (Lincolnshire) • Dove (Derbyshire) • Idle & Torne (Nottinghamshire) • Lower Trent & Erewash (Nottinghamshire) • Welland (Leicestershire, Rutland)	• Food and drink industry • Paper and printing industry • Irrigated agriculture • Domestic consumption in offices and schools.
London and South East England	• London (particularly South London) • Stour (Kent) • Darent & Cray (Kent)	• Irrigated agriculture • Domestic consumption in offices and schools • Paper and printing industry
South West England	• Hampshire & Avon (West Hampshire, South Wiltshire) • Kennet & Pang (North Wiltshire) • Upper Thames (South Gloucestershire, West Oxfordshire)	• Irrigated agriculture • Domestic consumption in offices, schools and accommodation • Paper and printing, rubber, and chemicals industries • Food and drink industry

In addition to expanding the sectors identified for focus in the short-term, and, actions to cover the whole of the East of England and South East regions, Table 6.4 identifies some additional specific areas which could be focussed upon in the medium term.

Table 6.4 Areas and sectors recommended for consideration in the medium term (in four to ten years from now)

Government region	Specific catchments	Non-household sectors
Midlands	• Nene Catchment (Northamptonshire) • Middle Severn Catchment (Worcestershire) • Avon Catchment (Warwickshire)	• Food & drink industry • Paper & Printing industry • Irrigated agriculture • Domestic consumption in offices & schools.
South West England	• Tamar/Torbay catchment (Devon)	• Irrigated agriculture • Domestic consumption in offices, schools and accommodation • Mineral extraction industry.

Table 6.5 Areas and sectors recommended for consideration in the longer term (more than ten years from now)

Region	Specific catchments	Non-household sectors (based on current consumption profile)
South Wales	Whole region	• Food & drink industry • Paper and printing industry • Mineral products industry
Midlands	Whole region	• Food & drink industry • Paper & Printing industry • Irrigated agriculture • Domestic consumption in offices & schools.
South West England	Whole region	• Irrigated agriculture • Domestic consumption in offices, schools and accommodation • Paper and printing, rubber and chemicals industries • Food & drink industry

There are a number of other considerations that should be made when work begins to identify water conservation methods that WRAP and other stakeholders can support based on these recommendations. In particular:

- work that is already underway in collaboration with non-household sectors;
- the 'water hierarchy', and the difference between water wastage and water use; and
- methods by which comparisons within a sector can be carried out to enable benchmarking by particular companies.

Work already being carried out in collaboration with non-household sectors

There are a variety of initiatives underway to reduce water consumption across the non-household sector. In particular there is work undertaken by water utilities[18] and work undertaken by WRAP (previously through the Envirowise programme).

Currently water utilities already have a number of initiatives in place such as:

- issuing major companies in its region with water self-audit packs;
- carrying out water audits and providing advice;
- carrying out efficiency surveys;
- leakage detection;
- roadshows to encourage water efficiency and water recycling; and
- retrofit programmes in schools and public buildings such as police stations and government offices.

The Federation House Commitment (FHC) is a voluntary agreement (also known as a responsibility deal), managed by WRAP and the Food and Drink federation (FDF). Launched in January 2008, the FHC aims to help manufacturing companies in the food and drink sector to reduce water usage within their company, and by doing so, contribute towards an overall sector-wide water reduction target of 20% by the year 2020 against a 2007baseline. (See www.fhc2020.org.uk) . FHC signatories pledge to review their on-site water use, develop and implement site specific action plans and report their annual water use data through the FHC. In return signatories receive tailored technical assistance that could include site reviews, development of site water balances or in-house training and opportunities for peer networking.

Young's joined the FHC in 2007. It has used the tools that the FHC has provided to share skills and knowledge across the organisation and has now delivered savings of up to 30% reduction across the group, resulting in a staggering 155,000m3 savings since joining the FHC. It has put in place further targets for the next five years aimed at bringing about a 7% reduction in consumption year on year (FHC Annual Progress Report 2010).

In 2010 FHC signatories reduced their water use by 11.9% per tonne (excluding water in product), compared to the 2007 baseline. The FHC can be considered a successful initiative because it had industry buy-in from the outset due to clearly demonstrable benefits associated with the water conservation measures employed. As water

[18] *Since 1996, each water utility has had a duty under section 93A of the Water Industry Act 1991 (WIA91) to promote water efficiency to its customers.*

is generally perceived as a low-cost resource, the demonstration of clear economic benefit is a necessary prerequisite for substantial investment in water conservation measures.

WRAP is also working in partnership with a number of water companies to provide training and information to their customers, primarily SMEs, on water efficiency opportunities.

The Strategic Forum for Construction Water Sub-Group is currently working towards a 20% reduction in water use associated with construction sites against a 2008 baseline. The current focus of the group is on gathering evidence of clear benefits associated with water conservation measures in order that there is justification for promoting best practice techniques.

A hierarchy of water conservation activities

It is relevant to consider a form of water hierarchy when contemplating water conservation measures. In simple terms, a suitable water hierarchy – which would be used to prioritise activities – would be to consider:

- eliminating water wastage in processes first; and

then

- reducing consumption of the water with the largest life-cycle impact.

The latter point might be the choice between reducing mains water use in favour of direct abstraction, or harvesting rainwater to offset mains water use, or focussing on reducing water use in processes which require the water to be heated. In all cases, both the financial and environmental cost (including implications for an organisation's carbon footprint) must be considered.

The water hierarchy is based upon a five step process (Manan et al., 2006), which should be considered in order:

1. source elimination;
2. source reduction;
3. direct reuse/outsourcing;
4. regeneration reuse; and
5. freshwater use.

For any process, solutions should be sought at each stage if possible, thereby ensuring that freshwater is only used as a last resort.

Methods of within-sector benchmarking

In order to encourage water conservation measures within a particular sector, it is necessary to understand the water-using processes in some detail. This includes:

- the process in which water is used;
- the volume of water used for the process;
- the value of the process to the sector in question;
- alternative processes that could be used and the water consumption of those methods; and
- calculation of the benefit associated with implementation of the best practice process.

In order to carry out these steps it is likely that within-sector benchmarking would be required in order to ascertain particular sites that were deemed to be particularly efficient (to communicate good practice), or inefficient (to tackle first). In order to carry out this type of benchmarking, consideration of water use in relation to output would be appropriate. Performance measures, such as the volume of water used to produce one tonne of finished product[19], would have to be routinely monitored and reported.

[19] *A measure such as the volume of water used per FTE employee or volume of water used per unit of utilised floor area is more appropriate for sectors which are largely office-based.*

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Appendix A Key communications and requests

A.1 Data requests for abstraction information

A.1.1 England and Wales

The following request was submitted to the National Abstraction Licensing database team:

WRc are conducting a study on behalf of WRAP and the Environment Agency (EA) to review data on freshwater availability and use across the UK. This includes looking at water use across different sectors and regions. Data are being collected from various sources and will be summarised by region and Standard Industrial Classification (SIC) 2007. One key source of data is the NALD for directly abstracted water. As part of this project, we will undertake a mapping exercise to align the NALD secondary use codes to SIC2007. WRc is aware from previous work, on behalf of the Strategic Forum for Construction *that, at least in the construction sector, a small proportion of licence holders were classified with the wrong NALD use code. We are hoping to correct this and provide an updated NALD and SIC2007 assignment where possible. We are aware that this will not be a straightforward exercise. For this reason we are requesting information to Company Name level from NALD (but see exclusions below).*

Summary of data request

The following data items are requested by company name (licence holder) for all groundwater and ***non-tidal*** *surface water abstractions:*

- *licence number;*
- *secondary Code;*
- *secondary Category;*
- *use code;*
- *use description;*
- *licence holder;*
- *region;*
- *authorised annual abstraction volume;*
- *abstraction type: groundwater/surface water;*
- *2006 return (including nil, and null returns);*
- *2007 return (including nil, and null returns); and*
- *2008 return (including nil, and null returns).*

Note, where there are multiple licences for one company in any category (all other details being equal, i.e. region, use, secondary category, abstraction type), we do not require the volume of individual abstractions (actual and authorised) however we recognise that this may be the easiest method by which to provide information to us.

Exclusions:

1. Licence holders in breach of licence conditions for any year

We understand that you cannot provide the Licence Holder details plus authorised and actual abstraction volumes where this information would identify a breach for an individual/group of individuals (under Data Protection Act). We are therefore explicitly requesting that those licence holders who have breached their licence in any year be excluded from the data we have requested – even if the licence holder is not an individual/group of individuals to save time in processing the request.

2. Primary NALD codes W, E, C and X

We will be considering water use from public supply separately using information supplied directly from water utilities and therefore ***do not*** *require information relating to Primary NALD codes W (Water Supply) Nor do we require data for Primary Codes C, E and X (Crown & Govt, Environmental and Impounding).*

We would ask that information on all other groundwater and non-tidal surface water abstraction types be provided, i.e.

NALD primary code	Primary description	NALD secondary code	Secondary Description
A	Agriculture	AQF	Aquaculture Fish
		AQP	Aquaculture Plant
		FOR	Forestry
		AGR	General Agriculture
		HOR	Horticulture & Nurseries
		ORC	Orchards
		ZOO	Zoos/Kennels/Stables
I	Industrial, Commercial, Public Services	BRW	Breweries/Wine
		BUS	Business Parks
		CHE	Chemicals
		CON	Construction
		CRN	Crown & Government
		CVY	Statutory Water Conservancy Operation
		DAR	Dairies
		DRG	Drainage Operation
		EXT	Extractive
		FAD	Food & Drink
		GOF	Golf Courses
		HOL	Holiday Sites, Camp Sites & Tourist Attractions
		HOS	Hospitals
		HRB	Ports & Harbour Authority Operation
		HTL	Hotels, Public Houses & Conference Centres
		LAU	Laundry
		MCH	Machinery & Electronics
		MTL	Metal
		MIN	Mineral Products
		MUN	Municipal Grounds
		NAV	Navigation
		OTI	Other Industrial/Commercial/Public Services
		PAP	Paper & Printing
		PET	Petrochemicals
		PAD	Public Administration
		RAC	Racecourses
		REF	Refuse & Recycling
I (continued)	Industrial, Commercial, Public Services (continued)	RES	Research non-University/College
		RET	Retail
		RUB	Rubber
		SCH	Schools & Colleges
		SLA	Slaughtering
		SPO	Sports Grounds/Facilities
		TXT	Textiles & Leather
		TRA	Transport
P	Production of Energy	ELC	Electricity
		MEC	Mechanical Non-Electrical
M	Amenity	IND	Industrial/Commercial/Energy/Public Services
		PRI	Private Non-Industrial

Thank you for your assistance. To discuss this request further, please contact the Project Manager at WRc using the contact details below.

A.1.2 Northern Ireland

The Water Management Unit (WMU) was contacted at the Northern Ireland Environment Agency (NIEA).

Initial correspondence

WRc are conducting a study on behalf of WRAP and the Environment Agency (EA) to review data on freshwater availability and use across the UK. This includes looking at water use across different sectors and regions. The project is mainly looking at the use of water by industrial and commercial sectors. It will be used to target water efficiency measures for industrial and commercial sectors if water resources are under pressure. Data are being collected from various sources and will be summarised by region and Standard Industrial Classification (SIC) 2007.

Before sending you the details on our request for abstraction information, we would like to understand how you categorise abstraction in Northern Ireland.

I will call you later this week to discuss this further.

Data request

WRc are conducting a study on behalf of WRAP and the Environment Agency (EA) to review data on freshwater availability and use across the UK. This includes looking at water use across different sectors and regions. The project is mainly looking at the use of water by industrial and commercial sectors. It will be used to target water efficiency measures for industrial and commercial sectors if water resources are under pressure. Data are being collected from various sources and will be summarised by region and Standard Industrial Classification (SIC) 2007.

Summary of data request

In order to determine the consumption of water by industrial and commercial sectors, I am looking to collect information, on an annual, sector by sector basis. Although the baseline year of 2006/07 would be ideal, if you have actual (measured/reported) abstraction data available for a more recent year, we would prefer actual and maximum authorised volumes from this more recent time period.

We are seeking volumetric data by business sector, for example:

- *agriculture, forestry and fishing;*
- *mining and quarrying;*
- *manufacturing;*
- *electricity, gas, steam and air conditioning supply;*
- *waste management and remediation activities;*
- *construction;*
- *wholesale and retail trade, repair of motor vehicles;*
- *transportation and storage;*
- *accommodation and food service activities;*
- *information and communication; and*
- *other sectors.*

Note: If you have a different sectoral classification for abstraction activities (more or less detailed than the sector listing above) we are happy to have any volumetric data by your own classification if this makes it easier to share your data with us.

The following data items are requested by company name (licence holder) for all groundwater and ***non-tidal*** *surface water abstractions, where available:*

- *use code;*
- *use description;*
- *licence holder;*
- *region;*
- *authorised annual abstraction volume;*
- *abstraction type: groundwater/surface water; and*

- *actual (measured) abstraction volume (most complete information preferable).*

Note, where there are multiple licences for one licence holder (all other details being equal, i.e. region, use, abstraction type), we do not require the volume of individual abstractions (actual and authorised) however we recognise that this may be the easiest method by which to provide information to us.

Exclusions:
1. Licence holders in breach of licence conditions for any year
We understand that you cannot provide the Licence Holder details plus authorised and actual abstraction volumes where this information would identify a breach for an individual/group of individuals (under the Data Protection Act). We are therefore explicitly requesting that those licence holders who have breached their licence in any year be excluded from the data we have requested – even if the licence holder is not an individual/group of individuals to save time in processing the request.

Further conversations with the WMU at NIEA yielded useful contextual information which is reported in the relevant chapters of this report. However, no quantitative information on actual volumes directly abstracted by sector in Northern Ireland is currently available.

A.1.3 Scotland

Following an initial telephone call to current contacts in SEPA, it was recommended that WRc should place an information request via SEPA's website. Subsequent contact with the WFD team at SEPA has yielded further contextual information but, to date, no volumetric information on actual volumes directly abstracted by each sector is readily available.

A.2 Data Requests for Trade Effluent Volumetric discharge data (Direct discharge to water bodies)

A.2.1 England and Wales

WRc contacted the Environment Agency Water Quality Policy and National Surface Water Quality Technical Services teams. The project brief was explained, noting that the EA was a partner in the project, and the availability of effluent flow data for industrial sectors that discharge direct to water bodies (non-tidal) was requested.

The national team at EA Head Office asked operational teams in EA Area and Regional offices to advise them know of any flow data from industrial sources they receive, where it is stored, and in what format. A colleague from the Pollution Prevention and Control (PPC) team was copied into this request for data to answer this question from a PPC viewpoint.

