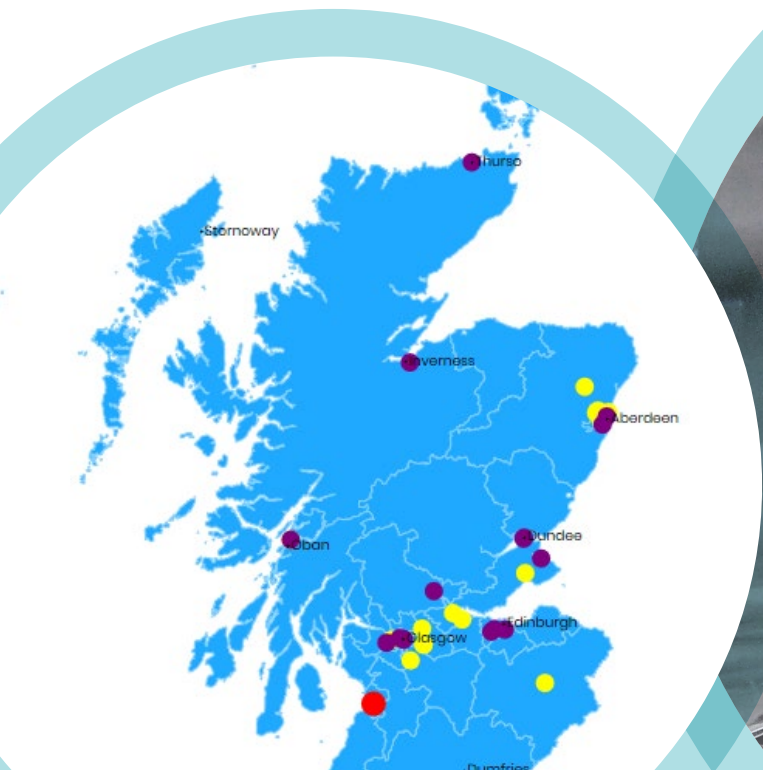
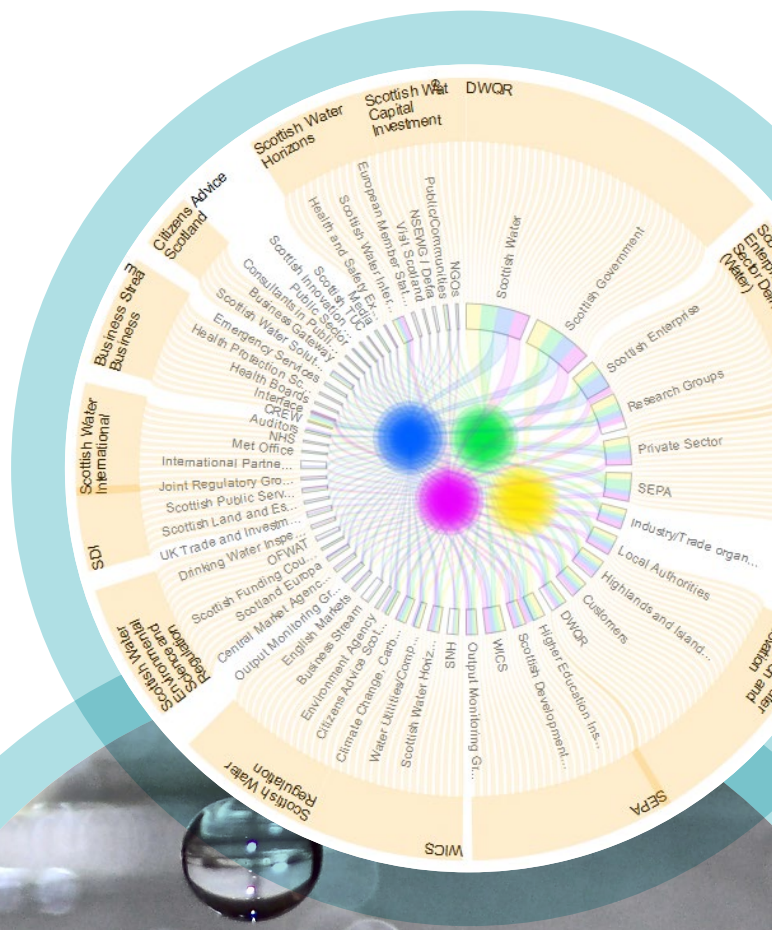




