

# Catchment Management Modelling Platform

Bridget Emmett

Centre for Ecology and Hydrology

Project Lead

# Project aims



- Enable better access to data and modelling for catchment management
- Develop more integrated modelling to deliver holistic solutions for multiple pollutants, services & policies
- Community building to develop questions and encourage joint working



©Shutterstock

UKWP report on 'Agriculture's Impact on Water Quality'

# Project aims

- Enable better access to data and modelling for catchment management
- Develop more integrated modelling to deliver holistic solutions for multiple pollutants, services & policies 
- Community building to develop questions and encourage joint working 

*UKWP Report Key finding 2: We need unified predictive models encompassing all key aspects of agriculture and water management that inform future policy and commercial interests.*

*UKWP Report Key finding 7: We need greater collaboration between researchers, industry and policy makers with the necessary framework to deliver effective joint working.*

UKWP report on 'Agriculture's Impact on Water Quality'

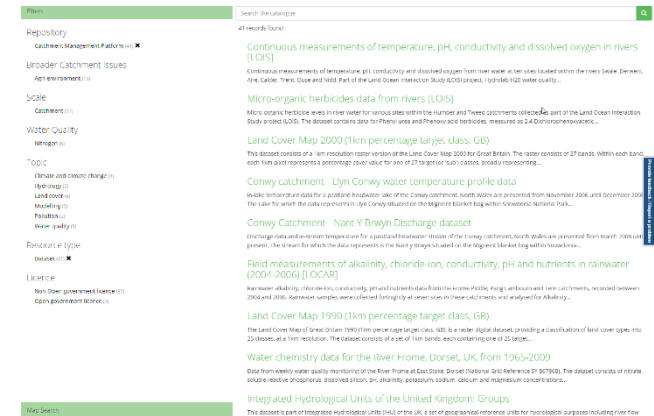
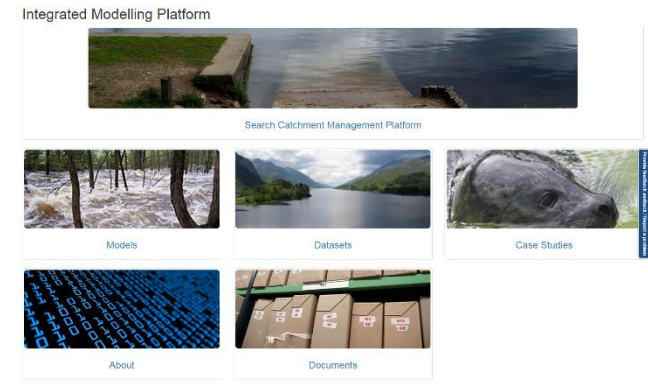


ATKINS



# What will the project deliver?

- A web-based platform for catchment management
- Case studies to identify key data and models as defined by users and benefits of model coupling
- Standards to facilitate model coupling
- Model selection tool
- Signposting and access to the key datasets
- Input and output library from Case Studies to enable re-use





