



## DRIVER TECHNICAL REPORT

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# COMPILING DROUGHT IMPACT REPORTS FOR THE UK

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## INTRODUCTION

This document outlines the procedure used for identifying and entering drought impacts to the European Drought Impact report Inventory (EDII) for the UK in the DrIVER project. The EDII is a database of drought impacts for Europe (<http://www.geo.uio.no/edc/droughtdb/index.php>) and was developed as part of the EU project Drought R&SPI (Stahl et al. 2012). The aims of this project included to enhance understanding of the environmental and socio-economic impacts of drought and contribute towards improved drought management (Drought R&SPI, 2014). Drought impacts are rarely consistently recorded; exceptions include the US Drought Impact Reporter (<http://droughtreporter.unl.edu/>). The EDII provides a standard format for reported drought impacts to be recorded in Europe. The DrIVER project aims to explore the links between drought impacts and drought indicators to pave the way for enhanced monitoring and early warning systems in Europe, North America and Australia. The EDII therefore captures drought impacts from one of the partner continents.

The material in this document is a combination of information from Kohn et al. (2014) and experiences from collating drought impacts for the UK in the DrIVER project.

## WHAT IS AN IMPACT?

Drought has wide ranging impacts on the environment and society; impacts can be both positive and negative depending on the type, duration and severity of drought as well as the perspective of the person recording the impact (Lloyd-Hughes, 2013). A drought impact is described by the US-Drought Impact Reporter (National Drought Mitigation Centre, 2014) as, “*An observable loss or change that occurred at a specific place and time because of drought.*” and the EDII records only negative impacts on the environment, economy and society (Kohn et al. 2014).

The definition of an impact and the associated metadata can be subjective; this can make it hard for multiple users to enter consistent impact data. EDII entries are checked by database managers in Freiburg to ensure a degree of consistency amongst records. However, following the guidelines from Kohn et al. (2014) and the outcomes of collating UK impact data set out in this document will contribute to the consistency of future entries of impact reports for the UK. The section below gives some examples of ‘drought impacts’ which should not be added to the EDII.

## EXAMPLES

Below are some examples of source material which should not be entered to the EDII.

- *‘Dry weather has led to a 15% increase in winter oilseed rape yields.’* Although the dry weather in the drought event caused the oilseed rape yield to increase, because the increase would be a positive impact for producers, it cannot be entered to the EDII.
- *‘Low levels in several of South East’s reservoirs - including Ardingly. South East Water applied for a drought permit in November but it wasn’t needed due to rainfall.’* This impact should not be added to the EDII because the drought permit was not as rainfall increased reservoir levels. The reduction in reservoir levels by itself cannot be classed as an impact.
- *‘River levels drop to lower than normal for the time of year - especially SW England.’* or *‘Low levels in several of South East’s reservoirs - including Arlington.’* or *‘Low aquifer levels - Otter sandstone (Devon).’* These descriptions of low flows/levels in rivers/reservoirs/aquifers should not be entered in to the EDII. Although the flows/levels dropped during the drought, they do not describe an observable impact on ecology/water resource management etc.

## UK DROUGHT IMPACT DATA

Work was undertaken as part of the DrIVER project to extend the coverage of drought impacts in the UK in the EDII. CEH was well placed to improve the coverage, holding copies of research and industry reports for droughts occurring between the early 1970s and 2000. The Environment Agency (EA) provided CEH with Drought Management Briefs (DMBs) covering England and Wales for the 2004-2007 and 2010-2012 drought events in the UK. These DMBs were generally produced weekly during each event, covering the following information:

- Weather
- River and groundwater situation
- Recorded environmental impacts
- Public water supply situation
- Reservoir situation
- Agricultural impacts and restrictions

The DMBs provide a unique set of high resolution spatial and temporal impact data. Many of the impacts added to the EDII are discrete entries and may not have an end date. The DMBs meant impacts could be tracked week to week, allowing an end date to be entered for each impact from these sources. They also covered a broad range of impacts on different sectors and recorded impacts occurring in England and Wales.

Sub-sections in this report with the title 'UK IMPACT DATA ENTRY' relate to the procedures used to enter this UK data from reports and DMBs to the EDII.

## DATABASE ENTRY

Entries to the EDII can be made via the EDII website (<http://www.geo.uio.no/edc/droughtdb/index.php>) after an account has been set up or using a MS Access form (contact Irene Kohn or Veit Blauhut, University of Freiburg).

### UK IMPACT DATA ENTRY

The UK impacts data was collated in a MS Excel worksheet with the same fields as the MS Access form and then loaded to the MS Access database by the EDII team in Freiburg.

## COPYRIGHT

The addition of information to the EDII is a form of publication. Contributors must ensure that the sources used must not have any copyright restrictions. Short quotes from source material are likely to be acceptable but the full reference of the source material must be given. The EDII team in Freiburg regularly check database submissions and reserve the right to reject submissions where necessary (Kohn et al. 2014).

## IMPACT ENTRY

The fields available for each entry are listed below. It is not necessary to complete all fields (\* = compulsory fields) however, the fields for each entry should be as complete as possible using the source information. The field requirements and details relating to UK drought impact entry are explained in the following sections.

Annex 1 gives some examples of completed entries of UK drought impacts in the EDII.

- Entry ID

- Information Source \*
- Date start (mm)
- Season start\*
- Date start (yyyy)\*
- Date end (mm)
- Season end
- Date end (yyyy)
- Related drought event\*
- Country\*
- Impact description\*
- Response description
- Reference\*
- NUTS1
- NUTS2
- NUTS3
- Location
- Impact category\*
- Impact type
- People affected
- Area affected
- Economic loss by impact
- Associated impact
- Associated impact description
- Type of measure
- Level of measure
- Additional info
- Related costs

## BASIC INFORMATION

The following fields will be covered in this section:

- Entry ID
- Information Source \*
- Reference \*

### ENTRY ID

This is a unique ID field given to each entry. When using the EDII website or the MS Access form, this is automatically assigned.

### UK IMPACT DATA ENTRY

A unique ID was created using the initials of the user and consecutive numbers (four digits with leading zeros), for example, LB\_0001, LB\_0002, LB\_0003 etc.



## INFORMATION SOURCE & REFERENCE

The 'Information source' field requires a code describing the type of reference used to source the drought impacts. The information source codes are listed in Table 1. 'Reference' is a required field of the EDII. The reference should be as complete as possible whether it is a web page, scientific article or a government document. This enables the reliability and appropriateness of the source to be checked.

Table 1 – Information source codes (Kohn et al. 2014)

ID	Information source
1	Database
2	Scientific article
3	Book (book section)
4	Newspaper article
5	Government report (national and regional agencies/organisation)
6	(Other) Government document
7	River Basin Organisation Report
8	Report (by NGO)
9	Press release by stakeholders or agencies
10	Report (private sector like insurance)
11	Thesis
12	Pamphlet
13	Personal observation
14	Web page
15	Map
16	other

## UK IMPACT DATA ENTRY

The appropriate information source code was chosen. The DMBs from the EA posed a challenge as they didn't easily fit into any classes, however, they were classed as '6 – (Other) Government document' throughout. DMBs throughout each event were numbered consecutively; these numbers were used to reference specific DMBs in the 'Reference' field. For each impact entry, the DMB the impact was mentioned in was referenced. For example:

- An impact occurring in several DMBs – '*Environment Agency 2010-2012 DMB 11; Environment Agency 2010-2012 DMB 14; Environment Agency DMB 16*'
- An impact occurring in multiple consecutive DMBs – '*Environment Agency 2010-2012 DMB 13- Environment Agency 2010-2012 DMB 21*'

## DATE INFORMATION

Impact entries must have a temporal reference to enter them into the database. The following fields will be covered in this section:

- Drought related event\*
- Date start (mm)
- Season start \*
- Date start (yyyy) \*
- Date end (mm)
- Season end

- Date end (yyyy)

## DROUGHT RELATED EVENT

The 'Drought related event' is a text field giving the drought event the impact occurred in, for example '1984 NW England' or '2010-2012 UK'. The naming of this relates to the established or commonly referred to reference periods for drought events. On the EDII website and MS Access form, this can be chosen from a drop-down list.