The response from one EA region on flow data is documented below (other Regions also responded with similar advice):

''From speaking to our Regional Data, Public Register and PPC teams, flow data is not so readily available from PPC or industry sites as it is from water utilities. I have separated my response on flow between PPC and private / industry dischargers.

PPC
I understand that we have about 800 IPPC permits in our region. We cannot use PAS to show us which permits are required to send us flow data, what determinants they have or where their discharge points are. All this data would have to be manually collated, if required.

Any flow data that is required to be submitted to us is stored in the local area office. Copies of the flow data are sent to the public register as well. Flow data is submitted in no specific format. It can either be email, paper or via CD. No flow data enters our region via CRM or GOR. None is therefore available on WISKI.

The frequency that the flow data is sent to us varies depending on the permit in question. It can be either quarterly or annually depending on what the permit states, or officer requests.

The content / type of data can vary as well, from daily maximum flow values, to daily averages at other sites or more specific 15 minute flow values at other sites as well.

Colleagues have mentioned that [our] region does not have a large percentage of PPC sites that discharge into rivers. Indeed, if they do, the impacts of this flow discharge may be minimal in volumetric terms because they are abstracting the same volume upstream and discharging the same volume, after use in a process, downstream again (in most cases) !

Permit holders are therefore obliged to record flow data, but not send it all in - only maximum values for example every few months. Permit holders are required to store the more detailed flow data (e.g. 15 minute values or longer durations) and send it to us only if we request this, but it is not routine to send any flow data in on a set frequency.

Industry
The PPC requirement is no different to a condition we would have included in (now old) discharge consents for private / industry discharges where flow was required to be measured. The condition I refer to is quoted below:

"A continuous flow measurement and recording system, to a specification provided by the Agency, shall be provided by XXX and operated to record the total daily volume, and the instantaneous or 15 minute integrated flow every 15 minutes, of the discharge or of trade effluent through the treatment works. An on-site visual display from which instantaneous or 15 minute integrated flow readings can be readily obtained by the Agency shall be provided and operated. The Consent holder shall hold records of the flow readings."

Therefore, we have no private / industry sites that are actively sending us flow data (like water utilities) for us to input into WISKI. I guess we do not ask for it, unless a problem were to occur downstream of the discharge when we may the seek flow data from the discharger then. We assume no flow news is good news.

Although this does not provide the project with any data, it may update you (or not!) on what happens with flow data in PPC / industry. I am sure the picture is not to dissimilar in other regions, unless a region has a sensitive flow issue with a discharge in which case we may be more routinely informed."

A.2.2 Northern Ireland

The Water Management Unit (WMU) was contacted at Northern Ireland Environment Agency (NIEA).

After a number of conversations, the following email was sent to the relevant contact. After a series of follow-up attempts by telephone, no data were elicited, but alternative sources at NIEA were suggested. WRc followed up those alternative sources for trade effluent data using other NIEA contacts but no data were obtained.

WRc is carrying out for WRAP a review of data on freshwater availability and use across the UK. The project is looking at the use of water by different industrial and commercial sectors.

In order to determine the consumption of water in the non-household sector, WRc is looking to collect information on the total volume of trade effluent discharged to water courses by sector across Northern Ireland, for at least the financial year 2006/07, and ideally for the period 2006-2009.

We appreciate the confidentiality of the information you hold regarding specific trade effluent consents. I should stress that the project does not require any data pertaining to effluent quality, nor does it require information on specific consents. We are simply interested in the total volumes of trade effluent discharged to water courses, summarised by sector or business type, for the period indicated above.

These data will then be used to calculate the consumption of water by UK region and by sector using the SIC2007 system. It will therefore be extremely helpful if you could provide us with total volumetric data by sector.

You may already have an internal classification of TE activities. We would be happy to receive volumetric data by your own classification if this makes it easier to share your data with us.

Thank you in advance for your contribution to this project for WRAP.

A.2.3 Scotland

Following an initial telephone call to current contacts in SEPA, it was recommended that WRc should place an information request via SEPA's website. Unfortunately, SEPA reported that such data are not readily available electronically hence no data could be obtained in the time-frame and scope of the current project.

A.3 Data requests for trade effluent volumetric discharge data (discharge to sewers)

The following email was sent to relevant contacts in all sewerage companies in the UK:

WRc is carrying out for WRAP a review of data on freshwater availability and use across the UK. The project is especially looking at the use of water by different industrial and commercial sectors.

In order to determine the consumption of water in the non-household sector, WRc is looking to collect information on the total volume of trade effluent discharged to sewers ***by sector*** *for your company area, for at least the financial year 2006/07, and ideally for the period 2006-2009.*

In your role as trade effluent manager / officer within your company, we appreciate the confidentiality of the information you hold regarding specific trade effluent consents. I should stress that the project does not require any data pertaining to effluent quality, nor does it require information on specific consents. We are simply interested in the total volumes of trade effluent discharged to your sewers, summarised by sector or business type, for the period indicated above.

These data will then be used to calculate the consumption of water by UK region and by sector using either the SIC2007 system or the classification used by the National Abstraction Licensing Database (NALD).

It will therefore be extremely helpful if you could provide us with total volumetric data by sector, e.g. for:

- *agriculture, forestry and fishing;*
- *mining and quarrying;*
- *manufacturing;*
- *electricity, gas, steam and air conditioning supply;*
- *water supply; sewerage, waste management and remediation activities;*
- *construction;*
- *wholesale and retail trade, repair of motor vehicles;*
  transportation and storage;
- *accommodation and food service activities;*
- *information and communication; and*
- *other sectors.*

You may already have a company internal classification of TE activities (more or less detailed than the sector listing above). We would be happy to receive volumetric data by your own classification if this makes it easier to share your data with us.

Appendix B Data manipulation methodology

B.1 Abstraction (NALD) data for England and Wales

NALD describes sectoral use by a number of hierarchical descriptor fields. As discussed at the Project Inception meeting, the most meaningful field for the assessment of sectoral use is that of 'Secondary Description'. These NALD secondary descriptions (e.g. manufacturing, construction) are listed in Appendix D. NALD data were received in spreadsheet format (28,958 NALD records representing 13,749 licenses and 8,344 companies) and converted back into a database format for post-processing.

Step 1 First-pass assignment of SIC2007

A first-pass assignment of SIC2007 to the NALD information was conducted by comparing the NALD 'secondary descriptions' with the descriptions of SIC2007 divisions. One or more SIC division codes (there are 88 in total) were assigned to each of the 43 NALD secondary descriptions[20]. In so doing, each NALD secondary description was assigned one or more of the 21 available SIC section codes. This assignment was based on the judgement of the WRc project team using SIC2007 explanatory notes from the Office for National Statistics for guidance (ONS, 2009a). A full listing of SIC section and division codes and their descriptions is given in Appendix C.

Clearly for the summary reporting of volumetric data against SIC, the assignment of more than one SIC code to an abstraction licence is not ideal in terms of the objectives of the work.

For forty of the NALD secondary descriptions, alignment to a single SIC section was possible. However, three NALD secondary description categories had multiple SIC section codes assigned to them (number of NALD records and corresponding number of companies in parenthesis):

- mineral Products (725 NALD records / 146 companies);
- industrial/Commercial/Energy/Public Services (260 NALD records / 150 companies); and
- other Industrial/Commercial/Public Services (1,588 NALD records / 468 companies).

Furthermore, WRc were aware from previous work that the NALD 'construction' secondary description (88 NALD records or 30 companies) was likely to contain a combination of mining activities (SIC section 'B') and other manufacturing uses (SIC section 'C').

As such, the NALD 'construction' secondary description along with the three listed above required additional attention.

Step 2 Second-pass assignment of SIC2007

Company name information was used to ascribe a SIC2007 code to each of the records in the NALD construction category plus the three other secondary description categories listed above. Information was sought from company websites to determine their primary activity. Information was also sought from the Companies House website (Companies House, 2010) to ascertain the nature of business based on SIC2003 codes which were subsequently converted to SIC2007 using ONS's own mapping of SIC2003 to SIC2007 (ONS, 2009b).

A total of 2,467 records (694 companies) were assigned a single SIC2007 section code following the above process. A SIC2007 section code could not be assigned to 194 records (100 companies) because:

- a one-to-one mapping between NALD and SIC was not possible; and
- the primary activity could not be ascertained from the company name field (e.g. for licence holders whose surname appeared as the company name).

The number of licences that could not be assigned a single SIC section code belonged to the four NALD categories as follows (these were reviewed manually in Step 5):

[20] *There are 60 NALD secondary descriptions. However, only 43 of these relate to licences in the NALD extract obtained from the EA because of the deliberate exclusions listed in Appendix A.*

- construction (5 records / 2 companies);
- mineral Products (17 records / 8 companies);
- industrial/Commercial/Energy/Public Services (82 records / 50 companies); and
- other Industrial/Commercial/Public Services (90 records / 40 companies).

Step 3 SIC2007 assignment and check by random sampling
A random sample was selected from the NALD information with the initial SIC2007 section code to NALD alignment being updated accordingly where applicable. Each record from the NALD database was assigned a random number between 0 and 1 using a random number generator, irrespective of whether the assignment of a single SIC section code had been completed. Those records with a number of less than 0.01 were selected to obtain a one per cent random sample of the NALD information. This random sample contained 274 records, representing information on 258 companies from a total of 8,344 (3.1% of all companies).

The representativeness of this small sample was checked by comparing the proportion of records included from each NALD secondary description with the proportion in the NALD population. There was sufficient agreement in the major use categories to suggest that the sample chosen for quality control purposes adequately represented the bulk of the population.

As in Step 2, assignment of SIC2007 section codes to NALD licences was undertaken for the random sample using company name, with information from the Companies House website being used to ascertain the nature of business.

A comparison at the NALD secondary description level was made between the SIC2007 codes assigned in this step with those assigned in Step 2 (if available) or, failing that, Step 1. In total, 166 of the 274 records showed perfect agreement between the SIC sections that had been assigned as a result of Steps 1 and/or 2. For a further 77 records, a direct comparison could not be made as it was not possible to assign a section SIC2007 code to the licence in Step 3. As previous, this was due to it not being possible to ascertain the primary activity of the company from the company name field (i.e. those licence holders whose surname appeared as the company name). In these cases, it was assumed that the SIC section code assigned following Step 2 (where available) or Step 1 was correct.

Where there was no agreement between the SIC codes assigned in Step 1 of 2 and those assigned in Step 3 (the remaining 31 of 274 records), the SIC section code assigned during this quality control check was assumed to be correct. SIC section codes were updated accordingly for all records pertaining to the companies selected in this random sample.

Step 4 Sampling of top 1% by volume
Further quality control was undertaken by sampling the top one per cent of companies (83 out of 8,344 companies) based on the volume of water they abstracted in 2006. This sample accounted for 91.3% of the total volume of water abstracted in this year (approximately 5.7 billion cubic metres). For this sample of companies, a manual check was undertaken to ensure that the correct NALD secondary description and SIC2007 code had been assigned to each of the companies. In many cases, multiple NALD secondary descriptions were aligned to the companies, thus a total of 169 distinct records were manually checked.

There were three distinct records where the SIC2007 code appeared to be incorrect, this representing 2.76% of the total volume abstracted in 2006. In these instances the SIC2007 division and section codes were corrected using the expert judgment of a senior member of the WRc project team.

Step 5 Sampling of data passed through Step 2, Step 3 or Step 4
Further quality control was undertaken by sampling those companies (801 companies) where the SIC2007 code was altered during Step 2, Step 3 or Step 4. For these companies, the SIC2007 section code that was previously assigned was checked against the NALD secondary description and the NALD use description to ensure that the SIC2007 code accurately reflected the correct sectoral use for the abstracted water. As multiple NALD secondary descriptions and NALD use descriptions were aligned to many of the companies, a total of 1,359 distinct records were checked.

Where the previously assigned SIC2007 code conflicted with the NALD secondary description or the NALD use description, the SIC2007 section code was corrected to reflect the NALD secondary description/NALD use

description. A total of 137 out of 1,359 distinct records (representing 83 companies) were corrected, with these corrections being based on the expert judgment of a senior member of the WRc project team.

Step 6 Sampling of data assigned to selected SIC2007 codes

Further quality control was undertaken by sampling a selection of companies (176 companies) that were assigned either SIC2007 section codes 'I', 'K', 'M' and 'N' during Steps 1 through 5. These were selected as the total volume of water abstracted in 2006 varied significantly compared to abstraction volumes reported in a recently published report (Enviros Consulting Ltd, 2008). For these four SIC2007 section codes (250 distinct records), the SIC2007 section code that was previously assigned was checked against the NALD secondary description, the NALD use description and the primary activity of the company as determined from the Companies House website. This quality control was undertaken to ensure that the SIC2007 code accurately reflected the correct sectoral use for the abstracted water.

Where the previously assigned SIC2007 code conflicted with either the NALD secondary description, the NALD use description or the primary activity of the company, the SIC2007 section code was corrected accordingly. A total of 88 out of 250 distinct records (representing 56 companies) were corrected, with these corrections being based on the expert judgment of a member of the WRc project team.

Step 7 Handling null returns

For 2006, there was no volumetric data available (i.e. a 'null return') for a total of 2,267 abstraction returns (covering 1,885 licences). To estimate the volume of water abstracted in 2006 for these abstraction returns, the data were divided into several groups based on the number of abstraction returns and NALD secondary descriptions, these being:

- licences with one abstraction return and one secondary description;
- licences with one abstraction return and multiple secondary descriptions;
- licences with multiple abstraction returns and one secondary description; and
- licences with multiple abstraction returns and multiple secondary descriptions.

For licences with one abstraction return and one secondary description, 'null returns' were estimated using the ratio of the total actual abstraction from licences and the total licensed volume for the secondary description associated with the licence. This ratio was determined by the following calculation steps:

A = the total actual abstraction from returns received for licences (10,480 in total) within each secondary description.

B = the total licensed volume (maximum annual quantity) from returns received for licences (10,480 in total) within each secondary description.

A divided by B.

For 939 licences, the appropriate ratio was multiplied by the licensed volume (maximum annual quantity) for the licence. This ensured that for each licence, the return was the same proportion of the licensed volume as those abstraction returns provided to the EA. This methodology also ensured that the estimated volume of water abstracted did not exceed that of the total licensed volume for each licence.

For licences with multiple abstraction returns and one secondary description, a number of licences had 'null returns' for each of the abstraction returns associated with the licence. In these cases, the appropriate calculated secondary description ratio (see calculation steps above) was multiplied by the licensed volume (maximum annual quantity) for each of the licences. This volume calculated was subsequently apportioned evenly between the abstraction returns associated with each licence. This ensured that the estimated total volume of water abstracted did not exceed the total licensed volume for the licence. In total, an estimated volume of water abstracted was assigned to 211 abstraction returns (covering 94 licences) using this method.