Scotland's centre of expertise for waters

Scotland's Water Sector Map: 2017





Published by CREW – Scotland's Centre of Expertise for Waters. CREW connects research and policy, delivering objective and robust research and expert opinion to support the development and implementation of water policy in Scotland. CREW is a partnership between the James Hutton Institute and all Scottish Higher Education Institutes supported by MASTS. The Centre is funded by the Scottish Government.

This document was produced by:
Urban Water Technology Centre
Abertay University
Bell Street, Dundee,
DD1 1HG

Please reference this report as follows: UWTC (2017), Scotland's Water Sector Map: 2017 Phase II, Available online at: crew.ac.uk/publications

Dissemination status: Unrestricted

Copyright: All rights reserved. No part of this publication may be reproduced, modified or stored in a retrieval system without the prior written permission of CREW management. While every effort is made to ensure that the information given here is accurate, no legal responsibility is accepted for any errors, omissions or misleading statements. All statements, views and opinions expressed in this paper are attributable to the author(s) who contribute to the activities of CREW and do not necessarily represent those of the host institutions or funders.

ISBN: 978-0-902701-52-6

Contents

EXECUTIVE SUMMARY	3
1.0 INTRODUCTION	4
2.0 REVIEW OF THE RESEARCH OBJECTIVES	4
3.0 METHODOLOGY	4
3.1 SCOPE AND SCALE	4
3.1.1 Update to existing layers:	4
3.1.1.1 Review of companies layer	4
3.1.1.2 Review of higher education institutions (HEI) layer	5
3.1.2 Addition of new layers	5
3.1.2.1 Specialist test facilities	5
3.1.2.2 Laboratory test facilities:	6
3.2 SECTOR INTERCONNECTIONS UPDATES.	6
4.0 KEY OUTPUTS	6
4.1 INTERACTIVE MAP: SCOPE AND SCALE OF THE WATER SECTOR	6
4.2 INTERACTIVE WHEEL: INTERCONNECTIONS IN THE WATER SECTOR	8
5.0 RECOMMENDATIONS FOR ONGOING MAINTENANCE AND UPDATING OF THE MAPS.	9
5.1 INTERACTIVE MAP: SCOPE AND SCALE DATA	9
5.2 INTERACTIVE WHEEL: SECTOR INTERCONNECTIONS	9
6.0 APPENDICES	11

Executive Summary

Background to research

In 2015, a review of Scotland's Water Sector was published by CREW in support of the Scottish Government's Hydro Nation Strategy. This work reported on the scope and the scale of Scotland's Water Sector, and how different parts of the sector link together using visual tools in the form of Scotland's Water Map (See: [Scotland's water sector](#)). In 2017, a review of this work was requested in order to update Scotland's Water Sector Map with new data, enhance functionality, and to expand the previous map to include testing and demonstration facilities in Scotland that may assist water-technology development and research.

Objectives of research

The specific objectives of the work were:

1. To review the first Scottish Water Sector report and provide updates where relevant
2. To expand and enhance the previous exercise to add a further layer to the map to include testing and demonstration facilities in Scotland that may be of benefit to water-technology developers and researchers
3. To illustrate these data and connections in the form of a map, or other appropriate visualisation, in line with that contained within the 2015 report.

Key findings and recommendations

An update to the 2015 "Scotland's Water Sector" interactive map was carried out. This review included an update to the data presented in the 2015 version, and the addition of new data layers. Reviewed and enhanced layers included the water sector Companies layer, and the Higher Education Institutions layer, for which the latter included a review of water sector related facilities and research and development services available. The addition of new layers included laboratories carrying out water analysis or monitoring (both public and private), and specialist facilities for testing, demonstration or provision of specialist expertise or services.