## START & END DATES

The start date (and end date if known) should be entered; as a minimum the season and year should be entered. The start date is the season/month an impact first occurred in a specific location or NUTS1 and the end date when the impact ceased in the specific location or NUTS1. If the start/end month is known, the season should also be entered using the classification in Table 2. If only the start/end season is given, the appropriate start/end date (mm) should be entered using the classification in Table 2.

Table 2 – Seasons classification used in EDII

Season	Months
Spring	March, April, May
Summer	June, July, August
Fall	September, October, November
Winter	December, January, February

## SPATIAL INFORMATION

Impact entries must have some basic spatial information to enter them into the database. The following fields will be covered in this section:

- Country \*
- NUTS1
- NUTS2
- NUTS3
- Location

The country the impact occurred in should be entered in the 'Country' field and the 'Location' field should be populated with the river name, town, county etc. as appropriate. The NUTS1-3 fields should be populated with the appropriate code, see the sections below. At a minimum, an impact entry should have a NUTS1 code assigned. However, impacts for the whole country (UK) or its constituent parts (England, Northern Ireland, Scotland & Wales) can be entered if necessary.

## INTRODUCTION TO NUTS

Spatial information is added to impact entries using NUTS (Nomenclature of Territorial Units for Statistics). These are standard hierarchical subdivisions of member states of the European Union (eurostat, 2012). There are three classes of NUTS. NUTS1 are major socio-economic regions, whilst NUTS2 and NUTS3 are smaller areas within each NUTS1. There are 12 NUTS1 in the UK (

Figure 1), these are broken down into varying numbers of NUTS2 and NUTS3 (Annex 2).



▪ Figure 1 - NUTS1 of the UK (after eurostat, 2012)

## UK IMPACT DATA ENTRY

When using the EDII website or the MS Access form, multiple NUTS1 can be selected for each entry. However, when compiling UK drought impacts when an impact covered more than one NUTS1 region, a separate entry was made for each NUTS1. This was to enable analysis of the data at the NUTS1 level. For example:

- *'Loss of income for Thames Water due to hosepipe and sprinkler bans costing £500,000.'* Thames Water's remit covers areas in UKI and UKJ. Two entries would therefore be added with the same text, an entry for each NUTS1 (UKI and UKJ).
- *'Hosepipe ban - all Severn Trent Water customers.'* Severn Trent Water's remit covers areas in UKE, EKF, UKG, UKK and UKL. Five entries would therefore be added with the same text, an entry for each NUTS1 (UKE, EKF, UKG, UKK and UKL).
- *'Some rivers and streams in the Midlands dried up/low flows. Fish rescued where necessary. >350 farmers affected by abstraction licence conditions.'* This impact would be entered twice, once for the East Midlands (UKF) and once for the West Midlands (UKG).

- *'Low levels in feeder reservoirs for Kennet & Avon Canal. Restrictions for boaters. Section in Wiltshire closed 17th Nov-4th Jan.'* This impact would be entered twice, the Kennet and Avon Canal passes through two NUTS1 (UKK and UKJ), as reservoir names were not given, it was assumed the feeder reservoirs were also located in both these NUTS1.

Similarly, when multiple locations are mentioned in the impact description, they would have a separate entry as the text is describing two distinct impact occurrences. For example:

- *'Intrusion of sea water upstream as a result of low flows - River Ancholme, River Freshney, River Witham, River Bure & the Norfolk Broads.'* This impact would be entered five times, once for each river/location even if the rivers are located within the same NUTS1.
- *'Low oxygen levels on the River Nene & River Ouse.'* This impact would be entered twice, once for each river.
- *'River dried up, trapping fish on River Teme (Leintwardine, Heres) & Byne Brook (near Aston Scott, Shropshire).'* This impact would be entered twice, once for each river even though the rivers are located in the same NUTS1.

## IMPACT DETAILS

The following fields will be covered in this section:

- Impact description \*
- Impact response
- Impact category \*
- Impact type
- People affected
- Area affected
- Economic loss by impact

## IMPACT DESCRIPTION & IMPACT RESPONSE

The details of the impact should be entered in the 'Impact description' field as the text appears in the source material or summarised from tables/figures. If there was a management response to the drought impact, this should be entered in the 'Impact response' field. For example, *'Low river flows led to fish becoming trapped in pools on River Lathkill, Derbyshire.'* would be entered in the 'Impact description' field and *'Fish rescued 26 May'* would be entered in the 'Impact response' field.

## UK DROUGHT IMPACT ENTRY

The impact response was entered in the 'Impact description' field in addition to the 'Impact response' field. This was at the request of Irene Kohn (University of Freiburg) as in some exports from the EDII the 'Impact response' field is not included. Entering the information in both fields ensures the user should always have access to the data. For example, in the example given in the section above, *'Low river flows led to fish becoming trapped in pools on the River Lathkill, Derbyshire. Fish rescued 26 May.'* would be entered in the 'Impact description' field. The details of the fish rescue, *'Fish rescued 26 May'*, would be duplicated in the 'Impact response' field.

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## IMPACT CATEGORY & IMPACT TYPE

Each entry is assigned an impact category and impact type code to allow data to be analysed by type of impact. Impact categories are listed below, a full list of impact categories and types can be found in Annex 3. An entry can only have a single impact category assigned (but multiple impact types from within the category) when using any of the methods of recording impacts (EDII website, MS Access form or MS Excel). If the impact description covers multiple impact categories, separate entries with the same impact description should be made for each category. At a minimum, an impact entry must have an impact category code assigned.

- Agriculture & livestock
- Forestry
- Freshwater aquaculture & fisheries
- Energy & industry
- Waterborne transport
- Tourism & recreation
- Public water supply
- Water quality
- Freshwater ecosystems: habitats, plants & wildlife
- Terrestrial ecosystems: habitats, plants & wildlife
- Soil system
- Wildfires
- Air quality
- Human health & public safety
- Conflicts

If it is not clear which 'Impact type' the impact should be classed as the impact type 'Other' in the appropriate impact category or left blank.

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## OTHER IMPACT DETAILS

If the impact description gives details of the number of people affected, economic losses or an area of land affected, these details should be added in the 'People affected', 'Area affected' and 'Economic loss by impact' fields as appropriate.

## OTHER INFORMATION

The following fields will be covered in this section:

- Associated impact
- Associated impact description
- Type of measure
- Level of measure
- Additional information
- Related costs

It is not necessary to fill in these fields, however, as many fields should be completed as possible.

## ASSOCIATED IMPACTS

Drought impacts are often complex and have secondary impacts on sectors and regions not directly affected by drought. If the source gives information on secondary impacts, they should be entered in the associated impact fields (Kohn et al. 2014). The 'Associated impact' field should be filled with the appropriate code from Table 3 and a description from the source entered in the 'Associated impact description' field.

*Note* - These fields should only be completed if secondary impacts are not addressed in the main 'Impact description' field.

Table 3 – Associated impact codes for EDII impact entry (Kohn et al. 2014)

Code	Associated impact
1	Economic consequences beyond the reported impact
2	Lasting environmental impacts
3	Expansive effects on social life/public health
4	No specific information given

## MEASURES

A drought measure is an action taken in order to mitigate the impacts of drought, however, the definition and distinction from drought impact can be subjective (Kohn et al. 2014). Fields relating to measures should only be completed if a response was entered in the 'Response description' field. The level of measure describes the spatial scale covered by the measure imposed and the type of measure broadly categorises response measures. The measure types used are based on those defined in the Drought R&SPI project (De Stefano et al. 2012). The 'Level of measure' should be entered using the codes in Table 4 and the 'Type of measure' should be entered using the codes in Table 5. The cost of any implemented measures should be entered in Euros (€) in the 'Related cost' field.