# A user led Project:

## *The Community Forum*

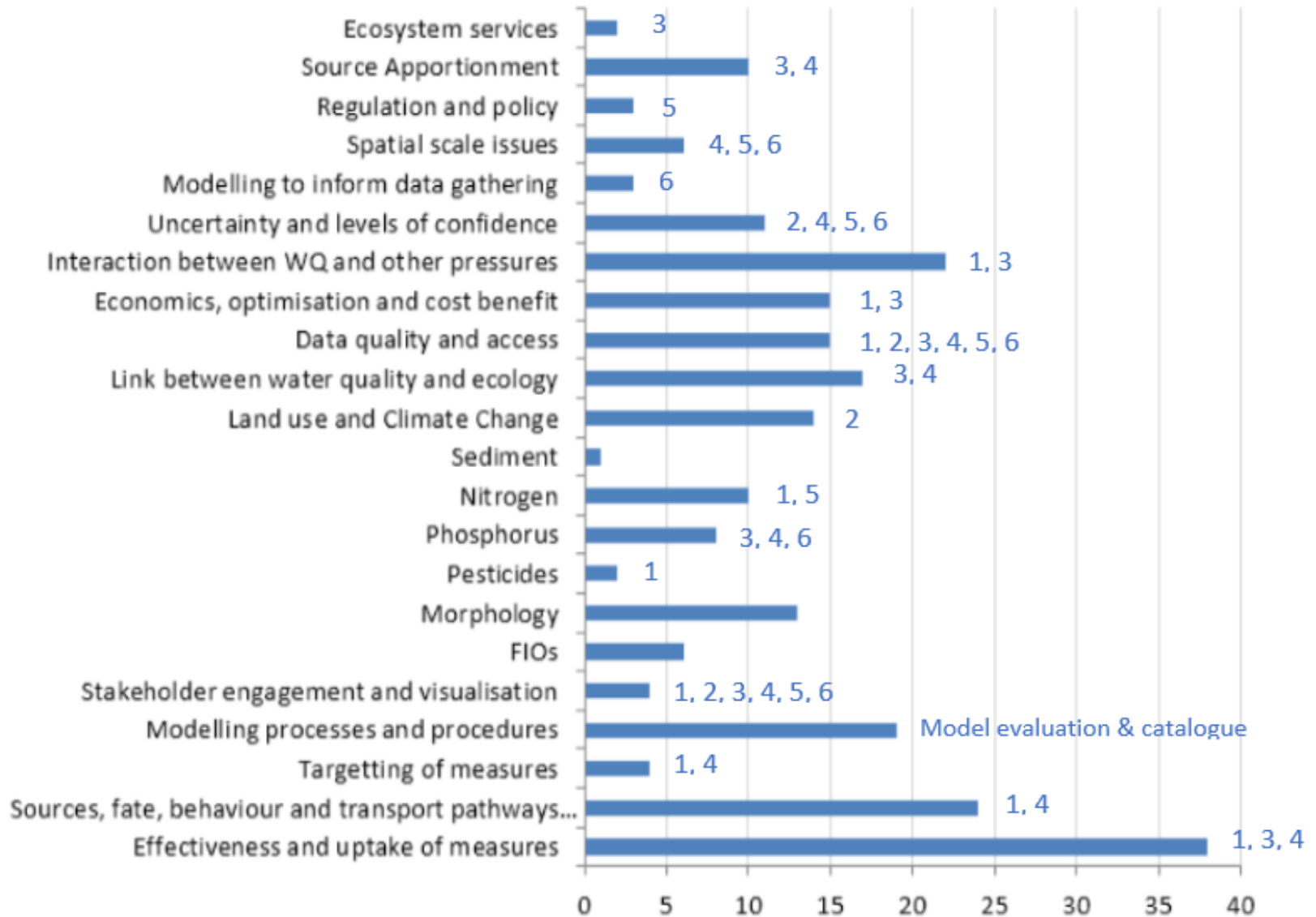
- Community Forum No. 1
  - More than 280 questions identified in the first Forum and 1:1 phone interviews from > 40 organisations
- Community Forum No. 2
  - Developed 7 case studies to cover:
    - As many of these issues as possible
    - Other issues specified by the funders
- Community Forum No. 3
  - Feedback on the Platform
    - Function / content
    - Look and feel





# 280 questions from 40 organisations summarised into 22 issues.

## Many captured in our 7 case studies



# + questions/issues from the funders

- Actions/interventions limited to those carried out for water quality
  - But to include models and tools to explore impacts on wider ecosystem services (GHG, biodiversity, cultural etc)
- The project funders also asked for Case Studies to cover the following:
  - Scale
  - Effectiveness of measures
  - Multiple pollutants
  - Interpolation from catchment to national and monitored to unmonitored sites
  - Performance of catchments under future climate change
  - Cost –effectiveness of measures
  - Apportionment

Uncertainty and ensemble approaches

# Case Studies

1. What are the multiple pollutant and ecosystem services responses to agri environment interventions at the farm to catchment scale.
2. And then at the national scale?
3. What are the costs and benefits of mitigation measures to reduce multi-pollutants upstream of intakes.
4. Will the effectiveness of pollution control measures continue under scenarios of future climate and land cover change at the catchment scale

# Case studies (cont.)

5. What is the uncertainty in ecological responses to water quality control measures at the river basin scale.
6. How does input data quality affect evaluations of interventions at catchment to national scales.
7. How can we interpolate from highly monitored to non-monitored catchments?