A review of interconnections within the sector was carried out based on the original methodology and interviews, with previous interviewees providing updated connections and scoring data where changes had occurred since the previous exercise. A revised scoring of influence across the key Hydro Nation themes was carried out and the interactive wheel was updated to reflect this.

A new landing page for access to the Interactive Map and Interaction Wheel was produced (<https://www.crew.ac.uk/watermap/>). The functionality and ability of users to interrogate data on the map has increased considerably, with the addition of new layers, user controls, and pop-up boxes for each data point providing additional data.

Key words

Scotland's Water Sector Map, Hydro Nation, Scope and Scale, Interconnections

1.0 INTRODUCTION

In 2015, a review of Scotland's Water Sector was published by CREW in support of the Scottish Government's Hydro Nation Strategy. This work reported on the scope and the scale of Scotland's Water Sector, and how different parts of the sector link together using visual tools in the form of Scotland's Water Map (See: [Scotland's water sector](#)). In 2017, a review of this work was requested in order to update Scotland's Water Sector Map with new data, enhance functionality, and to expand the previous map to include testing and demonstration facilities in Scotland that may assist water-technology development and research. The map is expected to support the Scottish Government's aim to make Scotland a 'Hydro Nation', where water resources are developed to maximise benefits to the Scottish economy.

2.0 REVIEW OF THE RESEARCH OBJECTIVES

The aim of this work was to review and update Scotland's Water Sector Map in order to allow developers, businesses, researchers and policy makers to understand the scope and scale of Scotland's water sector, and to better understand the connections between key actors across the sector.

The specific objectives of the work were:

1. To review the first Scottish Water Sector report and where relevant:
 - a. update information relating to the different parts of the Scottish water sector
 - b. collate information on each of these parts
 - c. demonstrate how these parts are linked to form the overall water sector
2. To expand and enhance the previous exercise to add a further layer to the map / report to include testing and demonstration facilities in Scotland that represent realistic deployment situations of benefit to water-technology developers and researchers.
3. To illustrate these data and connections in the form of a map, or other appropriate visualisation, in line with that contained within the 2015 report.

3.0 METHODOLOGY

In order to deliver the specific objectives of the work, the updates to the map and report included:

- a review of 'Scope and Scale' data, including the addition of new data layers
- a review of interconnections within the sector, based on the previous methodology and interviews
- an update to the visual presentation of the water sector map, including improved functionality.

3.1 Scope and scale (Interactive Map)

3.1.1 Update to existing layers:

An updated mapping platform was used for the 2017 map to improve visual appearance and user functionality. The source for the geographical data of the administrative regions used in the current update was downloaded from github (<https://github.com/martinjc/UK-GeoJSON>) in GeoJSON format. GeoJSON is a type of JSON file containing geographic data. In this case, it contains the shapes and locations of the regions of Scotland. This is loaded by the browser through the JavaScript D3 library (<https://d3js.org/>) and displayed as a scalable vector graphic (SVG). The fact that it is a vector image allows for the sharp picture that can be scaled without reduction of image quality.

The 2015 version of the map presented two layers of data: 'Companies' and 'Higher Education Institutions'. These were updated for the 2017 map as follows:

3.1.1.1 Review of companies layer

The following information was reviewed for the 2017 update of companies included in the original scope and scale map:

- a. All previous entries were reviewed and any companies found to be dissolved or in administration according to the Companies House register were removed from the list.
 - b. A list of current contractors for Scottish Water was reviewed, and new businesses added to the database where relevant. Businesses operating in Scotland but without a physical presence (head office or branch location) were excluded. (*Note: Companies found to be providing business services (e.g. hospitality, cleaning, insurance) or generic products or services (e.g. generic plant hire, supply of laboratory consumables) to Scottish*

Water had been included in the previous map, however these were excluded from the 2017 database. This was agreed to provide a more representative collection of businesses specifically working in the water sector.)

- c. The Hydro Nation Water Innovation Service (HNWIS) business database was reviewed and any companies not already identified were checked for relevance and added to the mapping database where appropriate.
- d. A review of publically available industry body member lists was carried out to identify new businesses added since 2015 (e.g. WIRS, CIWEM, WIF, ACE, British Water, CECA Scotland).