Table 4 – Level of measure codes for EDII impact entry (Kohn et al. 2014)

Code	Level of measure
1	Local activities
2	Regional/national measures
3	International aid
4	No information

Table 5 – Type of measure codes for EDII impact entry (Kohn et al. 2014)

Code	Type of measure	Description
1	Water demand management	These measures control or influence the amount of water used, for example by reducing the amount of water used before, during or after a drought event.
2	Education & awareness campaigns	
3	Environmental measure	These measures aim to mitigate the impact of drought on ecosystems.
4	Water supply management	These measures aim to increase the amount of available water to be used.
5	Recovery measures (compensation schemes. Ecosystem restoration)	Adopted measures are deactivated and restoration measures are

		implemented in the systems affected by drought.
6	Preventative and strategic measures	Developed and used under normal (non-drought) conditions with an aim to reinforce the structural system to increase its response capacity to droughts.
7	Other	
8	No information	

## UK IMPACT DATA ENTRY

It is possible to enter multiple measure types if appropriate. For example ‘*Cambridge Water asked customers to use water wisely and gave away free water efficiency devices.*’ would manage both water demand and provide education and awareness (i.e. measure types one and two).

*Note* - Measure type six is rarely used in the EDII because it is defined as a measure implemented before a drought so it is unlikely to be related to reports of ongoing drought impacts.

## ADDITIONAL INFORMATION

Any other information contained in the source material not covered by the other fields can be entered in this field.

## SPECIFIC PROBLEMS FROM UK IMPACT DATA ENTRY

This section describes specific questions/problems raised when compiling UK impact data from reports held by CEH and the DMBs. These issues were addressed at a meeting in Freiburg with Irene Kohn (22<sup>nd</sup> - 23<sup>rd</sup> July 2014) and by email. Answers to specific questions and a summary of the outcomes from these conversations are given below.

## MISSING INFORMATION

**Q:** Many entries taken from reports where there is missing spatial and temporal information meaning many cannot be added to the EDII. Is it possible to fill in missing temporal information using existing knowledge of the event? For example, the 1984 event in NW England is a typical summer seasonal drought. For impacts occurring in this event would it be possible to enter a summer start and end season as it is highly likely that all impacts would have occurred in this period?

**A:** Yes, for a situation as clear as this (the 1984 example), however, for other cases such as filling in spatial information from existing knowledge of the drought progression, the entry should contain only information from the source and spatial information should not be added.

## IMPACT CATEGORIES

**Q:** The DMBs contained a lot of information about restrictions placed on farmers, determining the amount of water they are able to abstract and use for various types of irrigation. These impacts were categorised as 7.1 and 1.8 (‘Local water supply shortage’ and ‘Other’). However, this does not cover the full impact on agriculture.

- A:** The impact type 1.4 was amended from 'Agriculture & Livestock Farming - Reduction of cultivated areas due to a lack of irrigation water' to 'Agriculture & Livestock Farming - Reduced availability of irrigation water.' This covers a wider range of impacts but is still specific to irrigation and agriculture. The impact categories/types 1.4 and 9.8 ('Freshwater Ecosystems - Violation of minimum flow requirements') should be used for restrictions on agricultural abstraction restrictions, including any other applicable impact categories/types for the individual impact report.
- Q:** During a drought, water companies and other abstractors can apply for a Drought Order allowing them to continue abstracting or to reduce compensation flows from a reservoir in order to maintain production or water supply. What impact category/type should these entries be classed as?
- A:** These impacts should be entered as impact category 7 (public water supply), type 7.1 or 7.2, 'Local water supply shortage/problems (drying up of springs/wells, reservoirs, streams)' or 'Regional/region-wide water supply shortage/problems (drying up of springs/wells, reservoirs, streams) respectively, depending on the scale of the Drought Order. The impact category and type 9.8 ('Violation of minimum flow requirements') should also be entered because of the temporary changes to the flow requirements.

In some cases, it was difficult to assign an impact category due to the cross-cutting nature of the impacts. These impacts below give examples of the types of impacts which proved problematic in the UK drought impact data entry and the final drought categories used.

- *'Low levels in Saddington Reservoir - feeder for Grand Union Canal in Leicester. Kilby Lock 30 & Kings Lock 38 (both Leicester) only to be used 0900-1600.'* This impact was entered three times: once as 'Waterborne Transportation Impaired navigability of streams' (5.1), once as 'Tourism & Recreation – Other' (6.5) and once as 'Public Water Supply – Regional/region-wide water supply shortage/problems' (7.2). Impact categories/types 5.1 and 6.5 were chosen because although the restriction of the lock use affected transportation on the canals, a lot of this transport is likely to have been recreational transport. 7.2 was assigned because of the low levels in the feeder reservoir.
- *'Small sewage treatment works did not operate effectively as biological filters dried out. Had to tanker in water to prevent the process from halting.'* This impact would be entered twice: once as a water supply impact (7) and once as a water quality impact (8).
- Entries relating to siltation, such as, *'Navigation was made more difficult by low flows and increased siltation – River Ouse.'* This was entered as an impact on waterborne transport (5) and freshwater ecosystems (9.14 'other').
- *'The fires burnt the sites of important long-term research projects.'* This impact was given an impact category of Wildfires (12); the damage to the research sites was entered as an associated impact. This was a detailed entry, it was important to capture all of the information from the source in the entry even if it didn't fit well with the predefined categories.
- *'Dry warm weather has caused algal blooms - The Serpentine, Hyde Park. Warning signs erected in affected areas.'* This impact was entered twice, once as 'Water Quality – (Temporary) water quality deterioration/problems of surface waters (natural and manmade); e.g. significant change of physio-chemical indicators, increased concentrations of pollutants, decreased oxygen saturation levels, eutrophication, algal bloom' (8.2) and 'Freshwater Ecosystems – Drying up of shallow water areas, weed growth or algae bloom' (9.9) as both these impact types relate to algal blooms.

## IMPACT LOCATION

- Q:** In some cases, the impact description says there was a general impact across a region and then gives a specific location within the region. Should the specific location be used as the location of the impact?



- A:** Impacts like this should be entered as two impact entries, one entry for the larger region, and another for the specific location. For example, *‘Headwater recession (in some cases hundreds of metres) of Winterbourne streams in the Berkshire Downs as a result of decreased ground water levels - 2-3m below normal levels - River Pang.’* should be entered twice, once for the Berkshire Downs and once for the River Pang.

## OTHER

Below are some other examples of problematic entries and the drought categories assigned:

- Advice/requests from water companies for customers to save water are technically a response to drought; however, it could stand alone as an entry in the EDII and would be classed as 7.1 or 7.2 (local/regional water supply shortages/problems). However, the Measure type should also be completed (Education or awareness campaign and water demand management).
- Post drought impacts can be entered in the EDII, for example, *‘Heavy showers on the dried soil led to soil erosion, flushing pollutants into rivers.’* This entry can be added as both ‘Water Quality – (Temporary) water quality deterioration/problems in natural surface waters (streams or lakes) or reservoirs’ (8.2) and ‘Soil System – Drought-related soil erosion processes’ (11.1).

## DATA ANALYSIS

Some initial analysis has been undertaken by both CEH and the University of Freiburg attempting to link reported impacts to drought indicators.

## DATA PREPARATION

To enable the text-based impact entries to be analysed, they were converted into a monthly time series of impact occurrence per NUTS1/impact category. The following rules were used to convert impact entries to impact occurrences (Bachmair et al. 2014):

- The month/year of drought impact start/end is used for impact occurrence (impacts occurred during the whole time span)
- If only the start/end season is given, the start/end month is assigned using the seasonal months assigned in Table 2 and the impact is assumed to have occurred in each month of the season(s)
- Multiple entries are created for entries which describe an impact occurring in multiple NUTS1 or locations
- Multiple entries are created for entries which describe an impact which fits into multiple impact categories
- The impact entry is omitted from the analysis if:
  - No month/season start date and only a year is given
  - No impact category is assigned
  - A country level spatial reference is given with no indication of affected NUTS1/locations

## UK IMPACT DATA ENTRY

Separate entries were already made for those impact reports covering multiple locations/NUTS1 and impact categories (see the ‘

Spatial information’ and ‘Impact description & impact response’ sections above).

## UK DATA HOLDINGS

As of November 2014 the EDII holds 4913 impact occurrences for the UK (Bachmair et al. 2014). Figure 2 and Figure 3 show the spatial and temporal distribution of UK drought impact reports from 1970 to 2012. The most entries are recorded for the drought of 1975-76, followed by the 2010-2012 event (Figure 2). The majority of these impact entries were occurred in the South East of England, followed by Wales. Scotland, Northern Ireland and North East England had the least number of impacts reported over time (~6) (Figure 3).