# Models and data used to deliver Case Studies and available on the Platform

## Models

- SAGIS
- FARMSCOOPER
- QUESTOR
- INCA N and P
- LUCI ecosystem services

## Community fund

- SWAT (Metaldehyde)
- INCA-FIO
- SEPARATE

## Data

- Landcover 1km
- Catchment boundaries
- River Flow data
- Diffuse pollution source inputs
- Harmonised world soil database / NSI Scotland
- DTMs
- .....etc

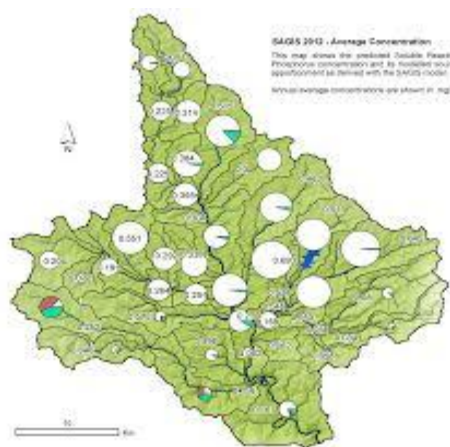
# Data catalogue: contents

Datasets used by models (SAGIS, Farmscoper, INCA, LUCI, QUESTOR, ...)

Key national scale datasets imported (Land Cover Map, Soils, Hydro-met variables)

Monitoring data: national (NRFA, WIMS, NWIS), and catchment (DTC, Avon, Tarland, Thames, Conwy, LOCAR, etc.)

Land Use and Farm Practice information

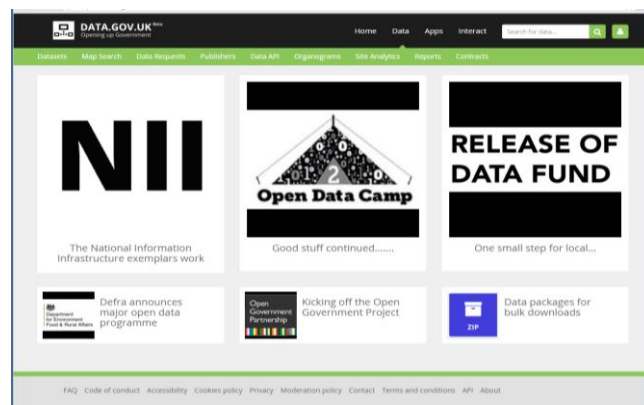
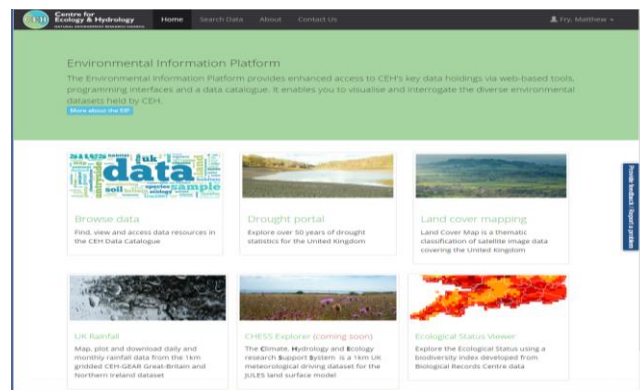


# Datasets: different approaches

Datasets from existing catalogues  
(CEH EIP, data.gov.uk, JHI)

New metadata records to describe  
existing online resources (Scottish  
soils data, EDINA, Defra Farm  
Practice data)

New metadata where data is  
currently unavailable on the web  
(e.g. EA WIMS, IACS)