Information collected about each company followed the same format as used in the previous mapping exercise, such as company size (SME or Non-SME), company locations and type (head office or branches - all branch locations were noted in the database), and general business category. This information was sourced from a combination of Company House data, and company websites. Location data was recorded as company postcode, which was converted to latitude/longitude coordinates for mapping (<https://gridreferencefinder.com/postcodeBatchConverter/>). Trading addresses were used as opposed to registered addresses wherever possible.

Companies were assigned to five general categories, with some companies being classified under more than one category, particularly larger firms. These categories were based on the groupings used in the previous mapping exercise. Some consideration was given to whether new or amended categories would be appropriate for the 2017 update. For example, company SIC codes were reviewed, but due to the extensive range of codes and poor alignment between similar companies, SIC codes were deemed to be unsuitable for the purposes of the mapping exercise. In addition, a review of Scottish Enterprise (SE) company categories was also carried out in an attempt to link the categories as closely as possible. Generally, there was good alignment of categories, however not all categorisations

mapped directly, with some additional categories used by SE that were not applied to the current map. The final set of company categories are listed in Table 1 with examples of the types of companies included. This reduced number was seen to provide a simple and easy to understand set of descriptors for map users.

3.1.1.2 Review of higher education institutions layer

A layer of higher education institutions (HEIs) with water sector relevant expertise was included in the previous version of Scotland's Water Sector Map. The 2017 update has maintained this layer, with improved functionality and additional information. A review of relevant test facilities and specialist services provided by the HEIs was carried out using a combination of internet searches and telephone discussions with key experts in various institutions. Links to research and innovation services and water-sector-relevant specialist facilities and services presented on HEI websites were reviewed and included as additional information for each HEI map point where available.

3.1.2 Addition of new layers

3.1.2.1 Specialist test facilities

The UK Water Partnership facilities register (<https://theukwaterpartnership.org/facilities-register/>) was proposed as a model to update information on specialist facilities and test centres. The facilities register displayed only two sites in Scotland (Gorthleck and Bo'ness) and work was undertaken to identify if other sites were available. The review of facilities was undertaken by way of telephone or in-person interviews with key stakeholders, in combination with a web search for possible facilities. The detail on the existing facilities sites was updated using information gathered from Scottish Water Horizons. The layer excluded HEI test sites, which are presented in the updated HEI layer.

Table 1 Company Categories: Scotland's Water Sector Map

Category	Example activities
Operations and Maintenance	Operational controls Electrical and data communications Cleaning and tankering Repair and maintenance Cost (£ t ⁻¹)
Construction and Engineering	Project management Construction of water or wastewater projects, drainage, flood prevention and SuDS schemes Civil engineering works Engineering consultancy – design and planning
Scientific consultancy	Scientific consultancy (Water testing, monitoring, ecological testing, EIA, drinking water or wastewater treatment process optimisation)
Water and wastewater treatment	Providers of water and wastewater treatment products, technology and specialist expertise
Supplier of materials or equipment	Supply of water treatment materials, chemicals, pipes, dosing systems, filtration systems

3.1.2.2 Laboratory test facilities:

A review of all UKAS accredited analytical laboratories in Scotland was carried out to identify the scope of water related analysis and the location of labs in Scotland. This review included public and private laboratories. Data was collected on general capabilities, such as type of testing (chemistry/microbiology/field monitoring) and scope (drinking water/fresh water/marine). Additional information was gathered through telephone interviews with Scottish Water Commercial Services, SEPA Commercial Services, Scottish Public Analysts and James Hutton Ltd to identify the range of additional services or test facilities available across Scotland.

3.2 Sector interconnections updates

In the previous interconnections mapping exercise, interviews were carried out with key stakeholders, mapping the interconnection of representative groups across Scotland's water sector. These interconnections were scored for their relative importance to key Hydro Nation themes of Governance & International Development, Environmental Protection, Economic Opportunities, and Research and Development. This information was used to produce an Interactive Wheel, allowing users to interrogate how various groups interact, and the relative importance of those interactions across the water sector.