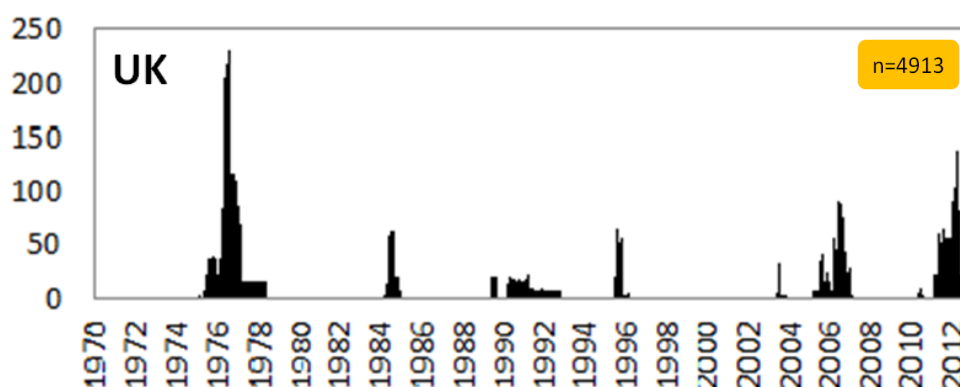


Figure 2– Drought impact reports in the EDII for the UK (after Bachmair et al. 2014).

## DATA ANALYSIS – FIRST STEPS

First steps have been taken in analysing the UK drought impact occurrences in relation to drought indicators.

Figure 4 shows the average Standardised Precipitation Index (SPI; 1, 3 and 6 month accumulation periods) for a selection of NUTS1 in the UK for the 2010-2012 event calculated from observed gridded data (Tanguy, 2014). The number of impacts recorded in each month of this event taken from DMBs is plotted against the SPI.

Figure 5 shows the correlation between different drought indicators and the number of impact occurrences for the UK NUTS1 regions 1970-2012. The highest correlation is between the impact occurrences and longer accumulation period indices for the South East and East England. The correlations between indicators and impact occurrence are weaker in the North of the UK, but in general, stronger correlations are found at shorter accumulation periods (Bachmair et al. 2014).

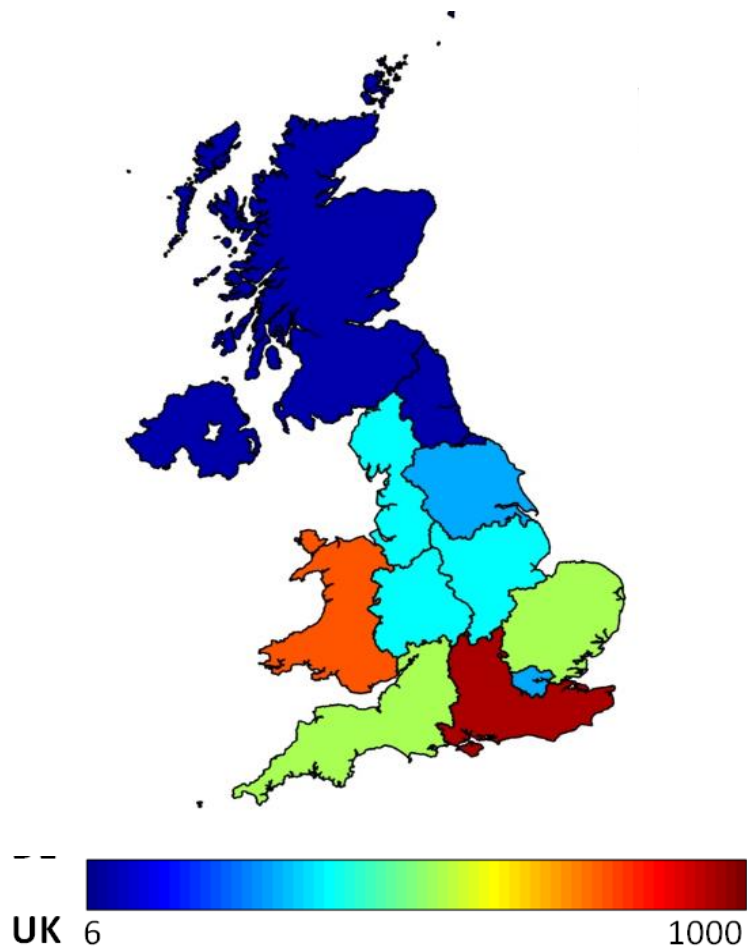


Figure 3 – Distribution of impacts in the EDII for the UK (after Bachmair et al. 2014).

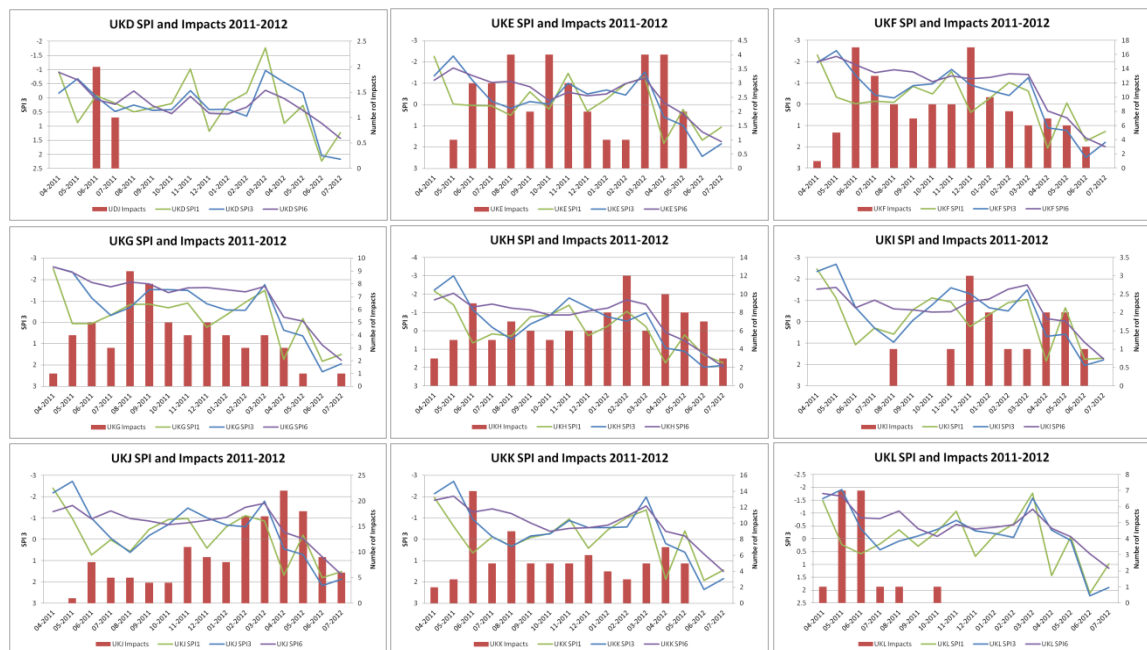


Figure 4 – First pass analysis of drought indicators (SPI1, SPI3 and SPI6) and drought impacts in UK NUTS1 for the 2010-2012 drought event.