For licences with multiple abstraction returns and one secondary description, a number of licences also had 'null returns' for at least one of the abstraction returns, while the other abstraction returns associated with the same licence had a return value. In these cases, the following calculation steps were performed:

C = the licensed volume (maximum annual quantity) for each licence.

D = the total actual abstraction from abstraction returns for each licence.

A divided by B (see calculation steps above), multiplied by C, minus D.

The final calculation above was applied to each licence, with the subsequent volume calculated being apportioned evenly between those abstraction returns associated with each licence that had a 'null return'. Again, this ensured that the estimated total volume of water abstracted for each licence did not exceed the total licensed volume for the licence. In total, an estimated volume of water abstracted was assigned to 995 abstraction returns (covering 758 licences) using this method.

For the remaining two groups (licences with one abstraction return and multiple secondary descriptions and licences with multiple abstraction returns and multiple secondary descriptions) there were 327 (1.9%) abstraction returns (covering 197 licences) which had an actual abstraction return value. However, as these groups contained multiple NALD secondary descriptions and thus multiple SIC2007 section codes for each licence, it was not possible to apportion the actual abstraction return between these secondary descriptions whilst ensuring that the estimated total volume of water abstracted for each licence did not exceed the total licensed volume for the licence.

Furthermore within these two groups, estimates could not be determined for 122 (0.7%) abstraction returns (covering 94 licences) which has a 'null return' value. This was due to the following reasons:

- there was no evidence base to apportion actual abstraction return between secondary descriptions as it was not possible to apply an appropriate methodology to the 327 abstraction returns that had an actual abstraction return value; and
- even if an evidence base were available, it would be based on 1.9% of abstraction returns thus resulting in there being little confidence in any subsequent calculations due to the size of the dataset.

Finally, it was noted that 162 abstraction returns (covering 150 licences) had a zero return for both the preceding and following years (2005 and 2007 respectively). On inspecting the entire NALD data extract, it was noted that of the 4,616 abstraction returns which returned 'zero' for 2006, over 90% of them (4,193) also abstracted no water in both 2005 and 2007. Therefore, it was decided to apply a 'zero' return value to those abstraction returns where data had not been returned in 2006 and had not abstracted any water in 2005 and 2007.

Step 8 Direct abstraction excluding non-consumptive uses

NALD information was interrogated to remove major non-consumptive uses. For the purposes of this study, non-consumptive uses are defined as a use of abstracted water which is returned to the immediate environment from where it came, with the water requiring little or no wastewater treatment. For analysis purposes, non-consumptive uses[21] are defined as the use of directly abstracted water in:

- fish farm/cress pond throughflow;
- hydraulic rams;
- hydroelectric power generation;
- milling and water power other than electricity generation;
- non-evaporative cooling;
- transfer between sources (post Water Act 2003); and
- transfer between sources (pre Water Act 2003).

In total, 1,259 abstraction returns (covering 1,095 licences) had non-consumptive 'use descriptions' associated with them. For the majority (1,070) of these abstraction returns), water was abstracted for solely non-consumptive uses, thus these were excluded from the dataset for the analysis of consumptive uses. For the remaining (189) abstraction returns, water was abstracted for a mix of non-consumptive and consumptive uses. Owing to the way that volumetric data are reported and held in NALD, it is not possible to apportion the volume

[21] *Consultation with the EA NALD and SEPA abstraction licensing teams confirmed that this subset of NALD secondary descriptions / water use types could be viewed as substantially or wholly non-consumptive.*

abstracted amongst the various 'use descriptions' without introducing considerable additional uncertainty. It was subsequently agreed with the client that upper and lower bounds on the 'true' value of consumptive use based on the selective and non-selective removal of major non-consumptive uses would be reported.

Specifically, the upper bound calculation constituted the removal of only those abstraction returns that had solely non-consumptive uses associated with them, while the lower bound calculation constituted the removal of all abstraction returns that had non-consumptive uses associated with them, irrespective of whether the abstraction return had 'use description's **not** defined as non-consumptive.

In other words,

Upper bound of consumptive use = total volume abstracted – volume abstracted for major non-consumptive uses (volume for abstraction returns which have **solely** non-consumptive uses associated with them)

Lower bound of consumptive use = total volume abstracted – volume abstracted for major non-consumptive uses (volume for abstraction returns which have at least one non-consumptive use associated with them)

Of a total of 16,937 abstraction returns (covering 13,749 licences), the dataset used to generate a sectoral **lower** bound estimate of consumptive use contained 15,678 abstraction returns covering 12,860 licences (in other words, 1,259 abstraction returns (covering 1,095 licences) were removed because **at least one** use of water from each of those abstraction returns is non-consumptive). The dataset used to generate a sectoral **upper** bound estimate of consumptive use contained 15,867 abstraction returns covering 12,995 licences (in other words, 1,070 abstraction returns (covering 957 licences) were removed because **all** uses from those abstraction returns are defined as non-consumptive).

B.2 Mains water use data

Fourteen of the twenty water utilities for which data were available used the Environment Agency's template (or a very close approximation) for their Water Resource Management Plan Table WRP8. For these utilities, identifying the appropriate value for some SIC section codes was straightforward. However, the template combines a number of SIC section codes, for example by presenting a single value for water use in all of SIC sections J, K, L, M, N, O, R, S, T and U. The remaining water utilities used alternative classifications with either different combinations of SIC2007 sections or no reference to SIC2007 at all. Therefore, data processing was required to enable values to be presented against each SIC2007 section. This involved a number of steps and the extent of processing varied across all water utility datasets:

1. The non-standard classifications were mapped to SIC2007 divisions (and hence sections) using the published descriptions for activities within each division.
2. For companies that did not use the template sections/divisions, it was assumed that the best estimate for how to divide by sector was to use the data from companies that did divide data this way. Average percentages for water use in each category of the template were therefore calculated across the companies with data in this format.
3. Data divided using alternative classifications were disaggregated where possible using the average percentages in Step 2. For example, Bristol Water's data included one row that corresponded to SIC divisions A, B and part of C, with two further rows also corresponding to division C. These values were combined and then split using the calculated percentages from Step 2.
4. It was not possible to use the method in Step 3 for sections D, E, J, K, L, M, N, O, P , Q, R, S, T and U because the template places these into three categories rather than fourteen. Such combinations commonly involved service activities and other that are likely to use water in a similar way. Using this assumption, the values were divided into separate sections using published employment data from Q1 of 2007 (ONS 2007). Employment statistics are deemed to be an appropriate surrogate variable for sector size.
5. All but one of the companies combined water use for electricity, gas and water utilities (SIC sections D and E). In these cases, data from the water utilities' annual returns to Ofwat (June Returns) (Ofwat, 2007a) were used to identify how much water the water utility itself used, except for three companies where this information was not available. The value from the June Returns was entered against section E and the remainder assigned to section D. Water use in section E excludes sewerage, but the amount of water used in this way is very small (expert opinion, WRc 2010) It was not possible to identify how much water was used by the waste sector and so this use is incorporated in section D rather than section E.
6. A combination of Steps 3, 4 and 5 were employed where necessary to separate the data for each sector.

For Northern Ireland Water, a breakdown of non-household water use by sector is provided in the WRMP. These percentages have been applied to the 2006/07 return made to the Northern Ireland All Utility Regulator.

Where possible, these SIC sections have been further broken down as in steps 1 to 6 above, however it was not possible to separate as many sections out as for the England & Wales regions. Therefore many SIC sections are blank, and the 'unallocated' volume of water is proportionally larger than for most other regions.

B.3 Trade effluent discharge to sewer

Trade effluent discharge data supplied by sewerage undertakers was predominantly categorised by discharge type (e.g. Laundry, Abattoir). The categorisation varied amongst sewerage undertakers. Each of the categories presented to WRc was assessed and assigned to the most appropriate SIC2007 division and section. This allowed the total volume of trade effluent discharged to sewer for each SIC section to be estimated.

There was some uncertainty over the correct SIC division to apply for some of the categories. Some categories (e.g. Engineering) are too broad to be assigned to a single SIC division, but could be assigned to a single SIC section. As other data types are reported by SIC section, this does not present an issue at this level of analysis. However, other categories cannot be assigned to any SIC section with confidence (e.g. 'Other'). There are also two categories (Bund Water and Laboratory & Animal Husbandry) where it was decided that these bridged two SIC sections. However, these two categories comprise only a small percentage (0.34%) of the data supplied by one sewerage undertaker and hence were excluded from further analysis. Table B.1 shows the proportion of data, by volume, from each sewerage undertaker which could be assigned to a SIC section. It can be seen that the majority of the data were successfully assigned to SIC sections.

Table B.1 Proportion of trade effluent data assigned to SIC section, by sewerage undertaker

Sewerage undertaker	Data period received	Calculation period	% total volume assigned	Proportion of June Return value
Anglian Water	2007-2010	Total of four years	81.83%	70.98%
Northumbrian Water	2006	Calendar year	88.05%	55.59%
	2007	Calendar year	87.88%	56.12%
	2008	Calendar year	86.32%	53.38%
	2009	Calendar year	85.83%	64.47%
Scottish Water	?	Unknown	81.47%	
Yorkshire Water	2006-2009	Average of four years	97.54%	100.54%
Northern Ireland Water	2009	Calendar year	100.00%	
South West Water	2007	Calendar year	96.33%	96.99%
	2008	Calendar year	95.26%	96.63%
	2009	Calendar year	93.17%	104.90%
	2010	Calendar year	90.96%	
Southern Water	2006/07	Financial year	95.03%	61.61%
	2007/08	Financial year	95.59%	58.76%
	2008/09	Financial year	95.26%	62.79%

Table B.1 also shows the percentage of the trade effluent volume, taken from Table 14 of the annual return of sewerage undertakers (June 2009), which is accounted for by the dataset provided. The discrepancy between the dataset and annual Return figures for Northumbrian Water is explained by special agreement volumes. Discrepancies for other companies may arise from differences in the reporting period, although there is a larger difference for the Southern Water data that may warrant further investigation.

A listing of those trade effluent categories which were manually assigned to SIC2007 is presented in Table B.2.

Table B.2 Manual assignment of SIC2007 to trade effluent categories defined by sewerage undertakers

Sewerage undertaker	Category as defined by sewerage undertaker	SIC division	SIC section
Scottish Water	Auction Market Waste Water	46	G
Scottish Water	Cat & Dog home	94	S
Scottish Water	Electronics Processing	26	C
Scottish Water	Electroplating waste water	25	C
Scottish Water	General Engineering	71	M
Scottish Water	Glass Grinding & Cuttings	23	C
Scottish Water	Manufacture of Filters	28	C
Scottish Water	Metal Finishing	24	C
Scottish Water	Miscellaneous Manufacturing e.g. Paint/Rubber/Polystyrene		C
Scottish Water	Oil Industry Chemicals/Laboratories	71	M
Scottish Water	Oil Industry Metal Cutting		C
Scottish Water	Oil Industry Pressure Testing	71	M
Scottish Water	Paint stripping		F
Scottish Water	Paper Goods Production	17	C
Scottish Water	Paper Printing	18	C
Scottish Water	Pharmaceutical Processing	21	C
Scottish Water	Pipe cleaning & flushing	49	H
Scottish Water	Pressure Testing	71	M
Scottish Water	Tannery Wastewater	15	C
Scottish Water	Textiles Manufacture	13	C
Scottish Water	Vehicle Washing	45	G
Scottish Water	Washing Commercial Vehicles (PCV/HGV)	45	G
Scottish Water	Washing Domestic Laundry	96	S
Scottish Water	Washing Garments	96	S
Scottish Water	Washing General	96	S
Scottish Water	Washing Industrial Laundry	96	S
Scottish Water	Washing Oil Industry Plant/Equipment	81	N
Scottish Water	Washing Plant/Equipment	81	N
Scottish Water	Washing process equipment	81	N
Scottish Water	Waste from fibreglass manufacture	23	C
Scottish Water	Cooling Water		
Scottish Water	Miscellaneous Cooling Water		
Scottish Water	Power generation	35	D
Scottish Water	Waste water from power generation	35	D
Scottish Water	Miscellaneous Contaminated Runoff/Waste Transfer/Fire Trg		
Scottish Water	Miscellaneous Tip Leachate	38	E
Scottish Water	Portable toilet effluent	37	E
Scottish Water	Remediation of contaminated land	39	E
Scottish Water	Tip Leachate	38	E
Scottish Water	Excavation dewatering	43 & 09	B
Scottish Water	Miscellaneous Concrete Production/Stone Cutting	23	C
Scottish Water	Car Washing	45	G
Scottish Water	Train wash	81	N
Scottish Water	Abattoir effluent	10	C
Scottish Water	Bakery effluent	10	C
Scottish Water	Drink Brewing	11	C
Scottish Water	Drink Distilling	11	C
Scottish Water	Drink Malting	11	C
Scottish Water	Drink Soft Drinks	11	C
Scottish Water	Fish market washdown	46 & 47	G
Scottish Water	Fish meal manufacture	10	C
Scottish Water	Fish processing	10	C

Sewerage undertaker	Category as defined by sewerage undertaker	SIC division	SIC section
Scottish Water	Fish Value Added		C
Scottish Water	Fish Wash		C
Scottish Water	Food Butchers	10	C
Scottish Water	Food Dairy	10	C
Scottish Water	Food Fruit/Veg	10	C
Scottish Water	Food General	10	C
Scottish Water	Hospital Waste	86	Q
Scottish Water	Patient Care General	86	Q
Scottish Water	Vegetable processing waste water	10	C
Scottish Water	Pelagic fish processing	10	C
Scottish Water	Salmon processing	10	C
Scottish Water	Screen printing of vinyl	18	C
Scottish Water	Shellfish processing	10	C
Scottish Water	Slaughterhouse waste	10	C
Scottish Water	Vegetable processing waste water	10	C
Scottish Water	Waste from food manufacture	10	C
Scottish Water	White fish processing	10	C
Scottish Water	Bund water	43 & 09	F & B
Scottish Water	Clinical trials in manufacturing cubicle		Q
Scottish Water	Demolition	43	F
Scottish Water	Gas Holder Runoff		D
Scottish Water	Groundwater		
Scottish Water	Hard standing/yard run off		
Scottish Water	LABORATORY	71	M
Scottish Water	Laboratory & Animal Husbandry	01 & 71	A & M
Scottish Water	Laboratory Effluent	71	M
Scottish Water	Laundry	96	S
Scottish Water	Miscellaneous Uncategorisable		
Scottish Water	Swimming Pool Effluent	93	R
Scottish Water	ZOO	91	R
Scottish Water	Drink Malting	11	C
Northern Ireland Water	Vehicle Washes	45	G
Northern Ireland Water	Cattle Marts	46	G
Northern Ireland Water	Swimming Pools	93	R
Northern Ireland Water	Chemical/Pharmaceutical Industry	21	C
Northern Ireland Water	Drinks Industry	11	C
Northern Ireland Water	General Manufacturing		C
Northern Ireland Water	Metal Manufacturing	25	C
Northern Ireland Water	Residential/Nursing Homes	87	Q
Northern Ireland Water	Textile Manufacturing	13	C
Northern Ireland Water	Food Manufacturing	10	C
Northern Ireland Water	Landfill Sites/Waste Disposal	38	E
Northern Ireland Water	Abattoirs	10	C
Northern Ireland Water	Dairy Industry	10	C
Northern Ireland Water	Haulage Companies	49	H
Northern Ireland Water	Bakeries	10	C
Northern Ireland Water	Laundries	96	S
Northern Ireland Water	Fish Industry	10	C
Northumbrian Water	Abattoir	10	C
Northumbrian Water	Chemical	20	C
Northumbrian Water	Engineering	71	M
Northumbrian Water	Farm	01	A
Northumbrian Water	Food	10	C
Northumbrian Water	Laundry	96	S
Northumbrian Water	Other		
Northumbrian Water	Swimming Pools	93	R