A review was carried out to identify whether the primary interconnections mapped in 2015 were still relevant in 2017, and whether new organisations should be added to the map. All stakeholders interviewed in 2015 were reissued with their original interconnections map and scoring for review. Stakeholders were asked to return these maps with changes, deletions and additions. Where required, changes were discussed over the telephone, and updates made. Coded data was updated with new connections and scores as required, and connections that were no longer relevant were removed.

4.0 KEY OUTPUTS

A new landing page for access to the Interactive Map and Interaction Wheel was produced (Figure 1. <https://www.crew.ac.uk/watermap/>). The landing page provides general information about each of the visualisations, and links to the interactive tools.

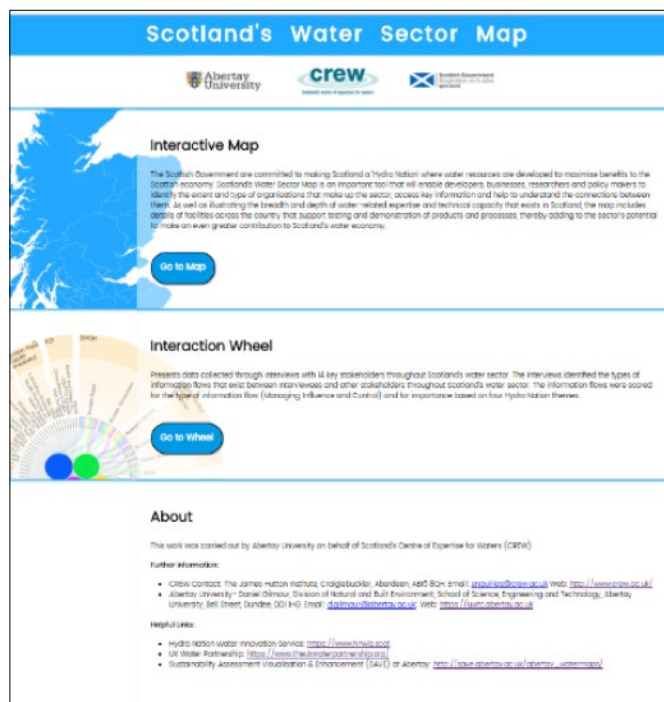


Figure 1 Scotland's Water Sector Map - landing page

4.1 Interactive Map: Scope and scale of the water sector

In carrying out the review of businesses operating in the water sector, a revised methodology was used as discussed in Section 3. Some caution must be used therefore in comparing 2015 and 2017 data. A comparison of the business data collected in 2015 and 2017 is provided in Table 2.

Table 2 Number of identified businesses working in Scotland's water sector 2015 and 2017. (Note: due to some businesses being assigned to more than one business category, the sum of categories is greater than the total number of businesses.)

	2015	2017
Total (excl. Business services, and non-water sector contractors for SW)	403	491
	Number of business locations	
O&M	70	119
Supplier	54	87
Consultants	83	141
Construction and Engineering	227	243
Water and Wastewater treatment	64	98
Scottish head offices	207	278
Of these, SMEs	187	242

The updated scope and scale map provides new layers as outlined in Section 3. In addition to new data, improvements to visual appearance, usability, and extractable information has improved considerably from the previous version. Figures 2 through 5 present the outputs of various layers.