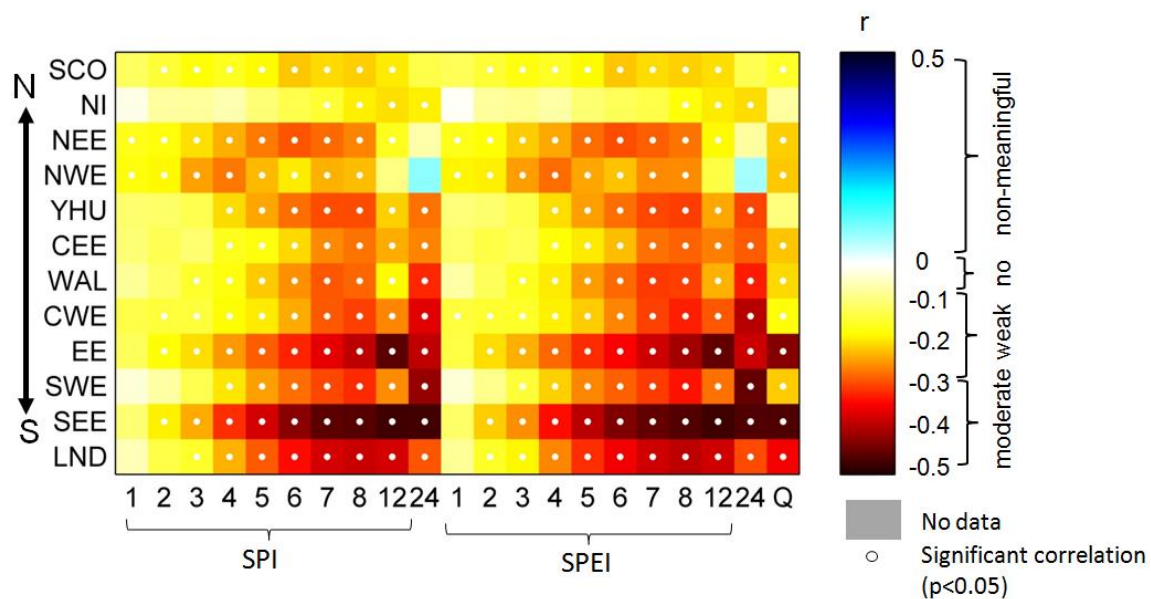


Figure 5 – Correlation between different drought indicators and the number of impact occurrences, Q = streamflow percentiles (Bachmair et al. 2014).

## CONCLUSION

The UK drought impact data collated under the DrIVER project has been added to the EDII for use in the analysis for DrIVER. However it has not yet been made public due to licensing issues with some of the references used. When the data is made available, the unique nature of the impacts data taken from the EA DMBs will contribute towards investigating the link between impacts and indicators paving the way towards improved drought monitoring and early warning.

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## ANNEX 1

Table of example completed UK drought impact entries (\* see below for explanations of the abbreviations/codes used for the seasons and references abbreviations only used in this table to make sure the table would fit on one page, when completing drought impact entries to be added to the EDII, the full season name and reference should be entered).

ENTRY ID	INFORMATION SOURCE	DATE START MM	SEASON START*	DATE START YYYY	DATE END MM	SEASON END*	DATE END YYYY	RELATED DROUGHT EVENT	COUNTRY	IMPACT DESCRIPTION	RESPONSE DESCRIPTION	REFERENCE*	NUTS1	NUTS2	NUTS3	LOCATION	IMPACT CATEGORY	IMPACT TYPE	PEOPLE AFFECTED	AREA AFFECTED	ECONOMIC LOSS BY IMPACT	ASSOCIATED IMPACT	ASSOCIATED IMPACT DESCRIPTION	TYPE OF MEASURE	LEVEL OF MEASURE	ADDITIONAL INFORMATION	RELATED COSTS
LB_0089a	6	8	Su	2011	10	F	2011	2010-2012 UK	UK	Low levels in feeder reservoirs for Oxford Canal. Restrictions for boaters - can only use locks between 0900 and 0400.	Restrictions for boaters - can only use locks between 0900 and 0400.	A	UKJ	UKJ1	UKJ14	Oxford	5	5.1	-	-	-	-	-	3.4	1	-	-
LB_0089b	6	8	Su	2011	10	F	2011	2010-2012 UK	UK	Low levels in feeder reservoirs for Oxford Canal. Restrictions for boaters - can only use locks between 0900 and 0400.	Restrictions for boaters - can only use locks between 0900 and 0400.	A	UKJ	UKJ1	UKJ14	Oxford	6	6.5	-	-	-	-	-	3.4	1	-	-
LB_0089c	6	8	Su	2011	10	F	2011	2010-2012 UK	UK	Low levels in feeder reservoirs for Oxford Canal. Restrictions for boaters - can only use locks between 0900 and 0400.	Restrictions for boaters - can only use locks between 0900 and 0400.	A	UKJ	UKJ1	UKJ14	Oxford	7	7.2	-	-	-	-	-	3.4	1	-	-

LB_0408	6	3	Sp	2006	5	Sp	2006	2005-2006 UK	UK	Sutton and East Surrey Water was issued with a drought permit to abstract waster from the River Eden to fill Bough Beech Reservoir during May.	-	E	UKJ	-	-	Sutton and East Surrey Water supply area	7	7.2;7.3	-	-	-	-	-	-	-	-	-
LB_0402b	6	3	Sp	2006	3	Sp	2006	2005-2006 UK	UK	Rivers suffering from low flows and build up of nutrients. With the higher temperatures algal blooms may develop in many parts of south east England. The EA monitored the first signs of the blooms.	-	D	UKJ	-	-	Rivers in South East England	9	9.9;9.8	-	-	-	-	-	-	-	-	-
LB_0402a	6	3	Sp	2006	3	Sp	2006	2005-2006 UK	UK	Rivers suffering from low flows and build up of nutrients. With the higher temperatures algal blooms may develop in many parts of south east England. The EA monitored the first signs of the blooms.	-	D	UKJ	-	-	Rivers in South East England	8	8.1;8.2	-	-	-	-	-	-	-	-	-
LB_0050	6	6	Su	2011	6	Su	2011	2010-2012 UK	UK	Essex and Suffolk Water urged householders to conserve water in summer.	-	C	UKH	UKH1;UKH3	UKH14;UKH3	Essex & Suffolk Water supply area	7	7.2;7.6	-	-	-	-	-	-	-	-	-
LB_0072b	6	7	Su	2011	7	Su	2011	2010-2012 UK	UK	Fish deaths due to high temperatures and low flows - River Brant (Lincoln).	-	B	UKF	UKF3	UKF30	River Brant	9	9.1;9.10	-	-	-	-	-	-	-	-	-
LB_0072a	6	7	Su	2011	7	Su	2011	2010-2012 UK	UK	Fish deaths due to high temperatures and low flows - River Brant (Lincoln).	-	B	UKF	UKF3	UKF30	River Brant	8	8.1	-	-	-	-	-	-	-	-	-

LB_0422	6	7	Su	2006	7	Su	2006	2005-2006 UK	UK	In Kent, the level of the River Darent dropped resulting in some stretches of the river becoming low and endangering coarse fish. EA switched on the River Darent augmentation scheme that pumps water into the river from several boreholes. There is still a stretch of river prone to dry up and fisheries staff were on standby to rescue fish that became stranded. All three support pumps were switched on after fish were found in distress around Westminster Mill and Horton Kirby, Kent.	EA switched on the River Darent augmentation scheme that pumps water into the river from several boreholes. There is still a stretch of river prone to dry up and fisheries staff were on standby to rescue fish that became stranded. All three support pumps were switched on after fish were found in distress around Westminster Mill and Horton Kirby, Kent.	F	UKJ	UKJ4	-	River Darent, Kent	9	9.8;9.9	-	-	-	-	-	-	3.5	1	-	-
LB_CEH_023a	6			1976			1976	1975-1976 UK	UK	Rod salmon catches 47% of the average from the previous 5 years.	-	G	-	-	-	UK	6	9.7	-	-	-	-	-	-	-	-	-	
LB_CEH_023b	6			1976			1976	1975-1976 UK	UK	Rod salmon catches 47% of the average from the previous 5 years.	-	G	-	-	-	UK	9	9.7	-	-	-	-	-	-	-	-	-	
LB_CEH_050a	6	8	Su	1995	11	F	1995	1995 England	UK	Abstraction Drought Order granted to Yorkshire Water allowing increased abstraction from the River Wharfe.	-	H	UKE	UKE2	UKE2	River Wharfe	7	9.8	-	-	-	-	-	-	-	-	-	
LB_CEH_050b	6	8	Su	1995	11	F	1995	1995 England	UK	Abstraction Drought Order granted to Yorkshire Water allowing increased abstraction from the River Wharfe.	-	H	UKE	UKE2	UKE2	River Wharfe	9	9.8	-	-	-	-	-	-	-	-	-	