Sewerage undertaker	Category as defined by sewerage undertaker	SIC division	SIC section
Northumbrian Water	Vehicle Wash	45	G
South-West Water	Brewery	11	C
South-West Water	Car Wash	45	G
South-West Water	Cattle Market	46	G
South-West Water	Cosmetics	20	C
South-West Water	Dairy Waste	01	A
South-West Water	Electroplater	25	C
South-West Water	Engineering	71	M
South-West Water	Fish processing	10	C
South-West Water	Fishprocessing	10	C
South-West Water	Food (beverages)	11	C
South-West Water	Food (meat)	10	C
South-West Water	Food Processing	10	C
South-West Water	Gasholder discharge		D
South-West Water	Industrial		C
South-West Water	Laboratory	71	M
South-West Water	Launderette	96	S
South-West Water	Laundry	96	S
South-West Water	Other		
South-West Water	Pharmaceutical	21	C
South-West Water	Photographic	74	M
South-West Water	Printers	18	C
South-West Water	Slaughterhouses	10	C
South-West Water	Swimming Pool	93	R
South-West Water	Textile	13	C
South-West Water	Tip Leachate	38	E
South-West Water	Vehicle / Plant washdown	45	G
South-West Water	Wastewater treatment	37	E
South-West Water	Yard washdown	81	N
Yorkshire Water	Abattoir & Meat Processing	10	C
Yorkshire Water	Animal By-products	10	C
Yorkshire Water	Brewing & Malting	11	C
Yorkshire Water	Building Supplies		C
Yorkshire Water	Chemical Distribution/Bat	46	G
Yorkshire Water	Chemical Manufacture	20	C
Yorkshire Water	Concrete Batching	23	C
Yorkshire Water	Cosmetics/Toiletries	20	C
Yorkshire Water	Cooling Water		
Yorkshire Water	Dairies & Creameries	1	A
Yorkshire Water	Soft Drinks Manufacturers	11	C
Yorkshire Water	Drum Washing	81	N
Yorkshire Water	Dyeing	13	C
Yorkshire Water	Electric Generation	35	D
Yorkshire Water	Engineering	71	M
Yorkshire Water	Farms & Auctions	01	A
Yorkshire Water	Finishing		C
Yorkshire Water	Other Food Industries	10	C
Yorkshire Water	Furniture	31	C
Yorkshire Water	Glass Industries	23	C
Yorkshire Water	Hospitals & Nursing Homes	86 & 87	Q
Yorkshire Water	Iron & Steel Manufacture	24	C
Yorkshire Water	Laithe Coolants		C
Yorkshire Water	Laundries & Launderettes	96	S
Yorkshire Water	Metal Platers	25	C
Yorkshire Water	Metal Processing	25	C
Yorkshire Water	Miscellaneous Manufacture	32	C

Sewerage undertaker	Category as defined by sewerage undertaker	SIC division	SIC section
Yorkshire Water	Mixed Dyeing/Scour Finish		C
Yorkshire Water	Others		
Yorkshire Water	Paint Manufacture	20	C
Yorkshire Water	Paper Manufacturing & Proc	17	C
Yorkshire Water	Pharmaceutical	21	C
Yorkshire Water	Photographic	74	M
Yorkshire Water	Printing	18	C
Yorkshire Water	Soap Manufacturing	20	C
Yorkshire Water	Sweets & Confectionery	10	C
Yorkshire Water	Swimming Pools	93	R
Yorkshire Water	Tanker Washing	81	N
Yorkshire Water	Tanners	15	C
Yorkshire Water	Textile Printing	13	C
Yorkshire Water	Utility Services		
Yorkshire Water	Vegetable Processing	10	C
Yorkshire Water	Vehicle Wash	45	G
Yorkshire Water	Waste Recycling (Oil) etc	19	C
Yorkshire Water	Waste Disposal Sites	38	E
Yorkshire Water	Raw Wool Scouring	13	C
Yorkshire Water	Water Treatment Plants	36	E
Yorkshire Water	Yarn Scouring	13	C
Southern Water	Chemical Formulation	20	C
Southern Water	Contact Lens Manufacture	32	C
Southern Water	Cosmetics & Toiletries	20	C
Southern Water	Essential Oils	06	C
Southern Water	Medical Equipment	32	C
Southern Water	Pharmaceuticals	21	C
Southern Water	Commercial Laundry	96	S
Southern Water	Dry Cleaning	96	S
Southern Water	Chemical Cleaning	81	N
Southern Water	Component Cleaning	81	N
Southern Water	Container Washing	81	N
Southern Water	Degreasing	81	N
Southern Water	Equipment Cleaning	81	N
Southern Water	Milk Processing	10	C
Southern Water	Brewery	11	C
Southern Water	Soft Drinks	11	C
Southern Water	Wine/Cider	11	C
Southern Water	Abattoir	10	C
Southern Water	Agricultural	01	A
Southern Water	Market washdown	46	G
Southern Water	Yard washdown	81	N
Southern Water	Bakery/Confectionery	10	C
Southern Water	Dairy Products	10	C
Southern Water	Fish Processing	10	C
Southern Water	Fruit Processing	10	C
Southern Water	Ice Cream Production	10	C
Southern Water	Meat Processing	10	C
Southern Water	Prepared Meals	10	C
Southern Water	Salad Preparation	10	C
Southern Water	Sweet Manufacturing	10	C
Southern Water	Vegetable Processing	10	C
Southern Water	Vegetable washing	10	C
Southern Water	Laboratories	71	M
Southern Water	Launderettes	96	S
Southern Water	Anodising	25	C

Sewerage undertaker	Category as defined by sewerage undertaker	SIC division	SIC section
Southern Water	Casting	24	C
Southern Water	Electroplating	25	C
Southern Water	Electropolishing	25	C
Southern Water	Metal Treatments	25	C
Southern Water	PCB Plating	25	C
Southern Water	Phosphating	25	C
Southern Water	Animal Breeding	01	A
Southern Water	Car Headliner Manufacture		C
Southern Water	Ceramics	23	C
Southern Water	Concrete Production	23	C
Southern Water	Contaminated Groundwater		E
Southern Water	Glass Optical	26 & 32	C
Southern Water	Lens Washing		C
Southern Water	Road Stone Production	23	C
Southern Water	Oil Recovery	06	B
Southern Water	Shellfish Processing	10	C
Southern Water	Textile Printing	13	C
Southern Water	Tray/bin washing	81	N
Southern Water	Treated Effluent		
Southern Water	Waste Nutritional Products		E
Southern Water	Waste Processing	38	E
Southern Water	Paint Production	20	C
Southern Water	Paper Production	17	C
Southern Water	Boiler Blowdown		
Southern Water	Coolant		
Southern Water	Filter Backwash Water		R
Southern Water	Hydraulic Testing		M
Southern Water	Process Water Treatment		
Southern Water	Surface Water		
Southern Water	Water Softener Regeneration		E
Southern Water	Photographic	74	M
Southern Water	Printing	18	C
Southern Water	Surface Water		
Southern Water	Commercial Swimming Pools	93	R
Southern Water	Filter Backwash Water	93	R
Southern Water	Recycling Centres	38	E
Southern Water	Tip Leachate	38	E
Southern Water	Waste Transfer Stations	38	E
Southern Water	Automatic Vehicle Washing	45	G
Southern Water	Boat Wash	33	C
Southern Water	General Wash	81	N
Southern Water	Jet Wash	81	N
Southern Water	Train washdown Facilities	81	N

Appendix C SIC2007 structure

Table C.1 SIC2007 structure: section codes and description

SIC2007 (Section)	Description
A	Agriculture, Forestry and Fishing
B	Mining and Quarrying
C	Manufacturing
D	Electricity, Gas, Steam and Air Conditioning Supply
E	Water Supply; Sewerage, Waste Management and Remediation Activities
F	Construction
G	Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles
H	Transportation and Storage
I	Accommodation and Food Service Activities
J	Information and Communication
K	Financial and Insurance Activities
L	Real Estate Activities
M	Professional, Scientific and Technical Activities
N	Administrative and Support Service Activities
O	Public Administration and Defence; Compulsory Social Security
P	Education
Q	Human Health and Social Work Activities
R	Arts, Entertainment and Recreation
S	Other Service Activities
T	Activities of Households as Employers; Undifferentiated Goods-and Services-Producing Activities of Households for Own Use
U	Activities of Extraterritorial Organisations and Bodies

Table C.2 SIC2007 structure: division codes and description

SIC2007 (Section)	SIC2007 (Division)	Description
A	01	Crop and animal production, hunting and related service activities
A	02	Forestry and logging
A	03	Fishing and aquaculture
B	05	Mining of coal and lignite
B	06	Extraction of crude petroleum and natural gas
B	07	Mining of metal ores
B	08	Other mining and quarrying
B	09	Mining support service activities
C	10	Manufacture of food products
C	11	Manufacture of beverages
C	12	Manufacture of tobacco products
C	13	Manufacture of textiles
C	14	Manufacture of wearing apparel
C	15	Manufacture of leather and related products
C	16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
C	17	Manufacture of paper and paper products
C	18	Printing and reproduction of recorded media
C	19	Manufacture of coke and refined petroleum products
C	20	Manufacture of chemicals and chemical products
C	21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
C	22	Manufacture of rubber and plastic products

SIC2007 (Section)	SIC2007 (Division)	Description
C	23	Manufacture of other non-metallic mineral products
C	24	Manufacture of basic metals
C	25	Manufacture of fabricated metal products, except machinery and equipment
C	26	Manufacture of computer, electronic and optical products
C	27	Manufacture of electrical equipment
C	28	Manufacture of machinery and equipment n.e.c.
C	29	Manufacture of motor vehicles, trailers and semi-trailers
C	30	Manufacture of other transport equipment
C	31	Manufacture of furniture
C	32	Other manufacturing
C	33	Repair and installation of machinery and equipment
D	35	Electricity, gas, steam and air conditioning supply
E	36	Water collection, treatment and supply
E	37	Sewerage
E	38	Waste collection, treatment and disposal activities; materials recovery
E	39	Remediation activities and other waste management services
F	41	Construction of buildings
F	42	Civil engineering
F	43	Specialised construction activities
G	45	Wholesale and retail trade and repair of motor vehicles and motorcycles
G	46	Wholesale trade, except of motor vehicles and motorcycles
G	47	Retail trade, except of motor vehicles and motorcycles
H	49	Land transport and transport via pipelines
H	50	Water transport
H	51	Air transport
H	52	Warehousing and support activities for transportation
H	53	Postal and courier activities
I	55	Accommodation
I	56	Food and beverage service activities
J	58	Publishing activities
J	59	Motion picture, video and television programme production, sound recording and music publishing activities
J	60	Programming and broadcasting activities
J	61	Telecommunications
J	62	Computer programming, consultancy and related activities
J	63	Information service activities
K	64	Financial service activities, except insurance and pension funding
K	65	Insurance, reinsurance and pension funding, except compulsory social security
K	66	Activities auxiliary to financial services and insurance activities
L	68	Real estate activities
M	69	Legal and accounting activities
M	70	Activities of head offices; management consultancy activities
M	71	Architectural and engineering activities; technical testing and analysis
M	72	Scientific research and development
M	73	Advertising and market research
M	74	Other professional, scientific and technical activities
M	75	Veterinary activities
N	77	Rental and leasing activities

SIC2007 (Section)	SIC2007 (Division)	Description
N	78	Employment activities
N	79	Travel agency, tour operator and other reservation service and related activities
N	80	Security and investigation activities
N	81	Services to buildings and landscape activities
N	82	Office administrative, office support and other business support activities
O	84	Public administration and defence; compulsory social security
P	85	Education
Q	86	Human health activities
Q	87	Residential care activities
Q	88	Social work activities without accommodation
R	90	Creative, arts and entertainment activities
R	91	Libraries, archives, museums and other cultural activities
R	92	Gambling and betting activities
R	93	Sports activities and amusement and recreation activities
S	94	Activities of membership organisations
S	95	Repair of computers and personal and household goods
S	96	Other personal service activities
T	97	Activities of households as employers of domestic personnel
T	98	Undifferentiated goods- and services-producing activities of private households for own use
U	99	Activities of extraterritorial organisations and bodies