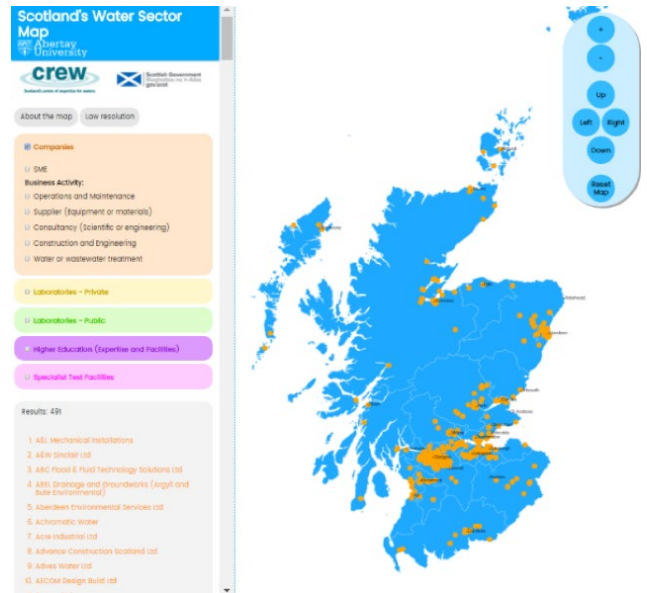


Figure 2 Scotland's Water Sector Map showing "Companies" as the active layer

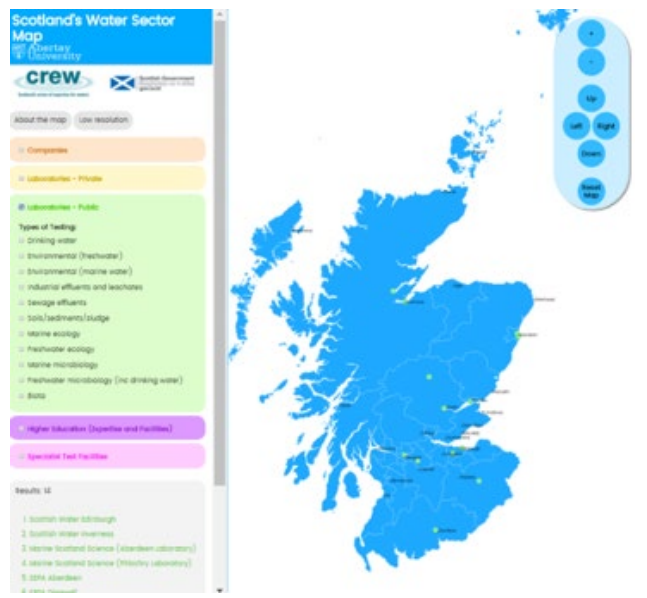
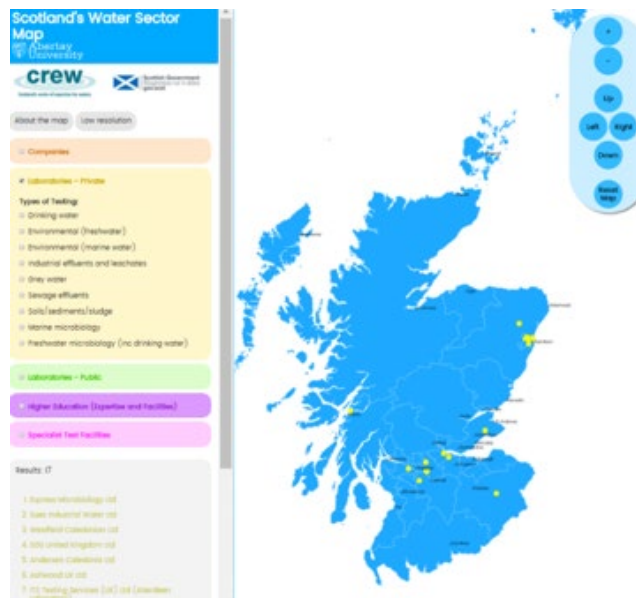


Figure 3 Scotland's Water Sector Map showing analytical Laboratories Private (Left) and Public (Right) as active layers