# Homepage

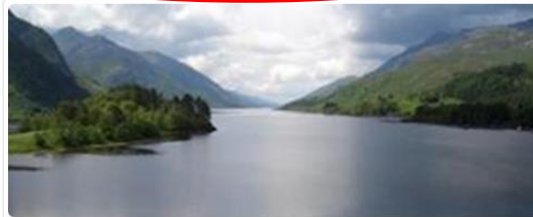
## Integrated Modelling Platform



[Search Catchment Management Platform](#)



[Models](#)



[Datasets](#)



[Case Studies](#)

Provide feedback / Report a problem



[About](#)



[Documents](#)

# Search/Model Selection Tool

## Broader Catchment Issues

- Agri-environment
- Biodiversity
- Ecological Response
- Ecosystem Services
- Greenhouse Gas Emissions
- Pollution Source Attribution

## Scale

- National
- Catchment

## Water Quality

- Nitrogen
- Phosphorous
- FIO
- Metaldehyde
- Sediment

Models

Datasets

Case Studies

[Provide feedback / Report a problem](#)



# Model Selection Tool - 2

## Dataset

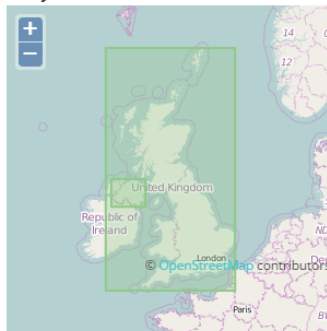
### Meteorological Office Rainfall and Evaporation Calculation System (MORECS version 2.0) - Draft

Monthly evaporation and soil moisture deficit for the UK calculated by MO using meteorological observations. The data is output as monthly averages over a 40 x 40 km grid and dates back to January 1961.

( created 1995-12-31 )

## Where/When

### Study area



### Temporal extent

1961-01-01 to present

## Online Resources

### Data journal paper

Hough, M. N. and Jones, R. J. A.: The United Kingdom Meteorological Office rainfall and evaporation calculation system: MORECS version 2.0-an overview, *Hydrol. Earth Syst. Sci.*, 1, 227-239, doi:10.5194/hess-1-227-1997, 1997.

## Quality

### Lineage

MORECS evapotranspiration and soil moisture deficit is calculated from daily values of hours of sunshine, air temperature, vapour pressure, wind speed and rainfall. For further details see Hough and Jones (1997).

### Get the data

Format of the data: Oracle

### Terms and Conditions apply

Please include the following acknowledgement where the data is reproduced - © Crown copyright [followed by year of first publication], the Met Office

### Models

INCA-N



# Model Selection Tool - 3

The screenshot shows a web browser window displaying the Model Selection Tool. The browser's address bar shows the URL <https://gateway-staging.ceh.ac.uk/apps/dimp/search.html>. The page header includes the Centre for Ecology & Hydrology logo and the text "NATURAL ENVIRONMENT RESEARCH COUNCIL". A "beta" badge and a user profile "Brown, Mike" are also visible.

The main content area is divided into three sections:

- Models:** A single card titled "LUCI" is displayed.
- Datasets:** A single card titled "Major ion and nutrient data from rivers [LOIS]" is displayed.
- Case Studies:** Four cards are displayed, each with a thumbnail image and a title:
  - Case Study One:** Multiple pollutant and ecosystem services responses to land management policies and agri-environment interventions at the farm.
  - Case Study Two:** Effectiveness of land management policies and agri-environment interventions for reducing pollutant loads and maintaining environmental.
  - Case Study Four:** Effectiveness of pollution control measures under scenarios of future climate and land cover change at the catchment scale.
  - Case Study Six:** Effects of input data quality and quantity on evaluation of land management policies and agri-environment interventions at.

A vertical sidebar on the left contains navigation options under three main categories:

- Broader Catchment Issues:** Agri-environment, Biodiversity, Ecological Response, Ecosystem Services, Greenhouse Gas Emissions, Pollution Source Attribution.
- Scale:** National, Catchment.
- Water Quality:** Nitrogen, Phosphorus, FIO, Metaldehyde, Sediment.

A vertical button on the right side of the page reads "Provide feedback / Report a problem".