Appendix D Final NALD alignment with SIC2007

SIC2007 (Section)	NALD Secondary Description	No. of Records	SIC2007 (Section)	NALD Secondary Description	No. of Records
Unclassified	Mineral Products	17	H	Other Industrial/Commercial/Public Services	8
Unclassified	Industrial/Commercial/Energy/Public Services	82	H	Transport	20
Unclassified	Other Industrial/Commercial/Public Services	90	H	Business Parks	4
A	Industrial/Commercial/Energy/Public Services	20	I	Hotels, Public Houses And Conference Centres	53
A	Orchards	4	I	Holiday Sites, Camp Sites & Tourist Attractions	151
A	Aquaculture Fish	590	I	Industrial/Commercial/Energy/Public Services	3
A	Other Industrial/Commercial/Public Services	57	I	Other Industrial/Commercial/Public Services	1
A	Private Non-Industrial	1	J	Other Industrial/Commercial/Public Services	20
A	Business Parks	2	J	Industrial/Commercial/Energy/Public Services	1
A	Golf Courses	8	K	Business Parks	1
A	Food & Drink	9	K	Other Industrial/Commercial/Public Services	20
A	Horticulture And Nurseries	579	K	Industrial/Commercial/Energy/Public Services	3
A	Aquaculture Plant	90	L	General Agriculture	8
A	Schools And Colleges	8	L	Holiday Sites, Camp Sites & Tourist Attractions	1
A	Forestry	3	L	Hotels, Public Houses And Conference Centres	11
A	General Agriculture	18,844	L	Business Parks	26
A	Mineral Products	1	L	Construction	1
B	Construction	26	L	Industrial/Commercial/Energy/Public Services	7
B	General Agriculture	13	L	Other Industrial/Commercial/Public Services	85
B	Other Industrial/Commercial/Public Services	92	M	Research Non- University/College	45
B	Business Parks	1	M	Private Non-Industrial	4
B	Golf Courses	3	M	Business Parks	17
B	Extractive	615	M	Other Industrial/Commercial/Public Services	10
B	Aquaculture Fish	8	M	Industrial/Commercial/Energy/Public Services	1
B	Mineral Products	535	M	Mineral Products	1
C	Construction	43	N	Other Industrial/Commercial/Public Services	3
C	Machinery And Electronics	81	O	Golf Courses	3
C	Other Industrial/Commercial/Public Services	751	O	Hotels, Public Houses And Conference Centres	3
C	Extractive	26	O	Holiday Sites, Camp Sites & Tourist Attractions	17
C	Metal	230	O	Municipal Grounds	12
C	Mineral Products	130	O	Other Industrial/Commercial/Public Services	37
C	General Agriculture	26	O	Industrial/Commercial/Energy/Public Services	35
C	Food & Drink	737	O	Public Administration	9
C	Petrochemicals	68	P	Mineral Products	2
C	Breweries/Wine	382	P	Hotels, Public Houses And Conference Centres	1
C	Rubber	22	P	General Agriculture	2
C	Aquaculture Fish	1	P	Schools And Colleges	136
C	Slaughtering	23	P	Industrial/Commercial/Energy/Public Services	3
C	Sports Grounds/Facilities	6	Q	Hospitals	55
C	Paper And Printing	155	Q	Other Industrial/Commercial/Public Services	9
C	Textiles & Leather	177	R	Chemicals	8
C	Chemicals	268	R	Municipal Grounds	43
C	Dairies	96	R	Navigation	4
C	Industrial/Commercial/Energy/Public Services	10	R	Other Industrial/Commercial/Public Services	99
C	Golf Courses	2	R	Business Parks	1
D	Other Industrial/Commercial/Public Services	59	R	Petrochemicals	4
D	Electricity	282	R	Racecourses	72
D	Industrial/Commercial/Energy/Public Services	1	R	Research Non- University/College	3
D	Mechanical Non Electrical	75	R	Rubber	4
E	Construction	1	R	Sports Grounds/Facilities	159
E	Mineral Products	16	R	Private Non-Industrial	2
E	Private Water Undertaking	1	R	Golf Courses	1,309
E	General Agriculture	2	R	Electricity	4
E	Private Non-Industrial	2	R	Metal	4
E	Other Industrial/Commercial/Public Services	53	R	Mechanical Non Electrical	2
E	Industrial/Commercial/Energy/Public Services	5	R	Extractive	1
E	Refuse And Recycling	49	R	Machinery And Electronics	1
F	Industrial/Commercial/Energy/Public Services	4	R	Holiday Sites, Camp Sites & Tourist Attractions	79
F	General Agriculture	34	R	Mineral Products	2
F	Construction	13	R	Construction	4
F	Other Industrial/Commercial/Public Services	71	R	Industrial/Commercial/Energy/Public Services	59
F	Mineral Products	5	R	Zoos/Kennels/Stables	17
G	Industrial/Commercial/Energy/Public Services	6	R	Hotels, Public Houses And Conference Centres	8
G	Mineral Products	11	R	General Agriculture	33
G	Holiday Sites, Camp Sites & Tourist Attractions	3	S	Laundry	55
G	Horticulture And Nurseries	2	S	Holiday Sites, Camp Sites & Tourist Attractions	1
G	Other Industrial/Commercial/Public Services	73	S	Industrial/Commercial/Energy/Public Services	20
G	General Agriculture	4	S	Other Industrial/Commercial/Public Services	50
G	Retail	14	S	Private Non-Industrial	356
H	Navigation	7			

Appendix E Direct abstraction from non-tidal sources and mains water use, by sector

							Volume directly abstracted							
		Mains water use (Ml, 2006/07)					Consumptive use (upper bound estimate) (Ml, 2006)		Consumptive use (lower bound estimate) (Ml, 2006)		Non-consumptive use (upper bound estimate) (Ml, 2006)		Non-consumptive use (lower bound estimate) (Ml, 2006)	
SIC2007 Section	Description	England	Wales	Scotland	NI	Total UK	England	Wales	England	Wales	England	Wales	England	Wales
A	Agriculture, Forestry and Fishing	133,789	9,735	0	22,013	165,537	94,250	1,689	94,094	1,620	1,017,062	29,642	1,017,218	29,711
B	Mining and Quarrying	17,071	1,678	605		19,354	69,488	598	66,928	486	848	276	3,408	388
C	Manufacturing	302,163	21,978	74,985	15,612	414,739	382,829	168,218	309,113	33,383	36,813	2,927	110,529	137,762
DE	Electricity, Gas, Waste; Water; Sewerage	27,159	2,051	17,334	2,032	48,576	210,333	1,792	172,289	1,792	1,761,657	2,638,036	1,799,701	2,638,036
F	Construction	11,842	705	866		13,412	1,470	5,496	1,470	5,496	766	0	766	0
G	Wholesale and Retail	67,899	4,811	7,016	3,502	83,227	709	6	709	6	86	0	86	0
H	Transportation and Storage	44,647	1,571	1,749		47,968	952	2	952	2	89	0	89	0
I	Accommodation and Food Services	105,618	12,158	12,446	4,762	134,984	7,959	300	7,959	300	118	0	118	0
J	Information and Communication	13,824	527	586		14,937	104		104		4	0	4	0
K	Financial and Insurance	30,381	1,164	1,156		32,701	386		386		128	0	128	0
L	Real Estate	14,821	565	0		15,385	3,818		3,818		20	0	20	0
MN	Professional, Scientific and Technical; Administrative and Support Services	115,861	7,022	2,433		125,316	1,231	0	1,231	0	248	0	248	0
O	Public Administration and Defence; Compulsory Social Security	46,418	2,314	16,688	3,069	68,490	6,489	814	6,489	7	634	0	634	807
P	Education	61,064	4,778	4,236	4,971	75,048	2,407		2,407		35	0	35	0
Q	Human Health and Social Work	83,450	3,997	7,553	6,922	101,922	2,140	10	2,140	10	2	0	2	0
RSTU	Arts, Entertainment and Recreation; Other Goods and Services	45,988	1,546	6,950	701	55,185	41,233	2,616	40,752	2,616	23,463	224	23,944	224
Unclassified	Unallocated or unclassified	84,081	1,475	29,455	4,010	119,020	2,438	0	2,438	0	386	0	386	0
	Total	**1,206,076**	**78,074**	**184,058**	**67,594**	**1,535,802**	**828,236**	**181,541**	**713,279**	**45,718**	**2,842,359**	**2,671,105**	**2,957,316**	**2,806,928**

Appendix F Sectoral and regional direct abstraction (Non-tidal surface water only and groundwater only)

F.1 Assessment of direct abstraction from non-tidal surface water sources excluding major non-consumptive use

Table F.1 Estimated volume directly abstracted from non-tidal surface water sources in England and Wales, excluding major non-consumptive uses (upper bound estimate) and excluding that abstracted for public water supply, by sector and EA region (Ml, 2006)

SIC2007 Section	Description	Anglian	Yorkshire and NE	North West	South West	Southern	Midlands	Thames	Wales	England Total	Wales Total	Grand Total	*Rank*
A	Agriculture, Forestry and Fishing	31,623	4,015	542	1,322	3,957	11,158	1,316	1,231	53,933	1,231	**55,164**	*3*
B	Mining and Quarrying	72	1,139	6,786	4,272	13	2,610	30	236	14,923	236	**15,159**	*5*
C	Manufacturing	3,022	19,303	162,605	9,700	2,290	66,735	0	166,029	263,655	166,029	**429,684**	*1*
DE	Electricity, Gas, Waste; Water; Sewerage	4,814	72,103	9,563	3	1	73,634	39,542	1,009	199,660	1,009	**200,669**	*2*
F	Construction	2		0	0		0		5,496	2	5,496	**5,498**	*7*
G	Wholesale and Retail			31	7		0	144		182		**182**	*14*
H	Transportation and Storage		152		0		4	456	1	613	1	**613**	*12*
I	Accommodation and Food Services	0	2	6,824	8			189	10	7,023	10	**7,033**	*6*
J	Information and Communication											**0**	*16*
K	Financial and Insurance	0		0	229			32		261		**261**	*13*
L	Real Estate	98	228	2,547			7	459		3,339		**3,339**	*8*
MN	Professional, Scientific and Technical; Administrative and Support Services	0	0	0	0	0	0	0	0	0	0	**0**	*16*
O	Public Administration and Defence; Compulsory Social Security	2		976	1	5	8	178	814	1,170	814	**1,984**	*11*
P	Education	0	16	1,020	971		11	10		2,027		**2,027**	*10*
Q	Human Health and Social Work					9			10	9	10	**19**	*15*
RSTU	Arts, Entertainment and Recreation; Other Goods and Services	4,996	1,716	2,559	5,225	590	7,987	3,878	2,408	26,950	2,408	**29,358**	*4*
Unclassified	Unallocated or unclassified	5	202	797	1,036	2	52	0	0	2,093	0	**2,093**	*9*
	Total	**44,635**	**98,876**	**194,249**	**22,773**	**6,867**	**162,205**	**46,232**	**177,244**	**575,839**	**177,244**	**753,082**	
	Rank	*6*	*4*	*1*	*7*	*8*	*3*	*5*	*2*				

Table F.2 Estimated volume directly abstracted from non-tidal surface water sources in England and Wales, excluding major non-consumptive uses (lower bound estimate) and excluding that abstracted for public water supply, by sector and EA region (Ml, 2006)

SIC2007 Section	Description	Anglian	Yorkshire and NE	North West	South West	Southern	Midlands	Thames	Wales	England Total	Wales Total	Grand Total	*Rank*
A	Agriculture, Forestry and Fishing	31,584	4,015	531	1,322	3,957	11,128	1,316	1,169	53,853	1,169	**55,021**	*3*
B	Mining and Quarrying	72	1,139	6,786	4,272	13	2,610	30	124	14,923	124	**15,046**	*5*
C	Manufacturing	3,022	19,303	162,596	8,231	2,290	4,337	0	31,560	199,779	31,560	**231,340**	*1*
DE	Electricity, Gas, Waste; Water; Sewerage	4,814	72,103	7,908	3	1	40,580	39,542	1,009	164,951	1,009	**165,960**	*2*
F	Construction	2		0	0				5,496	2	5,496	**5,498**	*7*
G	Wholesale and Retail			31	7		0	144		182		**182**	*14*
H	Transportation and Storage		152		0		4	456	1	613	1	**613**	*12*
I	Accommodation and Food Services	0	2	6,824	8			189	10	7,023	10	**7,033**	*6*
J	Information and Communication											**0**	*16*
K	Financial and Insurance	0		0	229			32		261		**261**	*13*
L	Real Estate	98	228	2,547			7	459		3,339		**3,339**	*8*
MN	Professional, Scientific and Technical; Administrative and Support Services	0	0	0	0	0	0	0	0	0	0	**0**	*16*
O	Public Administration and Defence; Compulsory Social Security	2		976	1	5	8	178	7	1,170	7	**1,177**	*11*
P	Education	0	16	1,020	971		11	10		2,027		**2,027**	*10*
Q	Human Health and Social Work					9			10	9	10	**19**	*15*
RSTU	Arts, Entertainment and Recreation; Other Goods and Services	4,968	1,716	2,559	5,043	590	7,716	3,878	2,408	26,468	2,408	**28,876**	*4*
Unclassified	Unallocated or unclassified	5	202	797	1,036	2	52	0	0	2,093	0	**2,093**	*9*
	Total	**44,567**	**98,876**	**192,574**	**21,123**	**6,867**	**66,452**	**46,232**	**41,793**	**476,692**	**41,793**	**518,485**	
	Rank	*5*	*2*	*1*	*7*	*8*	*3*	*4*	*6*				

Figure F.1 Estimated volume directly abstracted from non-tidal surface water sources in England and Wales, excluding major non-consumptive uses (upper and lower bound estimates presented) and excluding that abstracted for public water supply, by sector and country (Ml, 2006)