LB_CEH_301	3	1	W	1976	12	W	1976	1975-1976 UK	UK	Gradual increase in nitrate concentration in groundwater - Lytes Cary borehole and springs, Somerset.	-	K	UKK	UKK2	UKK23	Lytes Cary borehole & springs, Somerset	8	8.6	-	-	-	-	-	-	-	-	-
LB_CEH_152d	10	8	Su	1976	2	W	1977	1975-1976 UK	UK	Drought Order - reduce residual flow in Afon Aled Isaf from 4.0mgd to 2.5mgd and pump 5mgd from Llyn Aled, Gwynedd.	-	J	UKL	UKL1	UKL12	Llyn Aled, Gwynedd	9	9.8	-	-	-	-	-	-	-	-	-
LB_CEH_152c	10	8	Su	1976	2	W	1977	1975-1976 UK	UK	Drought Order - reduce residual flow in Afon Aled Isaf from 4.0mgd to 2.5mgd and pump 5mgd from Llyn Aled, Gwynedd.	-	J	UKL	UKL1	UKL12	Llyn Aled, Gwynedd	7	7.1;7.6	-	-	-	-	-	-	-	-	-
LB_CEH_152b	10	8	Su	1976	2	W	1977	1975-1976 UK	UK	Drought Order - reduce residual flow in Afon Aled Isaf from 4.0mgd to 2.5mgd and pump 5mgd from Llyn Aled, Gwynedd.	-	J	UKL	UKL1	UKL13	Afon Aled Isaf Reservoir	9	9.8	-	-	-	-	-	-	-	-	-
LB_CEH_152a	10	8	Su	1976	2	W	1977	1975-1976 UK	UK	Drought Order - reduce residual flow in Afon Aled Isaf from 4.0mgd to 2.5mgd and pump 5mgd from Llyn Aled, Gwynedd.	-	J	UKL	UKL1	UKL13	Afon Aled Isaf Reservoir	7	7.1;7.6	-	-	-	-	-	-	-	-	-
LB_CEH_113b	6	6	Su	1991	8	Su	1991	1988-1992 East Anglia	UK	Navigation was made more difficult by low flows and increased siltation - River Ouse.	-	I	UKH	-	-	River Ouse	9	9.8;9.14	-	-	-	-	-	-	-	-	-
LB_CEH_113a	6	6	Su	1991	8	Su	1991	1988-1992 East Anglia	UK	Navigation was made more difficult by low flows and increased siltation - River Ouse.	-	I	UKH	-	-	River Ouse	5	5.1	-	-	-	-	-	-	-	-	-



LB_CEH_423a	2	7	Su	1976	-	-	-	1975-1976 UK	UK	By July Grafham reservoir was affected by a severe bloom of Microcystis. The normal treatment was found to be incompatible with removing the offending bloom and the breakdown products that ensued. Alum treatment was introduced without soda softening and this gave substantial improvement in the final water but turbidity residuals were still above average.	The normal treatment was found to be incompatible with removing the offending bloom and the breakdown products that ensued. Alum treatment was introduced without soda softening and this gave substantial improvement in the final water but turbidity residuals were still above average.	M	UKH	UKH1	UKH12	Grafham Reservoir	8	8.2	-	-	-	-	-	4	1	-	-
LB_CEH_415	2	3	Sp	1976	9	F	1976	1975-1976 UK	UK	The demand for wet sludges substantially increased - 01/03/1976 - 30/09/1976 66% of all sludges in Anglian region were disposed to agricultural land (75% of which was as wet sludge).	-	M	UKH	-	-	Anglian Region	7	7.1;7.6	-	-	-	-	-	-	-	-	
LB_CEH_340	2	7	Su	1976	7	Su	1976	1975-1976 UK	UK	Winter crops died off prematurely due to the hot dry weather.	-	L	-	-	-	UK	1	1.1	-	-	-	-	-	-	-	-	
LB_CEH_317	3	4	Sp	1976	4	Sp	1977	1975-1976 UK	UK	Loss of £9,583,000 to the water industry.	-	K	-	-	-	UK	7	7.7	-	-	-	-	-	-	-	-	

LB_CEH_530b	LB_CEH_530a	LB_CEH_423b
3	3	2
8	8	7
Su	Su	Su
1976	1976	1976
8	8	-
Su	Su	-
1976	1976	-
1975-1976 UK	1975-1976 UK	1975-1976 UK
UK	UK	UK
Large areas of forest were also under threat from excessive fire damage and the Forestry Commission restricted public access to forests in many areas - Mortimer Forest, Shropshire.	Large areas of forest were also under threat from excessive fire damage and the Forestry Commission restricted public access to forests in many areas - Mortimer Forest, Shropshire.	By July Grafham reservoir was affected by a severe bloom of Microcystis. The normal treatment was found to be incompatible with removing the offending bloom and the breakdown products that ensued. Alum treatment was introduced without soda softening and this gave substantial improvement in the final water but turbidity residuals were still above average.
Forestry Commission restricted public access to forests in many areas - Mortimer Forest, Shropshire.	Forestry Commission restricted public access to forests in many areas - Mortimer Forest, Shropshire.	The normal treatment was found to be incompatible with removing the offending bloom and the breakdown products that ensued. Alum treatment was introduced without soda softening and this gave substantial improvement in the final water but turbidity residuals were still above average.
N	N	M
UKG	UKG	UKH
UKG2	UKG2	UKH1
UKG22	UKG22	UKH2
Mortimer Forest, Shropshire	Mortimer Forest, Shropshire	Grafham Reservoir
12	6	9
'	6.5	9.9
'	'	'
'	'	'
'	'	'
'	'	'
'	'	'
'	'	'
3	3	4
1	1	1
'	'	'
'	'	'

LB_CE133c	LB_CE133b	LB_CE133a	LB_0062
10	10	10	6
-	-	-	6
-	-	-	Su
-	-	-	2011
-	-	-	6
-	-	-	Su
-	-	-	2011
1975-1976 UK	1975-1976 UK	1975-1976 UK	2010-2012 UK
UK	UK	UK	UK
Due to high demand for water supply, consents to sink boreholes were granted - Wye catchment 14 consents were granted for industry, agriculture, supply and recreation purposes - 2mgd.	Due to high demand for water supply, consents to sink boreholes were granted - Wye catchment 14 consents were granted for industry, agriculture, supply and recreation purposes - 2mgd.	Due to high demand for water supply, consents to sink boreholes were granted - Wye catchment 14 consents were granted for industry, agriculture, supply and recreation purposes - 2mgd.	Fish distress in fishery ponds - Nottinghamshire. Advised owners about actions to protect fisheries.
-	-	-	Advised owners about actions to protect fisheries.
J	J	J	O
UKL	UKL	UKL	UKF
UKL2	UKL2	UKL2	UKF1
UKL21;UKL24	UKL21;UKL24	UKL21;UKL24	UKF14;UKF15;UKF16
Wye catchment	Wye catchment	Wye catchment	Nottinghamshire
7	4	1	3
7.2;7.6	-	-	3.3
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	3
-	-	-	2
-	-	-	-
-	-	-	-

[illegible]

LB_0041b	6	6	Su	2011	6	Su	2011	2010-2012 UK	UK	Heavy showers on the dried soil led to soil erosion, flushing pollutants into rivers.	-	Q	-	-	-	England and Wales	11	11.1	-	-	-	-	-	-	-	-	-	-
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#### Seasons:

Sp – Spring

Su – Summer

F – Fall

W – Winter

#### References:

A - EA 2010-2012 DMB 14-EA 2010-2012 DMB 21

B - EA 2010-2012 DMB 10

C- EA 2010-2012 DMB 07

D - EA 2005-2007 DMB 50

E - EA 2005-2007 DMB 52

F - EA 2005-2007 DMB 66-EA 2005-2007 DMB 67

G - National Water Council 1977 'The 1975-1976 drought'

H - National Rivers Authority 1995 'The drought of 1995 - A report to the Secretary of State for the Environment'

I - National Rivers Authority 'The drought of 1988-1992 in Anglia - A review'

J - Welsh National Water Development Authority Technical Data/Information Bank 1976 'The 1975-1976 Drought'

K - The Institution of Water Engineers & Scientists and The Institution of Civil Engineers 1977 'Proceedings of the one-day seminar on the operational aspects of the drought of 1975-1976' Chameleon Press, London.