# Homepage

## Integrated Modelling Platform



[Search Catchment Management Platform](#)



[Models](#)



[Datasets](#)



[Case Studies](#)

[Provide feedback / Report a problem](#)



[About](#)



[Documents](#)

# Model Catalogue

Filters

Search the catalogue



13 records found

Repository

Catchment Management Platform (13) ✕

Broader Catchment Issues

Scale

Water Quality

Topic

Resource type

Model (13) ✕

Licence

## MAGIC

Soil and Water acidification

## Kennet Model

Instream sediment, P, and macrophyte dynamics

## STREAM\_N

Catchment scale N

## INCA-N

INCA-N is a processed based dynamic model representation of plant/soil system nitrogen dynamics and instream biogeochemical and hydrological dynamics. It is spatially semi-distributed.

## SCAIL

Air quality impact tool as part of Aermod

## JULES

Land atmosphere model (water, energy and C including ANPP)

## Farmscoper - Cost

Agricultural mitigation cost assessment tool

## PLUS

Standing water body P

## QUESTOR

In stream water quality model

## SAGIS

River & lakes water quality model

## NIRAMS\_II

National scale N

Provide feedback / Report a problem

# Model Catalogue & Application

## Model Application

### Effectiveness of pollution control measures under scenarios of future climate and land cover change at the catchment scale

Within this application, the aim was to explore whether measures selected to improve the chemical status of the Tarland Burn are 'future proof', i.e. whether measures implemented to lower stream water suspended sediment, total phosphorus, total dissolved phosphorus and nitrate concentrations today will still improve the water quality in the 2050s, based on integrated climate projections and land use change scenarios.

To do this, the daily response of three pollutants (suspended sediment, phosphorus as total phosphorus and total dissolved phosphorus, and nitrate) has been assessed for a baseline (1981-2010) period and compared to model-based projections of the effects of measures (fertiliser application reduction, reduced final effluent concentrations), climate and land cover change, climate and land cover change plus a selection of effective measures. In addition, the models are used to explore potential time lags between the introduction of a measure and catchment response.

<b>Date</b>	16/06/2015
<b>Study Site</b>	Upper Tarland Burn catchment, a sub-catchment of the River Dee, Aberdeenshire
<b>Objective</b>	Investigate the effectiveness of measures to improve water quality in the Tarland Burn, given future projections of climate and land cover change.
<b>Funder Details</b>	Defra
<b>Modeller</b>	Leah Jackson-Blake, James Hutton Institute

#### Datasets

[Land Cover Map 2007](#)  
[EU ENSEMBLES datasets](#)  
[Tarland catchment monitoring data](#)

#### Model

[INCA-N](#)

## Input Data

- Met data: Met Office 5km gridded data for the baseline. For the future, scenarios from the EU ENSEMBLES project
- Data for calibration and validation: James Hutton Institute monitoring data, including discharge and chemistry data
- Land use data: baseline data from LCM07. Future scenarios of land use generated by the James Hutton Institute
- Fertilizer and manure inputs: British Survey of Fertilizer Practice
- Large number of additional parameters: expert-based or literature searches



# Homepage

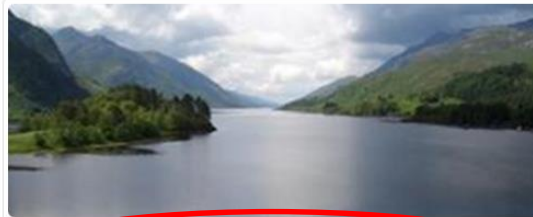
## Integrated Modelling Platform



[Search Catchment Management Platform](#)



[Models](#)



[Datasets](#)



[Case Studies](#)

Provide feedback / Report a problem



[About](#)



[Documents](#)

# Data Catalogue

## Repository

Catchment Management Platform (6) ✕

## Broader Catchment Issues

## Scale

Catchment (6)

## Water Quality

Nitrogen (6) ✕

## Topic

Water quality (3)

## Resource type

Dataset (6) ✕

## Licence

Non-Open government licence (6)

6 records found

### Field measurements of alkalinity, chloride-ion, conductivity, pH and nutrients in rainwater (2004-2006) [LOCAR]

Rainwater alkalinity, chloride-ion, conductivity, pH and nutrients data from the Frome Piddle; Pang Lambourn and Tern catchments, recorded between 2004 and 2006. Rainwater samples were collected fortnightly at seven sites in these catchments and analysed for Alkalinity...