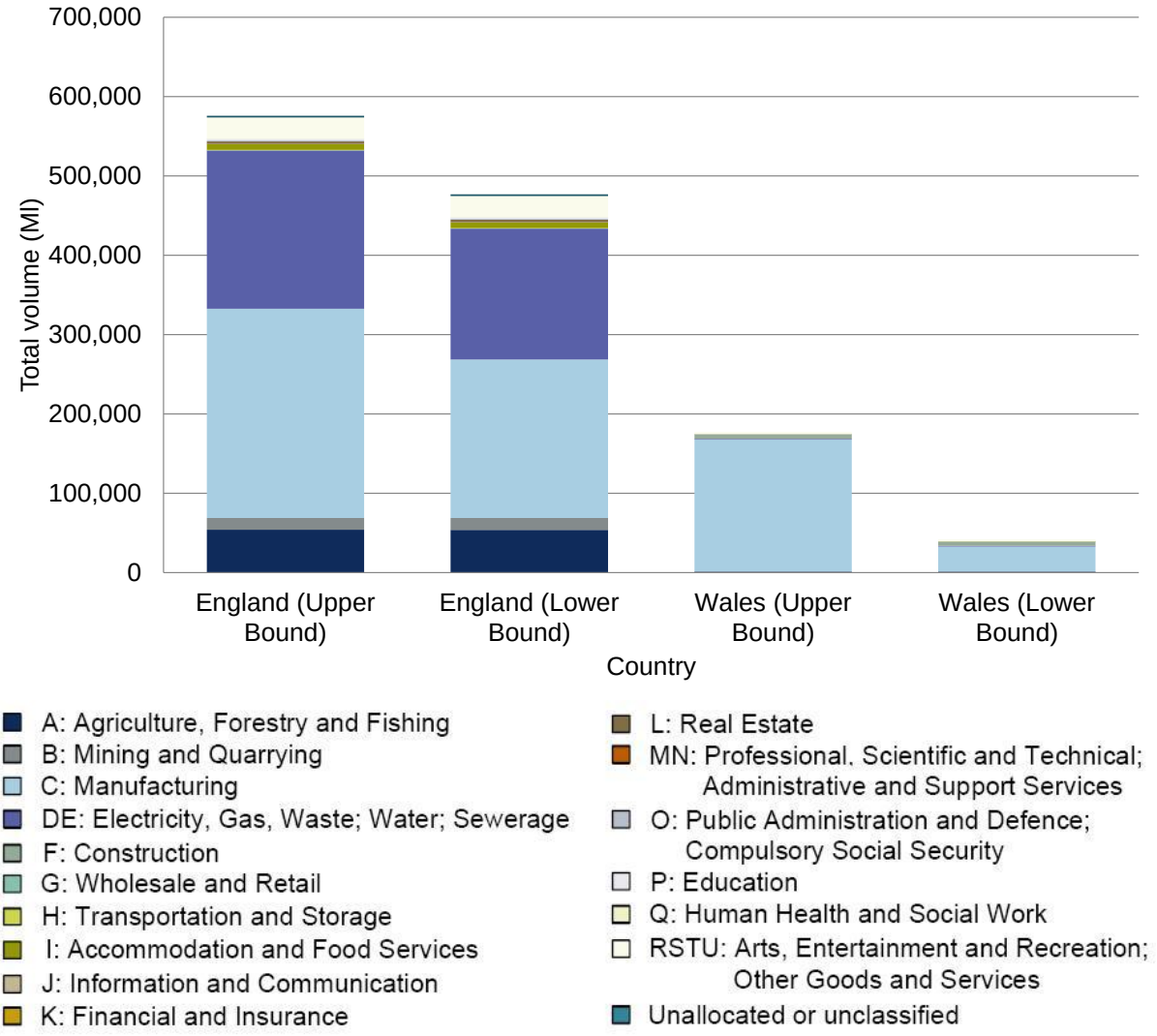
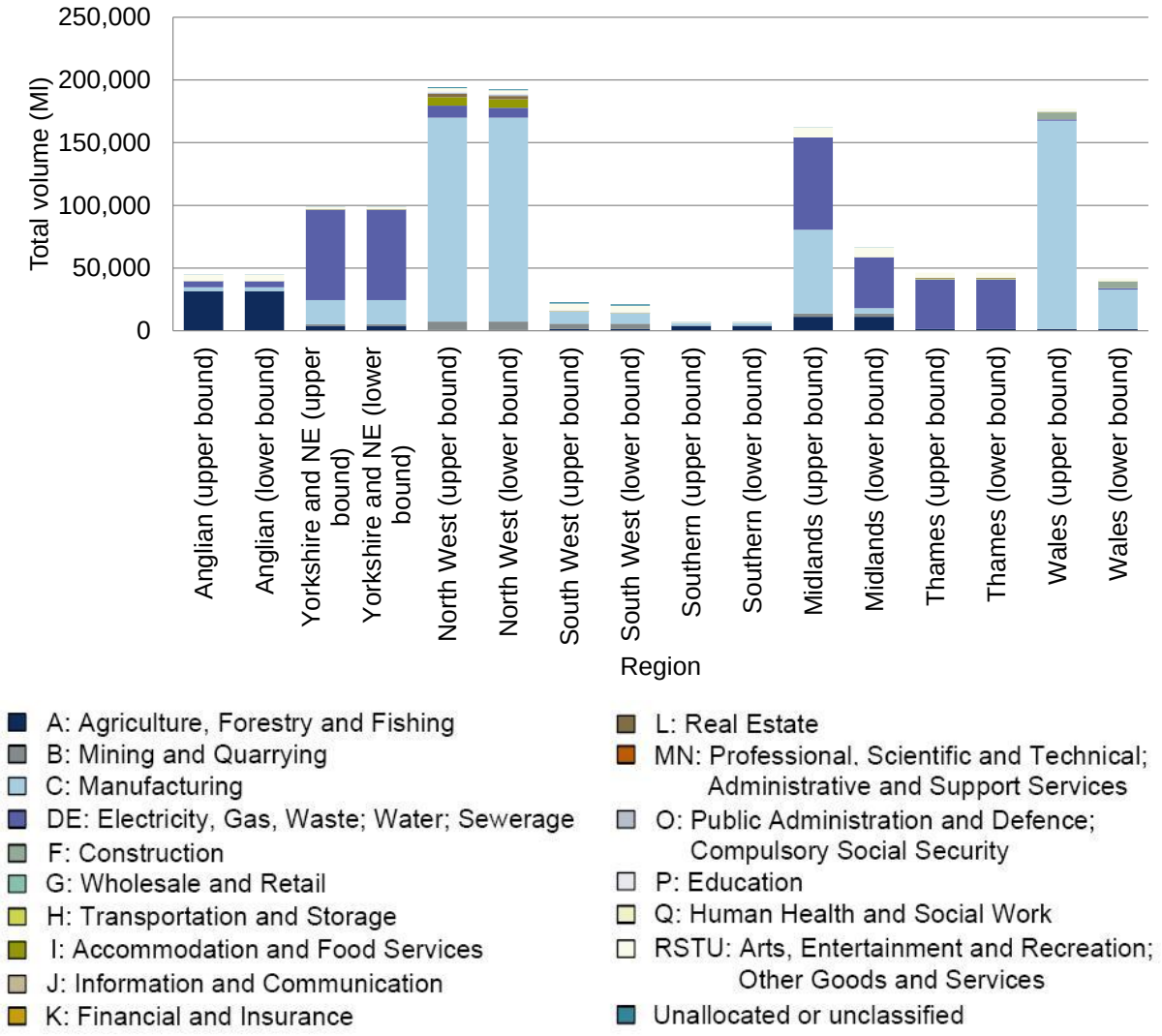


Figure F.2 Estimated volume directly abstracted from non-tidal surface water sources in England and Wales, excluding major non-consumptive uses (upper and lower bound estimates presented) and excluding that abstracted for public water supply, by sector and EA region (Ml, 2006)



F.2 Assessment of direct abstraction from groundwater sources excluding major non-consumptive uses

Table F.3 Estimated volume directly abstracted from groundwater sources in England and Wales, excluding major non-consumptive uses (upper bound estimate) and excluding that abstracted for public water supply, by sector and EA region (Ml, 2006)

SIC2007 Section	Description	Anglian	Yorkshire and NE	North West	South West	Southern	Midlands	Thames	Wales	England Total	Wales Total	Grand Total	*Rank*
A	Agriculture, Forestry and Fishing	17,269	5,375	1,024	4,721	2,882	7,439	1,601	457	40,310	457	**40,767**	*3*
B	Mining and Quarrying	7,919	6,571	7,612	3,068	2,116	16,651	10,628	362	54,565	362	**54,927**	*2*
C	Manufacturing	24,192	19,636	27,266	3,169	28,949	10,571	5,391	2,189	119,173	2,189	**121,362**	*1*
DE	Electricity, Gas, Waste; Water; Sewerage	3	4,227	4,250	18	62	682	881	784	10,123	784	**10,906**	*5*
F	Construction	285	124	40	1	920	29	70		1,469		**1,469**	*8*
G	Wholesale and Retail	101	39	91	8	0	21	267	6	527	6	**533**	*11*
H	Transportation and Storage		13	10	0	316		0	1	339	1	**340**	*15*
I	Accommodation and Food Services	124	87		536	1	15	172	290	936	290	**1,226**	*10*
J	Information and Communication		1			27		76		104		**104**	*17*
K	Financial and Insurance	70					37	18		125		**125**	*16*
L	Real Estate	4	32	0	27	62	25	329		479		**479**	*12*
MN	Professional, Scientific and Technical; Administrative and Support Services	375	72	53			45	686		1,231		**1,231**	*9*
O	Public Administration and Defence; Compulsory Social Security	42	2	53	5,148		15	59		5,319		**5,319**	*6*
P	Education	51	94		11	20	94	110		380		**380**	*13*
Q	Human Health and Social Work		85	289	128	102	577	949		2,131		**2,131**	*7*
RSTU	Arts, Entertainment and Recreation; Other Goods and Services	360	445	448	336	343	6,386	5,958	208	14,277	208	**14,485**	*4*
Unclassified	Unallocated or unclassified	57	10	84		0	174	20	0	345	0	**346**	*14*
	Total	**50,853**	**36,812**	**41,220**	**17,171**	**35,800**	**42,762**	**27,214**	**4,297**	**251,833**	**4,297**	**256,130**	
	Rank	*1*	*4*	*3*	*7*	*5*	*2*	*6*	*8*				

Table F.4 Estimated volume directly abstracted from groundwater sources in England and Wales, excluding major non-consumptive uses (lower bound estimate) and excluding that abstracted for public water supply, by sector and EA region (Ml, 2006)

SIC2007 Section	Description	Anglian	Yorkshire and NE	North West	South West	Southern	Midlands	Thames	Wales	England Total	Wales Total	Grand Total	*Rank*
A	Agriculture, Forestry and Fishing	17,194	5,375	1,024	4,721	2,881	7,439	1,601	452	40,234	452	**40,686**	*3*
B	Mining and Quarrying	7,919	6,571	6,141	3,068	2,032	15,647	10,628	362	52,006	362	**52,368**	*2*
C	Manufacturing	19,965	19,636	25,445	2,137	28,949	7,905	5,296	1,823	109,334	1,823	**111,156**	*1*
DE	Electricity, Gas, Waste; Water; Sewerage	3	4,227	915	18	62	682	881	784	6,788	784	**7,571**	*5*
F	Construction	285	124	40	1	920	29	70		1,469		**1,469**	*8*
G	Wholesale and Retail	101	39	91	8	0	21	267	6	527	6	**533**	*11*
H	Transportation and Storage		13	10	0	316		0	1	339	1	**340**	*15*
I	Accommodation and Food Services	124	87		536	1	15	172	290	936	290	**1,226**	*10*
J	Information and Communication		1			27		76		104		**104**	*17*
K	Financial and Insurance	70					37	18		125		**125**	*16*
L	Real Estate	4	32	0	27	62	25	329		479		**479**	*12*
MN	Professional, Scientific and Technical; Administrative and Support Services	375	72	53			45	686		1,231		**1,231**	*9*
O	Public Administration and Defence; Compulsory Social Security	42	2	53	5,148		15	59		5,319		**5,319**	*6*
P	Education	51	94		11	20	94	110		380		**380**	*13*
Q	Human Health and Social Work		85	289	128	102	577	949		2,131		**2,131**	*7*
RSTU	Arts, Entertainment and Recreation; Other Goods and Services	360	445	448	336	343	6,386	5,958	208	14,277	208	**14,485**	*4*
Unclassified	Unallocated or unclassified	57	10	84		0	174	20	0	345	0	**346**	*14*
	Total	**46,552**	**36,812**	**34,593**	**16,139**	**35,716**	**39,092**	**27,119**	**3,925**	**236,023**	**3,925**	**239,948**	
	Rank	*1*	*3*	*5*	*7*	*4*	*2*	*6*	*8*				

Figure F.3 Estimated volume directly abstracted from groundwater sources in England and Wales, excluding major non-consumptive uses (upper and lower bound estimates presented) and excluding that abstracted for public water supply, by sector and country (Ml, 2006)

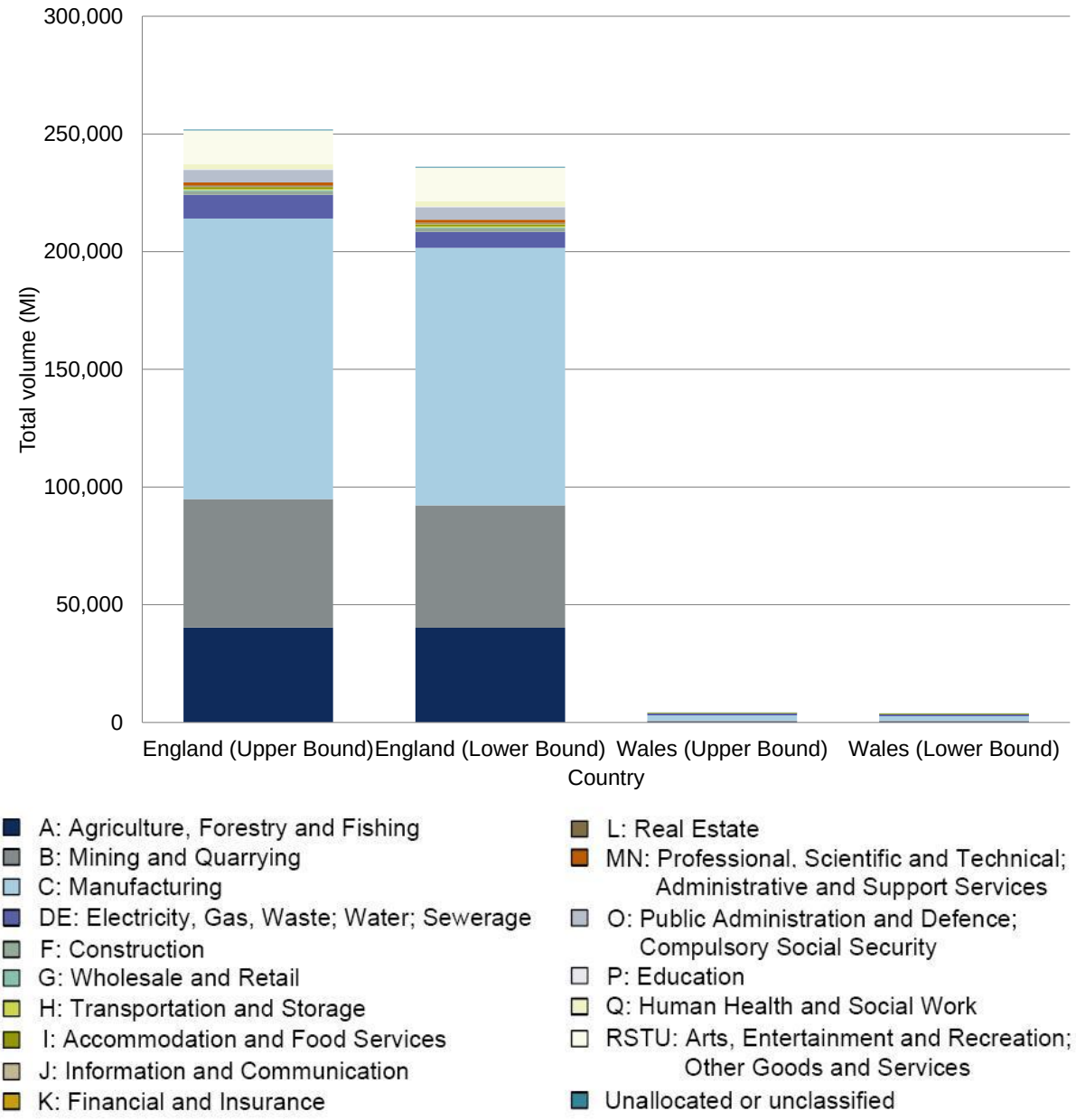
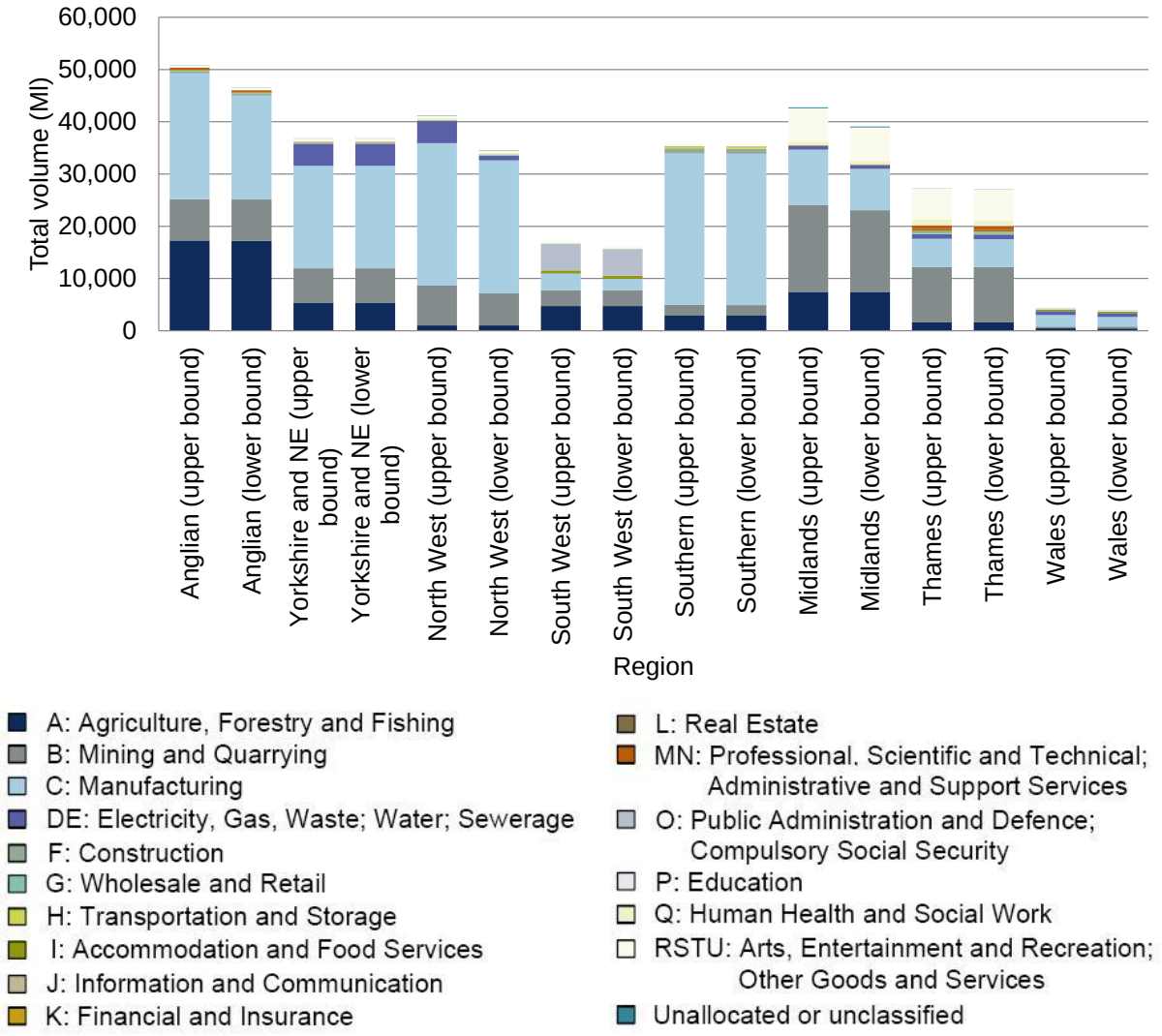