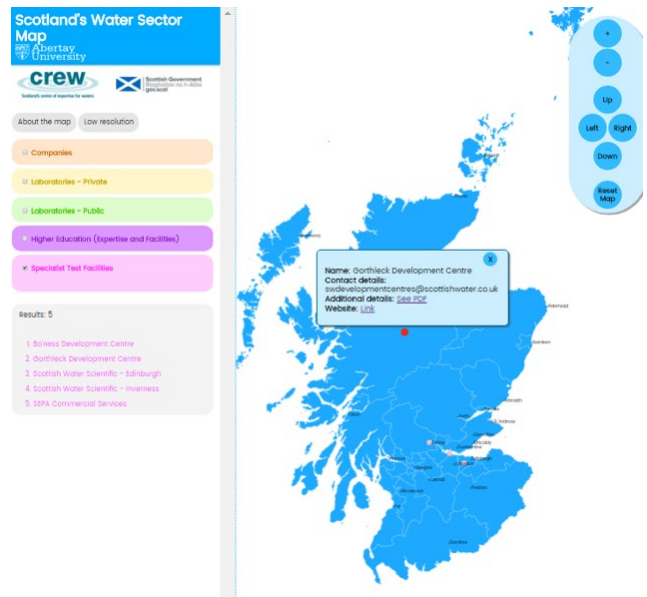
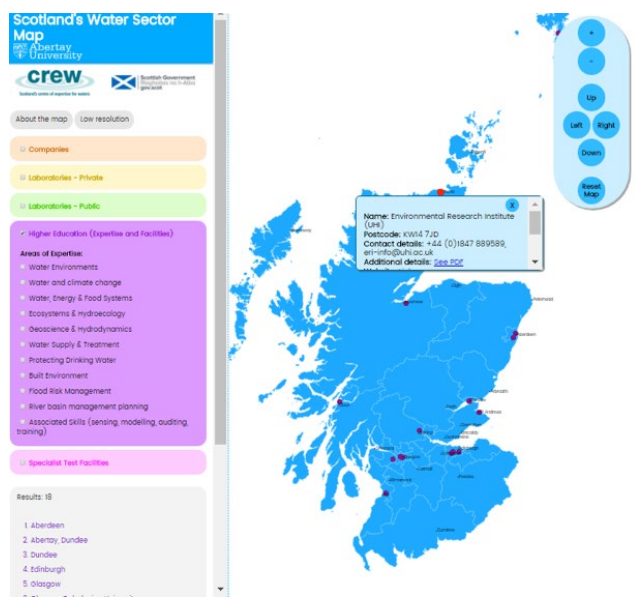


Figure 4 Scotland's Water Map showing Higher Education (Expertise and Facilities) as the active layer. A pop up box for each data point provides additional details, and links to relevant information

Figure 5 Scotland's Water Map showing Specialist Test Facilities as the active layer. A pop up box for each data point provides additional details, and links to relevant information

4.2 Interactive Wheel: Interconnections in the water sector

Some changes were noted in the interconnections between water sector actors in Scotland since the previous mapping exercise. There has been some reduction/streamlining in the number of connections for some interviewees. The prominence of the Hydro Nation Water Innovation Services, which was newly formed during the first mapping exercise, has increased in the 2017 update. In addition, the connection amongst the Innovation Centres in Scotland has been noted (e.g. Industrial Biotechnology Innovation Centre (IBioIC), Construction Innovation Centre (CIC)). Research groups such as CREW and Interface have also been included as individual entities, whereas in the previous map these were included in the general category of "Research groups". The prominence of Citizens Advice Scotland (CAS) has increased, taking into account the move of Consumer Futures activities to CAS. In addition, the Customer Forum was removed from the interconnections map, as despite being an important feature in the 2015 mapping exercise, the activities of the Customer Forum have now completed for the current cycle. Figure 6 shows the water sector Interaction Wheel, which shows the key groups interacting in the sector and their relative influence on key water sector themes.