### Water chemistry data for the River Frome, Dorset, UK, from 1965-2009

Data from weekly water quality monitoring of the River Frome at East Stoke, Dorset (National Grid Reference SY 867868). The dataset consists of nitrate, soluble reactive phosphorus, dissolved silicon, pH, alkalinity, potassium, sodium, calcium and magnesium concentrations...

### Conwy catchment - spatial water chemistry dataset

Surface water quality data for the Conwy catchment, North Wales are presented. The data cover stream and estuary survey locations sampled manually from 2007 to 2011 at varying intervals between fortnightly and quarterly. Survey locations were selected as draining the...

### High resolution nutrient chemistry of the River Frome, Dorset, UK (2004-2006)

This data resource consists of a nutrient concentration time series for the River Frome at East Stoke, Dorset, gathered between January 2004 and February 2006. Total phosphorus concentration data was gathered for the full duration of the project. Soluble reactive phosphorus...

### Major ion and nutrient data from rivers [LOIS]

Discrete data for major ions and nutrients in river water for 13 sites in the Humber catchment over the periods 1993 to 1997 and 1996 to 1997 and for 3 sites from the Tweed catchment over the period 1994 to 1997. Ions and nutrients measured were: Ammonia, Calcium (dissolved),...

### Field measurements of alkalinity, chloride-ion, conductivity, pH and nutrients in rivers (2003-2006) [LOCAR]

River water alkalinity, chloride-ion, conductivity, pH and nutrients data from the Frome Piddle; Pang Lambourn and Tern catchments, recorded between 2003 and 2006. River water samples were collected fortnightly at twenty three sites within these catchments and analysed...



# Data catalogue: metadata

The screenshot shows a web page from the Centre for Ecology & Hydrology (CEH) with the following content:

- Header:** CEH logo, 'Centre for Ecology & Hydrology', 'NATURAL ENVIRONMENT RESEARCH COUNCIL', navigation links (Home, Search Data, Help), and user 'Fry, Matthew'.
- Dataset Title:** Environment Agency Water Quality Samples - Compliance Monitoring - Draft
- Description:** This is a dataset of all water quality sampling held by the Environment Agency. Water quality sampling is taken for the purpose of compliance monitoring for licences under Environmental Permit Regulations or other regulation. It is also taken in the course of investigations, routine sampling, or volunteered data from third parties. 'Water Quality Samples' hold the actual sampled result and do not show the compliance of a permit without further assessment and cross reference of the permit conditions. [Text from EA National Dataset List, November 2015].
- Data Source:** Data is taken from the EA WIMS (Water Information System) database. Water quality measurements from a number of different "material types": River, estuary, groundwater, canal, lake, sewage, etc. As of 2014 the dataset consists of >50 million values for >700 determinands from >3.5 million samples at >30000 sites across England.
- Where/When:** Section with a 'Study area' map of the United Kingdom and 'Temporal extent' from 1962-01-01 to present.
- Online Resources:** EA metadata record (Limited metadata on data.gov.uk for unpublished dataset).
- Quality:** Section header.
- Get the data:** Section with 'Format of the data: Tabulated text formats' and a detailed paragraph: 'Data available under licence on request from the Environment Agency, by region for a given date range and list of determinands. Exceptionally, the Environment Agency may exclude individual samples or determinands from this dataset if there are compelling legal reasons to do so. Issues to Note - In general terms the areas that could conceivably give rise to a compelling legal or public policy reason include National Security Data protection Commercial Confidentiality the course of justice, the ability of a person to receive a fair trial or the ability of a public authority to conduct an inquiry of a criminal or disciplinary nature if any third party alleges that there is a compelling legal or public policy reason to exclude particular data we will investigate [Text from EA National Dataset List, November 2015].'
- Manage Metadata:** Section header.
- Vertical Sidebar:** 'Provide feedback / Report a problem'.