Figure F.4 Estimated volume directly abstracted from groundwater sources in England and Wales, excluding major non-consumptive uses (upper and lower bound estimates presented) and excluding that abstracted for public water supply, by sector and EA region (Ml, 2006)



Appendix G Direct abstraction from non-tidal sources including major non-consumptive uses

Table G.1 Estimated volume directly abstracted from all non-tidal sources in England and Wales, including major non-consumptive uses but excluding that abstracted for public water supply, by sector and EA region (Ml, 2006)

SIC2007 Section	Description	Anglian	Yorkshire and NE	North West	South West	Southern	Midlands	Thames	Wales	England Total	Wales Total	Grand Total	*Rank*
A	Agriculture, Forestry and Fishing	73,811	120,404	35,844	361,568	418,629	25,874	75,181	31,331	1,111,312	31,331	**1,142,643**	*2*
B	Mining and Quarrying	8,135	7,758	14,398	7,340	2,135	19,262	11,308	874	70,336	874	**71,210**	*4*
C	Manufacturing	35,341	48,952	191,929	13,921	36,784	85,107	7,607	171,145	419,642	171,145	**590,787**	*3*
DE	Electricity, Gas, Waste; Water; Sewerage	4,817	139,764	211,263	255,627	1,655	1,318,421	40,442	2,639,828	1,971,990	2,639,828	**4,611,818**	*1*
F	Construction	287	124	40	652	920	33	181	5,496	2,236	5,496	**7,732**	*8*
G	Wholesale and Retail	101	39	122	15	0	21	497	6	795	6	**801**	*15*
H	Transportation and Storage		164	10		316	4	546	2	1,041	2	**1,043**	*14*
I	Accommodation and Food Services	124	90	6,824	544	1	84	410	300	8,077	300	**8,377**	*6*
J	Information and Communication		1			27	0	80		108		**108**	*17*
K	Financial and Insurance	70		0	229		37	178		514		**514**	*16*
L	Real Estate	103	259	2,547	27	62	32	808		3,838		**3,838**	*9*
MN	Professional, Scientific and Technical; Administrative and Support Services	375	72	53			61	917	0	1,479	0	**1,479**	*13*
O	Public Administration and Defence; Compulsory Social Security	44	2	1,030	5,149	5	396	498	814	7,123	814	**7,937**	*7*
P	Education	51	110	1,020	982	20	139	120		2,442		**2,442**	*11*
Q	Human Health and Social Work		85	289	128	112	577	951	10	2,142	10	**2,152**	*12*
RSTU	Arts, Entertainment and Recreation; Other Goods and Services	5,387	2,217	7,055	5,629	933	30,854	12,622	2,840	64,696	2,840	**67,536**	*5*
Unclassified	Unallocated or unclassified	62	212	880	1,036	2	242	391	0	2,824	0	**2,825**	*10*
	Total	**128,709**	**320,253**	**473,304**	**652,847**	**461,601**	**1,481,145**	**152,736**	**2,852,645**	**3,670,595**	**2,852,645**	**6,523,240**	
	Rank	*8*	*6*	*4*	*3*	*5*	*2*	*7*	*1*				

Figure G.1 Estimated volume directly abstracted from all non-tidal sources in England and Wales, including major non-consumptive uses but excluding that abstracted for public water supply, by sector and country (Ml, 2006)

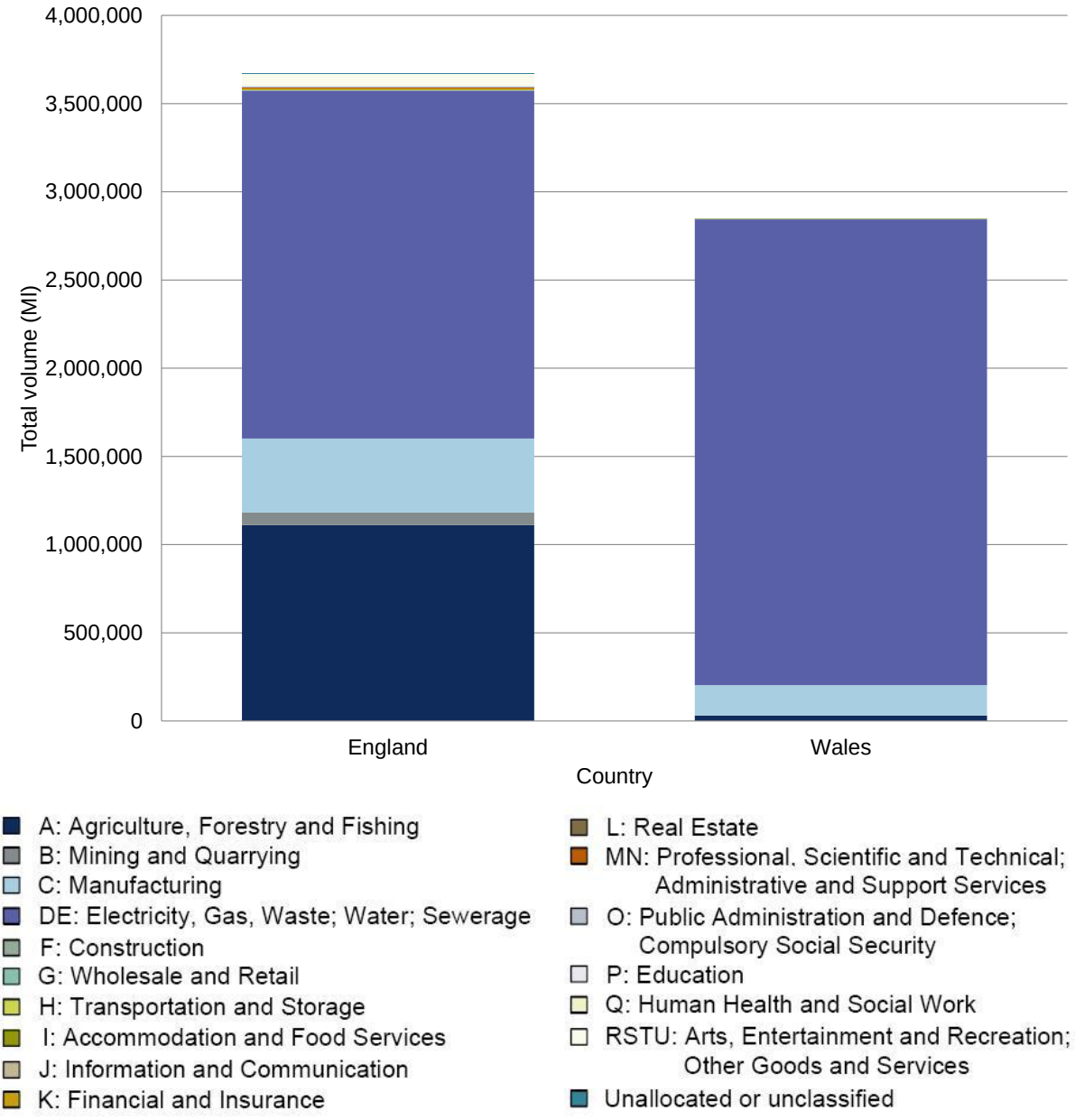
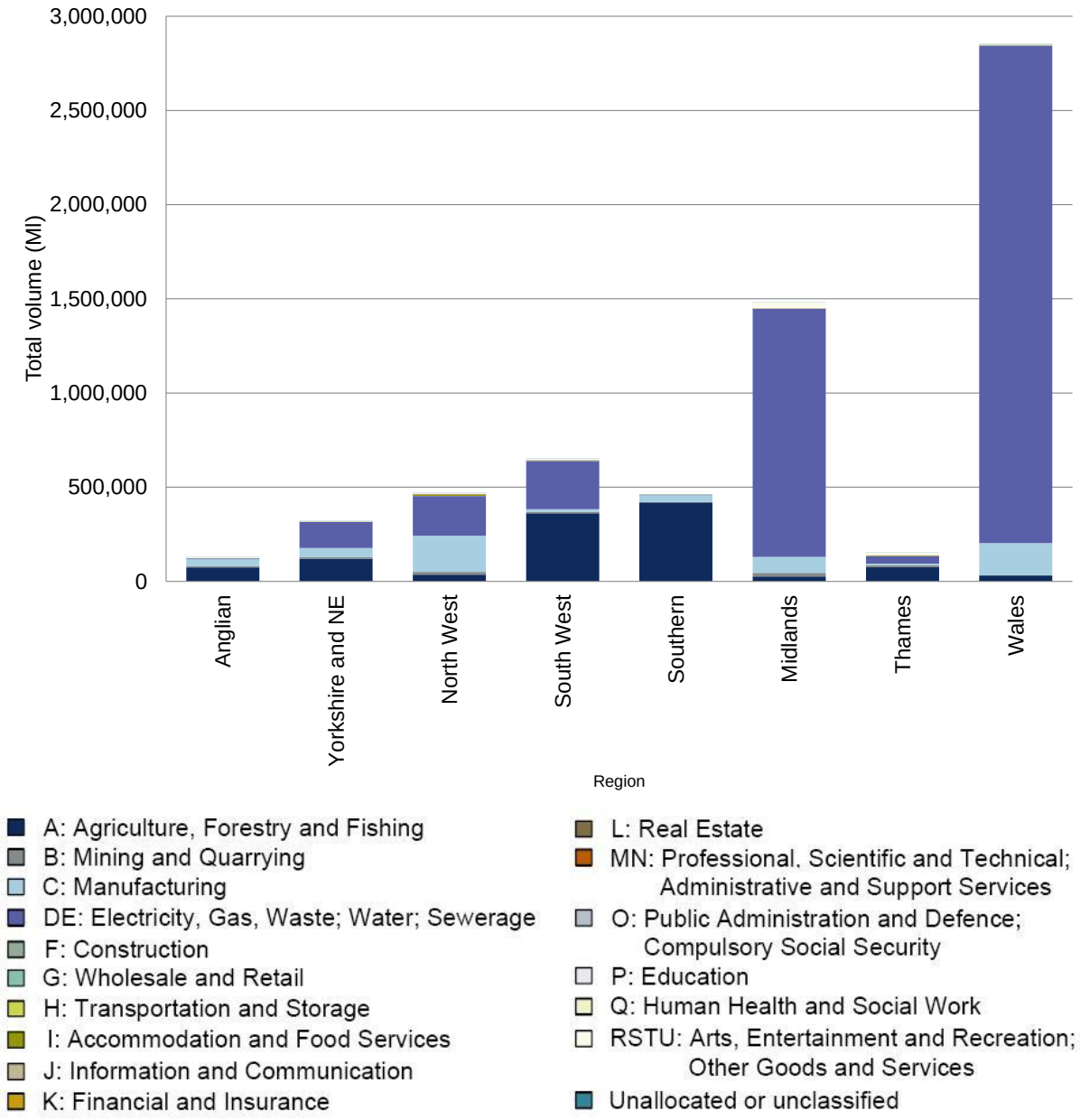


Figure G.2 Estimated volume directly abstracted from all non-tidal sources in England and Wales, including major non-consumptive uses but excluding that abstracted for public water supply, by sector and EA region (Ml, 2006)



Appendix H Previously published sectoral and regional direct abstraction data

H.1 Previously published data

Table H.1 Total direct abstraction in England and Wales by industrial sector (based on Table 1, ONS report[1])