L - Carter E.S 1978 'The effect of the drought on British agriculture' Proceedings of the Royal Society London A, **363**,43-54

M - Davies A.W. 1978 'Pollution problems arising from the 1975-1976 drought' Proceedings of the Royal Society London A, 363,97-107

N - Sargent P. 1980 'Amenity restrictions' in Doorkamp J.C., Gregory K.J. & Burn A.S. 1980 Atlas of Drought in Britain 1975-1976' Institute of British Geographers, London

O - EA 2010-2012 DMB 09

P - EA 2005-2007 DMB 30

Q - EA 2010-2012 DMB 06

## ANNEX 2

Table of UK NUTS1-3.

NUTS1		NUTS2		NUTS3	
UKC	North East England	UKC1	Tees Valley & Durham	UKC11	Hartlepool & Stockton-on-Tees
				UKC12	South Teeside (Middlesbrough, Redcar & Celveland)
				UKC13	Darlington
				UKC14	Durham
		UKC2	Northumberland & Tyne and Wear	UKC21	Northumberland
				UKC22	Tyneside (Newcastle upon Tyne, Gateshead, South Tyneside & North Tyneside)
				UKC23	Sunderland
UKD	North West England	UKD1	Cumbria	UKD11	West Cumbria (Allerdale, Barrow-in-Furness & Copeland)
				UKD12	East Cumbria (Carlisle, Eden & South Lakeland)
		UKD2	Cheshire	UKD21	Warrington
				UKD22	Cheshire East
				UKD23	Cheshire West & Chester
		UKD3	Greater Manchester	UKD31	Greater Manchester South (Manchester, Salford, Stockport, Tameside & Trafford)
				UKD32	Greater Manchester North (Bolton, Bury, Oldham, Rochdale & Wigan)
		UKD4	Lancashire	UKD41	Blackburn with Darwen
				UKD42	Blackpool
				UKD43	Lancashire CC
		UKD5	Merseyside	UKD51	East Merseyside (Knowsley, St Helens & Halton)
				UKD52	Liverpool
				UKD53	Sefton
				UKD54	Wirral
UKE	Yorkshire & The Humber	UKE1	East Riding & North Lincolnshire	UKE11	Kingston upon Hull
				UKE12	East Riding of Yorkshire
				UKE13	North & East Lincolnshire
		UKE2	North Yorkshire	UKE21	York
				UKE22	North Yorkshire CC
		UKE3	South Yorkshire	UKE31	Barnsley, Doncaster & Rotheram
				UKE32	Sheffield
		UKE4	West Yorkshire	UKE41	Bradford
				UKE42	Leeds
				UKE44	Calderdale & Kirklees
UKF	East Midlands	UKF1	Derbyshire & Nottinghamshire	UKF11	Derby
				UKF12	East Derbyshire (Bolsover, Chesterfield & North East Derbyshire)
				UKF13	South & West Derbyshire (Amber Valley, Derbyshire Dales, Erewash, High Peak & South Derbyshire)
				UKF14	Nottingham
				UKF15	North Nottinghamshire (Ashfield, Bassetlaw, Mansfield, Newark & Sherwood)

	UKF2	Leicestershire, Rutland & Northamptonshire	UKF16	South Nottinghamshire (Broxtowe, Gelding & Rushcliffe)
			UKF21	Leicester
			UKF22	Leicestershire CC & Rutland
			UKF24	West Northamptonshire (Northampton, Daventry & South Northamptonshire)
			UKF25	North Northamptonshire (East Northamptonshire, Corby, Wellingborough & Kettering)
	UKF3	Lincolnshire	UKF0	Lincolnshire CC
UKG	UKG1	Herefordshire, Worcestershire & Warwickshire	UKG11	Herefordshire
			UKG12	Worcestershire CC
			UKG13	Warwickshire CC
	UKG2	Shropshire & Staffordshire	UKG21	Telford & Wrekin
			UKG22	Shropshire CC
			UKG23	Stoke-on-Trent
			UKG24	Staffordshire CC
	UKG3	West Midlands	UKG31	Birmingham
			UKG32	Solihull
			UKG33	Coventry
			UKG36	Dudley
			UKG37	Sandwell
			UKG38	Walsall
			UKG39	Wolverhampton
UKH	UKH1	East Anglia	UKH11	Peterborough
			UKH12	Cambridgeshire CC
			UKH13	Norfolk
			UKH14	Suffolk
	UKH2	Bedfordshire & Hertfordshire	UKH21	Luton
			UKH23	Hertfordshire CC
			UKH24	Bedford
			UKH25	Bedfordshire CC
	UKH3	Essex	UKH31	Southend-on-Sea
			UKH32	Thurrock
			UKH33	Essex CC
UKI	UKI1	Inner London	UKI11	West Inner London (City of London, Camden, Fulham, Kensington, Wandsworth & Westminster)
			UKI12	East Inner London (Hackney, Haringey, Islington, Lambeth, Lewisham, Newham, Southwark & Tower Hamlets)
	UKI2	Outer London	UKI21	East & North East Outer London (Barking & Dagenham, Bexley, Enfield, Greenwich, Havering, Redbridge & Waltham Forest)
			UKI22	South Outer London (Bromley, Croydon, Kingston upon Thames, Merton & Sutton)
			UKI23	West and North West Outer London (Barnet, Brent, Ealing, Harrow, Hillingdon, Hounslow & Richmond upon Thames)
UKJ	UKJ1	Berkshire, Buckinghamshire & Oxfordshire	UKJ11	Berkshire
			UKJ12	Milton Keynes
			UKJ13	Buckinghamshire CC
			UKJ14	Oxfordshire
	UKJ2	Surry, East & West Sussex	UKJ21	Brighton & Hove
			UKJ22	East Sussex CC
			UKJ23	Surrey

	UKJ3	Hampshire & Isle of Wight	UKJ24	West Sussex CC
			UKJ31	Portsmouth
			UKJ32	Southampton
			UKJ33	Hampshire CC
			UKJ34	Isle of Wight
	UKJ4	Kent	UKJ41	Medway
			UKJ42	Kent CC
UKK	UKK1	Gloucestershire, Wiltshire & Bristol/Bath area	UKK11	Bristol
			UKK12	Bath & North East Somerset, North Somerset & South Gloucestershire
			UKK13	Gloucestershire CC
			UKK14	Swindon
			UKK15	Wiltshire
	UKK2	Dorset & Somerset	UKK21	Bournemouth & Poole
			UKK22	Dorset CC
			UKK23	Somerset
	UKK3	Cornwall & Isles of Scilly	UKK30	Cornwall & Isles of Scilly
	UKK4	Devon	UKK41	Plymouth
UKK42			Torbay	
UKK43			Devon CC	
UKL	UKL1	West Wales & The Valleys	UKL11	Isle of Anglesey
			UKL12	Gwynedd
			UKL13	Conwy & Denbighshire
			UKL14	South West Wales (Ceredigion, Carmarthenshire & Pembrokeshire)
			UKL15	Central Valleys (Methyr Tydfil & Rhondda Cynon Taf)
			UKL16	Gwent Valleys (Blaenau Gwent, Caerphilly & Tofaen)
			UKL17	Bridgend & Neath Port Talbot
			UKL18	Swansea
	UKL2	East Wales	UKL21	Monmouthshire & Newport
			UKL22	Cardiff & Vale of Glamorgan
			UKL23	Flintshire & Wrexham
			UKL24	Powys
UKM	UKM2	Eastern Scotland	UKM21	Angus & Dundee
			UKM22	Clackmannanshire & Fife
			UKM23	East Lothian & Midlothian
			UKM24	Scottish Borders
			UKM25	Edinburgh
			UKM26	Falkirk
			UKM27	Perth and Kinross & Stirling
			UKM28	West Lothian
	UKM3	South Western Scotland	UKM31	East Dumbartonshire, West Dumbartonshire, Helensburgh & Lomond
			UKM32	Dumfries & Galloway
			UKM33	East & North Ayrshire mainland
			UKM34	Glasgow
			UKM35	Inverclyde, East Renfrewshire & Renfrewshire
			UKM36	North Lanarkshire
			UKM37	South Ayrshire
	UKM38	South Lanarkshire		
	UKM5	North Eastern Scotland	UKM50	Aberdeen & Aberdeenshire
	UKM6	Highlands & Islands	UKM61	Caithness & Sutherland, Ross & Cromarty



		UKM62	Inverness, Narin Moray, Badenoch & Strathspey
		UKM63	Lochaber, Skye & Lochalsh, Arran & Cumbrae, Argyll & Bute (except Helensburgh & Lomond)
		UKM64	Eilean Siar (Western Isles)
		UKM65	Orkney Islands
		UKM66	Shetland Islands
		UKN01	Belfast
UKN	Northern Ireland	UKN02	Outer Belfast (Carrickfergus, Castlereagh, Lisburn, Newtownabbey & North Down)
		UKN03	East of Northern Ireland (Antrim, Ards, Ballymena, Banbridge, Craigavon, Down, Larne)
		UKN04	North of Northern Ireland (Ballymoney, Coleraine, Derry, Limavady, Moyle & Strabane)
		UKN05	West & South of Northern Ireland (Armagh, Cookstown, Dungannon, Fermanagh, Magherafelt, Newry & Mourne, Omagh)
	UKN0		Northern Ireland

## ANNEX 3

Table of impact categories and impact types for EDII impact entry.