Existing text

New text to provide better information

Information on access

# Data catalogue: metadata

Centre for Ecology & Hydrology  
NATURAL ENVIRONMENT RESEARCH COUNCIL

Home Search Data Help

Fry, Matthew

Temporal extent  
1962-01-01 to present

Online Resources

[EA metadata record](#)  
Limited metadata on data.gov.uk for unpublished dataset

Quality

**Lineage**  
This data is provided in calendar year cuts. Data on sampling site name, location and types are included for identification of sites and their type. Sample dates identify when the site was taken. Data on the purpose, determinand and sample material are provided in both code and descriptive formats The results are provided to the greatest resolution as stored in Environment Agency systems. There are instances where the result is greater or less than the limit of detection, these results are identified with greater or less than brackets. The limitation of this data is that there may be other information such as site visits and other monitoring information taken in to consideration when assessing compliance, this is not included in this dataset. [Text from EA National Dataset List, November 2015].

Data quality issues include inconsistencies in determinands, with numerous determinands used for similar measures, making retrieval of consistent information difficult.

Other contacts

**Custodian** [Environment Agency](#)

**Distributor** [Environment Agency](#)

Spatial

**Spatial representation type** textTable

**Spatial Reference System** OSGB 1936 / British National Grid

to do so. Issues to note – in general terms the areas that could conceivably give rise to a compelling legal or public policy reason include National Security Data protection Commercial Confidentiality the course of justice, the ability of a person to receive a fair trial or the ability of a public authority to conduct an inquiry of a criminal or disciplinary nature If any third party alleges that there is a compelling legal or public policy reason to exclude particular data we will investigate [Text from EA National Dataset List, November 2015].

Manage Metadata

[Edit...](#)

[Permissions...](#)

[Publish...](#)

Provide feedback / Report a problem

Links to other information on the web

Additional (subjective?) information on data quality

# Homepage

## Integrated Modelling Platform



[Search Catchment Management Platform](#)



[Models](#)



[Datasets](#)



[Case Studies](#)

Provide feedback / Report a problem



[About](#)



[Documents](#)



# 2 years into a 3 years project

- Identified data and model needs of Case Studies
- Captured these resources for the Platform including additional resources through an open call from the Community Fund
- Started model runs for the Case Studies
- Developed a model database and selection tool
- Undertaken a review of barriers and opportunities for model integration
- Scoped out design and functionality of the Platform and started testing with Users
- Platform launch data 31<sup>st</sup> March 2017



# Benefits to communities

- Practitioners
  - Access to data and practical models
  - Sharing of problems and solutions
  - Community to develop joint commissioning
  - More holistic solutions
- Academics
  - Better understanding of needs and timing of practitioners
  - Translation of science to practitioners
  - Access to data and models
  - Standards and protocols for coupling



Funding sought to enhance Platform;  
CEH/NERC to provide legacy as Platform host

Test benefits of model integration on outcomes

User input into platform design and functionality

Forum 3  
& UKWP

Select data, models and tools

funding  
pot

Data

Models

Tools

funding  
pot

Select case studies

Forum 2

What are the key questions?

Forum 1

# Breakout group questions

- Feedback on data catalogue, case studies and model selection tool
- Feedback on ‘look and feel’ of the platform
- Could and should this approach be extended to other aspects of water resources, and how?

# Questions?

# Case Studies matched to funders priorities

Funder issue	Case Study Number						
	1	2	3	4	5	6	7
Effectiveness of measures							
Performance of catchments under future climate change (and land management)							
Cost –effectiveness of measures							
Apportionment							
Uncertainty and data quantity and quality							
Interpolation from catchment to national and monitored to unmonitored sites							
Multiple Pollutants	Sediment; N; P; FIO; (biodiversity; carbon; flood mitigation)	N; P; FIO; agri-GHG	N; P; Metal-dehyde	Sediment; N; P	N; P	Based on Case Studies 1-5	To be agreed
Multiple scales	Catchment	National	River System	Catchment	River Basin	Catchment - National	Catchment – National