Sector	Direct Abstraction 2006/07 (m^3)	SIC2007 (Section)
Agriculture (incl. spray irrigation)	102,000,000	A
Fish farming, etc	1,284,000,000	A
Mining, quarrying	88,000,000	B
Food, drink, tobacco	98,000,000	C
Textiles, leather	12,000,000	C
Paper, pulp	125,000,000	C
Publishing, printing	1,000,000	C
Fuel refining	162,000,000	C
Chemicals	241,000,000	C
Rubber, plastics	2,000,000	C
Other non-metal mineral products	17,000,000	C
Basic metals	262,000,000	C
Fabricated metals	0	C
Misc. machinery & equipment	24,000,000	C
Transport equipment	32,000,000	C
Other manufacturing	1,000,000	C
Energy	3,772,000,000	D
Construction	6,000,000	F
Wholesale, repairs	2,000,000	G
Retail	44,000,000	G
Hotels, restaurants	3,000,000	I
Commercial & public services	56,000,000	
Education, health	4,000,000	P & Q
Total	**6,337,000,000**	

Note 1. Based on data from Table 1 from ONS report, *Environmental Accounts 2010: February 2010 Update* (ONS, 2010a)

Table H.2 Water consumption totals for industrial activities (based on Table 1, Envirowise report[1])

Industrial Activity	Borehole Abstraction (m^3)	River Abstraction (m^3)	River & Borehole Abstraction (m^3)	SIC2007 (Section)
Electricity, Gas, Steam and Hot Water Supply	45,890,676	2,634,124,814	2,680,015,490	D
Agriculture, Hunting	308,167,659	206,164,185	514,331,844	A
Fishing, Fish Farming and related services	677,579,870	677,579,870	1,355,159,740	A
Manufacture of Basic Metals	218,473,716	218,473,716	436,947,432	C
Manufacture of Chemicals	201,293,685	201,293,685	402,587,370	C
Recreational, Cultural and Sporting	0	20,879,306	20,879,306	R
Manufacture of Coke, Refined Petroleum Products and Nuclear Fuel	138,229,934	133,226,045	271,455,979	C
Hotels and Restaurants	4,576,083	0	4,576,083	I
Retail Trade	43,655,717	29,205,677	72,861,394	G
Manufacture of Pulp and Paper	104,032,053	104,032,053	208,064,106	C
Mining and Quarrying	142,848,013	0	142,848,013	B
Health and Social Work	2,125,619	1,422,040	3,547,659	Q
Manufacture of Food, Beverages and Tobacco	70,984,881	70,984,881	141,969,762	C
Auxiliary Transport Activities	27,996,719	18,729,807	46,726,526	H
Other Service Activities	21,774,456	14,567,113	36,341,569	S
Public Administration and Defence	9,934,076	6,645,898	16,579,974	O
Construction	6,413,642	4,290,727	10,704,369	F
Manufacture of Fabricated Metal Products	199,023	187,793	386,816	C
Manufacture of Transport Equipment	5,300	4,209,914	4,215,214	C
Education	2,132,932	1,426,931	3,559,863	P
Manufacture of Machinery and Equipment	18,561,351	20,788,714	39,350,065	C
Manufacture of Mineral Products	27,876,998	0	27,876,998	C
Real Estate Activities	3,775,912	2,526,085	6,301,997	L
Manufacture of Textiles	10,073,354	10,073,354	20,146,708	C
Activities of Membership Organisations	6,288,035	4,206,696	10,494,731	S
Manufacture of Rubber and Plastic Products	0	3,974,110	3,974,110	C
Wholesale Trade and Commission Trade	1,885,120	1,261,146	3,146,266	G
Research and Development	1,298,891	868,959	2,167,850	M
Manufacture of Furniture	21,669	14,496	36,165	C
Manufacture of Wood Products	166,383	111,311	277,694	C
Publishing, Printing and Recorded Media	0	2,261,867	2,261,867	C

Industrial Activity	Borehole Abstraction (m^3)	River Abstraction (m^3)	River & Borehole Abstraction (m^3)	SIC2007 (Section)
Water Transport	998,211	667,803	1,666,014	H
Other Business Activities	15,089	10,095	25,184	N
Manufacture of Electrical Machinery and Apparatus	206,044	137,843	343,887	C
Sale, Maintenance and Repair of Motor Goods	442	295	737	G
Mining of Coal, Lignite and Peat	4,955,745	0	4,955,745	B
Land Transport, Transport via Pipelines	121,773	81,466	203,239	H
Manufacture of Other Transport Equipment	891,265	0	891,265	C
Tanning and Dressing of Leather	141,747	94,828	236,575	C
Manufacture of Radio, Television and Communication Equipment	675,895	0	675,895	C
Insurance and Pension Funding	71,049	47,532	118,581	K
Activities Auxiliary to Financial Intermediation	53,107	35,528	88,635	K
Air Transport	30,385	20,327	50,712	H
Financial Intermediation	0	0	0	K
Manufacture of Office Machinery and Computers	11,257	7,531	18,788	C
Forestry, Logging and Related Service Activities	10,080	6,744	16,824	A
Total	**2,104,443,855**	**4,394,641,183**	**6,499,085,038**	

Note 1. Based on data from Table 1 from Envirowise report (Enviros Consulting Ltd, 2008)

Table H.3 Abstracted & mains usage and mains-only usage in England and Wales (Table 3, Envirowise report[1])

Government Office Region	Businesses using abstracted and mains water	Businesses using mains only water
East Midlands	1,104,332,635	693,594,449
East of England	544,605,153	915,295,196
London	110,760,392	1,083,571,111
North East	2,262,117,370	257,770,575
North West	983,140,282	913,871,981
South East	1,401,759,255	1,221,012,736
South West	1,998,486,006	851,237,752
Wales	687,218,219	1,333,770,440
West Midlands	260,384,904	728,769,461
Yorkshire & The Humber	1,249,924,205	785,446,636
Total (cubic metres)	**10,602,728,423**	**8,784,340,337**

Note 1. Table 3 from Envirowise report (Enviros Consulting Ltd, 2008)

H.2 Review of published material

Other published material relating to non-household water use by sector is presented here. It is important to note that the data analysis presented within this report was completed for the specific purposes of WRAP, and it is not intended to replace or be compared directly to other published data sources. There may be differences due to different categorisation methods and assumptions made. The analysis of direct abstraction data deliberately excludes figures for direct abstraction for public water supply as information on the sectoral use of public water supply was sought from water utilities instead.

Alternative values, from published material with different purposes and with differing levels of detail in the underlying analysis, are summarised in Table H.4 and commentary is provided below.

It is evident from Table H.4 that the three estimates of sectoral use of non-tidal abstractions from the studies listed are in broad agreement for all major use categories: the four highest ranking sectors are ranked in the same order by all three studies and account for 96-98% of the total volume of water abstracted from non-tidal sources. Within this broad agreement, however, there is some disparity between electricity and gas (SIC section D, somewhat higher in this study) and the other major sectors of agriculture, forestry and fishing (SIC section A) and manufacturing (SIC section C) whose estimates are both somewhat lower in this study than estimated by earlier studies.

The remaining sectors account for about 3% of the total volume of water directly abstracted from non-tidal sources in England and Wales. Notable differences in the remaining categories are apparent for the accommodation sector (SIC section I) where the proportion found in this study was slightly larger, and the wholesale/retail and transportation/storage sectors (SIC G and H) where the proportions were smaller compared to earlier studies.

These differences in the proportion of the total volume of water directly abstracted, particularly for the electricity and gas, agriculture and manufacturing sectors may be due to one or more of the following reasons:

- the alignment of the previously published data with appropriate SIC2007 sections was undertaken based on expert judgement by the WRc project team. As such, the results are unlikely to be directly comparable given different assumptions made by the three study groups;
- the previously published data reported direct abstraction for the financial year 2006/07 and the calendar year 2007. Minor differences are therefore to be expected given the difference in periods of analysis; and
- the method used for gap-filling null returns in the NALD information (described in Appendix B) replicated as closely as possible the method by the EA and in the Envirowise study. However, some of the null returns could not be estimated using the methodology adopted for this project, thus this may have served to under-estimate the water abstracted for those sectors with a larger number of null returns remaining such as the agricultural and manufacturing sectors.

Table H.4 Comparison of estimated direct abstraction from non-tidal sources (including non-consumptive uses) in England and Wales with previously published data

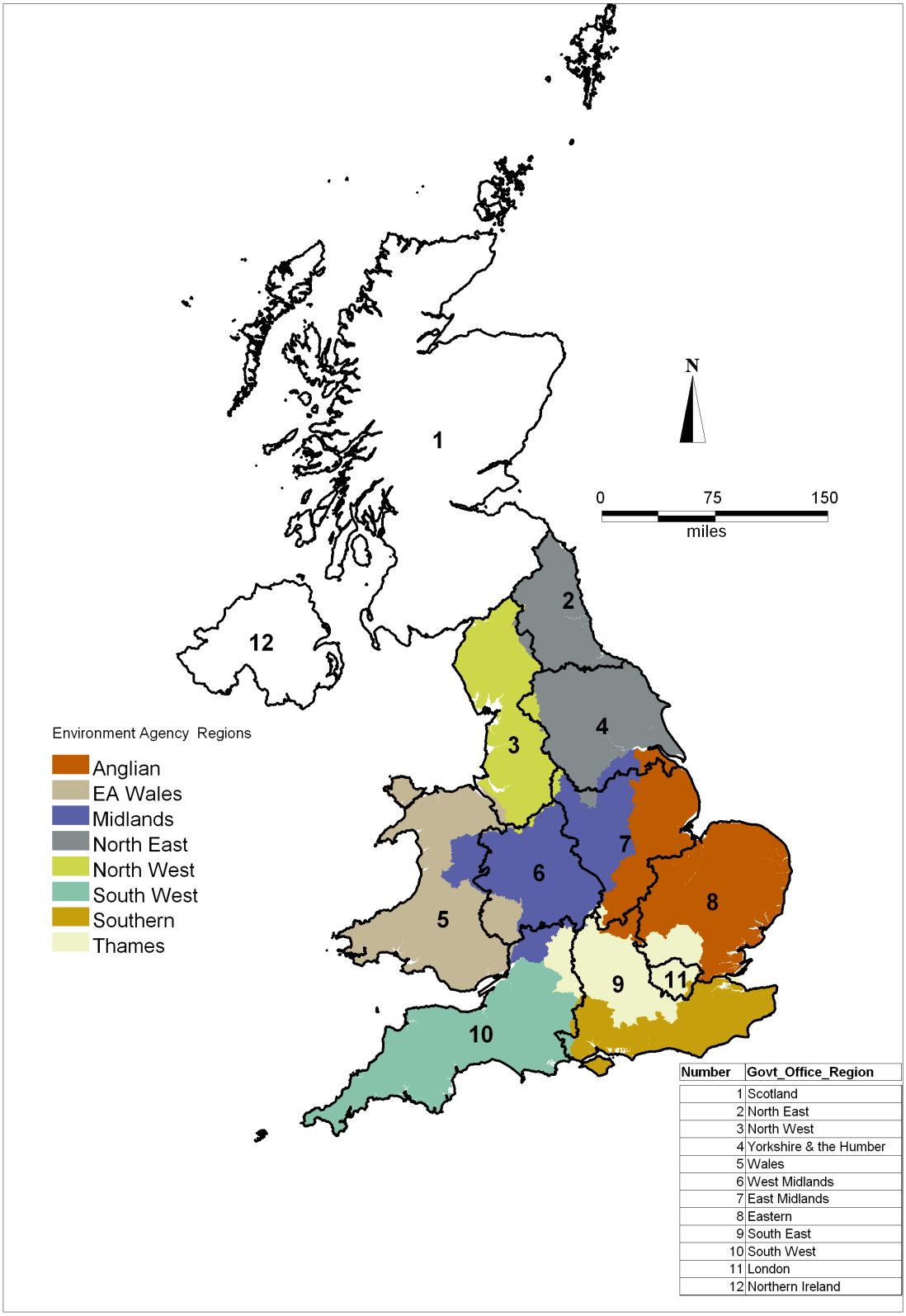
		This study (2006 data)		ONS Report[1] (2006/07 data)		Envirowise Report[2] (2007 data)	
SIC2007 (Section)	**Description**	**% of total**	***Rank***	**% of Total**	**Rank**	**% of total**	**Rank**
A	Agriculture, Forestry and Fishing	17.52%	***2***	21.87%	***2***	28.77%	***2***
B	Mining and Quarrying	1.09%	***4***	1.39%	***4***	2.27%	***4***
C	Manufacturing	9.06%	***3***	15.41%	***3***	24.03%	***3***
D	Electricity, Gas	70.64%	***1***	59.51%	***1***	41.24%	***1***
E	Waste; Water; Sewerage	0.06%	*11*	-	-	-	-
F	Construction	0.12%	*9*	0.09%	*6*	0.16%	*10*
G	Wholesale and Retail	0.01%	*17*	0.73%	*5*	1.17%	*5*
H	Transportation and Storage	0.02%	*16*	-	-	0.75%	*6*
I	Accommodation and Food Services	0.13%	*7*	0.05%	*7*	0.07%	*12*
J	Information and Communication	<0.01%	*19*	-	-	-	-
K	Financial and Insurance	0.01%	*18*	-	-	<0.01%	*16*
L	Real Estate	0.06%	*10*	-	-	0.10%	*11*
M	Professional, Scientific and Technical	0.02%	*15*	-	-	0.03%	*15*
N	Administrative and Support Services	<0.01%	*20*	-	--	<0.01%	*17*
O	Public Administration and Defence; Compulsory Social Security	0.12%	*8*	-	-	0.26%	*9*
P	Education	0.04%	*13*	-	-	0.05%	*13*
Q	Human Health and Social Work	0.03%	*14*	-	-	0.05%	*14*
R	Arts, Entertainment and Recreation	0.80%	*5*	-	-	0.32%	*8*
S	Other Goods and Services	0.24%	*6*	-	-	0.72%	*7*
T	Activities of Households as Employers	<0.01%	*21=*	-	-	-	-
U	Activities of Extraterritorial Organisations and Bodies	<0.01%	*21=*	-	-	-	-
Unclassified	Unallocated or unclassified	0.04%	*12*	-	-	-	-

Note 1. Based on data from Table 1 from ONS report, *Environmental Accounts 2010: February 2010 Update* (ONS, 2010a)

Note 2. Based on data from Table 1 from Envirowise report (Enviros Consulting Ltd, 2008)

Appendix J Alignment of EA regions with Government Office (Euro) regions

Figure J.1 Alignment of EA regions with Government Office (Euro) regions in the UK



Number	Govt_Office_Region
1	Scotland
2	North East
3	North West
4	Yorkshire & the Humber
5	Wales
6	West Midlands
7	East Midlands
8	Eastern
9	South East
10	South West
11	London
12	Northern Ireland

Waste & Resources Action Programme

The Old Academy
21 Horse Fair
Banbury, Oxon
OX16 0AH

Tel: 01295 819 900
Fax: 01295 819 911
E-mail: info@wrap.org.uk

Helpline freephone
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