Impact category	Impact type
1 Agriculture & livestock	1.1 Reduced productivity of annual crop cultivation: crop losses, damage to crop quality or crop failure due to dieback, premature ripening, drought-induced pest infestations or diseases etc.
	1.2 Reduced productivity of permanent crop cultivation
	1.3 Agricultural yield losses $\geq$ 30% of normal production (EU compensation threshold)
	1.4 Reduced availability of irrigation water
	1.5 Reduced productivity of livestock farming (e.g. reduced yields or quality of milk, reduced stock weights)
	1.6 Forced reduction of stock(early selling/slaughtering)
	1.7 Regional shortage of feed/water for livestock
	1.8 other
	1.9 Increased costs/economic losses
2 Forestry	2.1 Reduced tree growth and vitality
	2.2 Decrease in annual non-timber products from forest trees (e.g. cork, pine nuts, etc) (please specify which kind of product)
	2.3 Increased occurrence of water stress indicators and damage symptoms (e.g. premature ripening, seasoning checks, defoliation, worsened crown conditions etc.) (Please specify forest type/tree species in the description field)
	2.4 Increase of pest/disease attacks on trees (please specify species in the description field!)
	2.5 Increased dieback of trees (please specify tree species in the description field!)
	2.6 Increased dieback of planted tree seedlings (in nurseries or afforested area)
	2.7 Damage to short rotation forestry plantations (energy forestry)
	2.8 other
	2.9 Increased costs/economic losses
3 Freshwater aquaculture & fisheries	3.1 Reduced (freshwater) fishery production (please specify fish species in the description field)
	3.2 Reduced aquaculture production (please specify fish species in the description field)
	3.3 other
	3.4 Increased costs/economic losses
4 Energy & industry	4.1 Reduced hydropower production
	4.2 Impaired production/shut down of thermal/nuclear power plants (due to a lack of cooling water and/or environmental legislation for discharges into streams)
	4.3 Restriction/disruption of industrial production process (due to a lack of process water and/or environmental legislation/restrictions for discharges into streams)
	4.4 other
	4.5 Increased costs/economic losses
5 Waterborne transport	5.1 Impaired navigability of streams (reduction of load, increased need of interim storage of goods at ports)
	5.2 Stream closed for navigation
	5.3 other
	5.4 Increased costs/economic losses
6 Tourism & recreation	6.1 Reduced number of short-stay-tourists
	6.2 Reduced number of long-stay-tourists
	6.3 Sport/recreation facilities affected by a lack of water

		6.4	Impaired use/navigability of surface waters for water sport activities (including bans)
		6.5	other
		6.6	Increased costs/economic losses
7	Public water supply	7.1	Local water supply shortage / problems (drying up of springs/wells, reservoirs, streams)
		7.2	Regional/region-wide water supply shortage/problems (drying up of springs/wells, reservoirs, streams)
		7.3	Bans on domestic and public water use (e.g. car washing, watering the lawn/garden, irrigation of sport fields, filling of swimming pools )
		7.4	Limitations in water supply to households in rural areas (supply cuts, need to ensure water supply by emergency actions)
		7.5	Limitations in water supply to households in urban areas (supply cuts, need to ensure water supply by emergency actions)
		7.6	other
		7.7	Increased costs/economic losses
8	Water quality	8.1	Increased temperature in surface waters (close to or exceeding critical values)
		8.2	(Temporary) water quality deterioration/problems of surface waters( natural & manmade); e.g. significant change of physio-chemical indicators, increased concentrations of pollutants, decreased oxygen saturation levels, eutrophication, algal bloom)
		8.3	(Temporary) impairment of ecological status of surface waters (according to EU Water Framework Directive)
		8.4	(Temporary) impairment of chemical status of surface waters (according to EU Water Framework Directive)
		8.5	Increased salinity of surface waters (saltwater intrusion and estuarine effects)
		8.6	Problems with groundwater quality
		8.7	Increased salinity of groundwater
		8.8	Problems with drinking water quality (e.g., increased treatment, violation of standards)
		8.9	Problems with bathing water quality
		8.10	Problems with irrigation water quality
		8.11	Problems with water quality for use in industrial production processes
		8.12	other
		8.13	Increased costs/economic losses
9	Freshwater ecosystems: Habitats, plants & wildlife	9.1	Increased mortality of aquatic species (specify species (latin term) and state whether a rare/endangered/protected species is concerned in the description field)
		9.2	Increased species concentration near water
		9.3	Migration and concentration (loss of wildlife in some areas and too many in others)
		9.4	Increased populations of invasive (exotic) aquatic species
		9.5	Observation of adverse impacts on populations of rare/endangered (protected) riparian species
		9.6	Observation of adverse impacts on populations of rare/endangered (protected) species of wetlands
		9.7	Loss of biodiversity (decrease in species diversity)
		9.8	Danger for or actual violation of minimum flow or environmental flow requirements
		9.9	Drying up of shallow water areas, weed growth or algae bloom
		9.10	Drying up of perennial stream sections
		9.11	Drying up of lakes and reservoirs (which have a habitat function)
		9.12	(Mid-/Long-term) deterioration of wetlands
		9.13	Irreversible deterioration/loss of wetlands
		9.14	other
		9.15	Increased costs/economic losses

<b>10</b>	Terrestrial ecosystems: Habitats, plants & wildlife	10.1	Increased species mortality (specify species (latin term) and state whether a rare/endangered/protected species is concerned)
		10.2	Changes in species biology/ecology
		10.3	Loss of biodiversity (decrease in species diversity)
		10.4	Shift in species composition
		10.5	Reduced plant growth
		10.6	(Mid-/Long-term) deterioration of habitats
		10.7	Irreversible deterioration/loss of habitats
		10.8	Lack of feed/water for terrestrial wildlife
		10.9	Increased attacks of pests and diseases
		10.10	Increased contact of wild animals under stress (shortage/lack of feed and water) with humans/human settlements
		10.11	other
		10.12	Increased costs/economic losses
<b>11</b>	Soil system	11.1	Drought-related erosion processes (loss of soil fertility)
		11.2	Structural damage to private property due to soil subsidence/shrinkage
		11.3	Structural damages on infrastructures due to soil subsidence/shrinkage
		11.4	other
		11.5	Increased costs/economic losses
<b>12</b>	Wildfires	12.1	Increased burned area
		12.2	Increased number of wildfires
		12.3	Increased severity of wildfires
		12.5	Increased costs/economic losses
		12.6	other
<b>13</b>	Air quality	13.1	Air quality pollution effects/problems (dust bowl effect, wildfires, substitution of hydropower production by fossil energy)
		13.2	other
		13.3	Increased costs/economic losses
<b>14</b>	Human health & public safety	14.1	Heat stress problems (if drought is associated with a heatwave)
		14.2	Increased respiratory ailments (heat wave and air quality)
		14.3	Excess mortality during heat waves
		14.4	Drought induced public-safety issues (e.g. increased risk of structural damages)
		14.5	other
		14.6	Increased costs/economic losses
<b>15</b>	Conflicts	15.1	Water allocation conflicts - international
		15.2	Regional/local user conflicts
		15.3	other
		15.4	Increased costs/economic losses