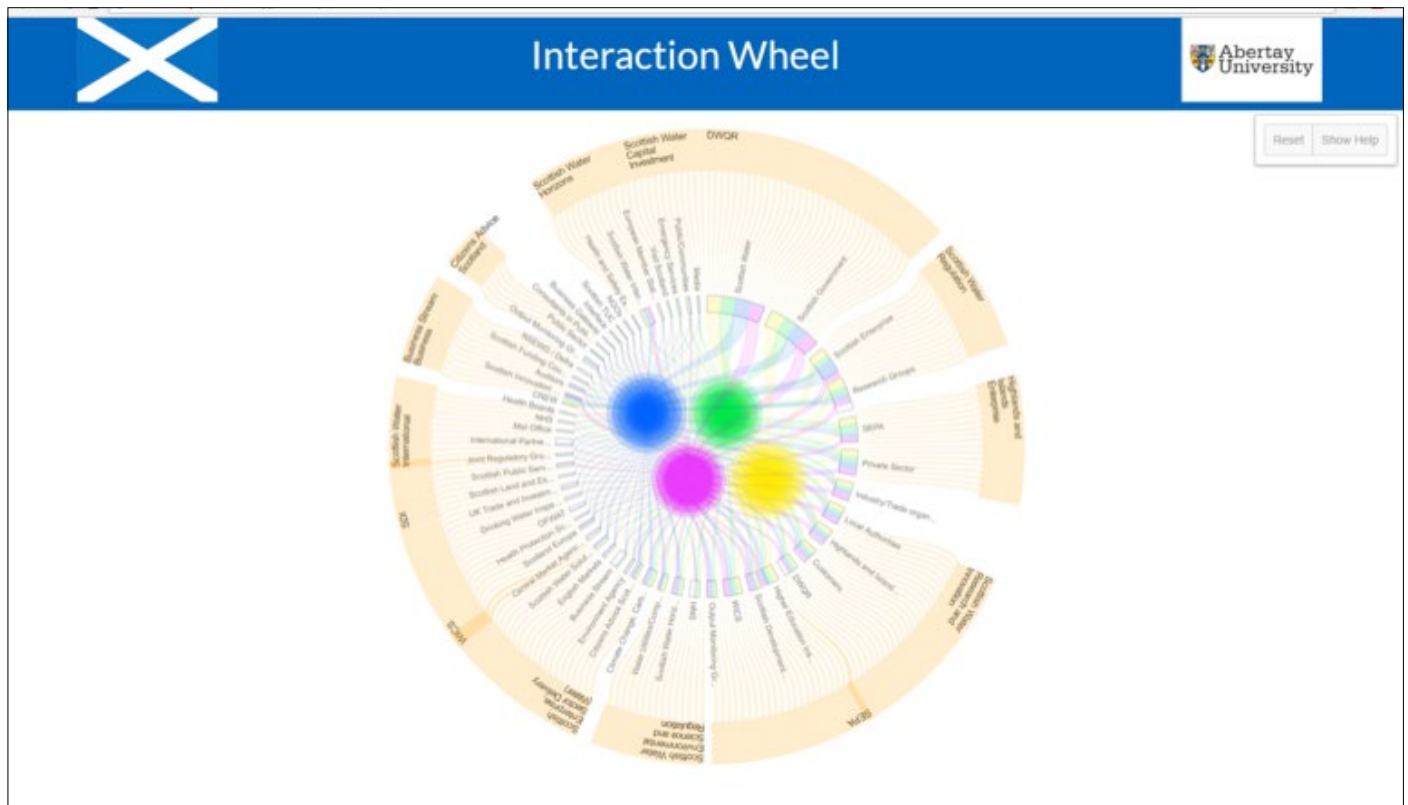


Figure 6 Interaction Wheel showing number of connections and relative thematic influence of various groups across Scotland's water sector

5.0 RECOMMENDATIONS FOR ONGOING MAINTENANCE AND UPDATING OF THE MAPS

It is recommended that a permanent host for Scotland's Water Sector Map be established to ensure data integrity and continuity. It is recommended that an annual review of map functionality is carried out (e.g. check for broken links, contact details), and a bi-annual review of map data is carried out to update data layers. In order to carry out the bi-annual updates, recommendations are made for both the Interactive Map and the Interactive Wheel.

5.1 Interactive Map: Scope and Scale Data

The existing mapping platform recognises data contained in a series of .csv files, with specified column names. These files contain the data point ID along with geographical data, tags, and additional information specific to the layer that appears in pop-up boxes on the map. In order to update this data, column headings should remain consistent. Rows can be deleted or added as required, maintaining the format as laid out in the master .csv files. The .csv files can be found within the file directory of the web app with detailed information on how to update them with new data provided in a READ_ME file and developers guide provided with this report. Guidance for data review for each layer is as follow:

- A. Review of company database (COMPANIES.csv)
 - Confirmation of existing businesses, and updates to size, location, business activity. This information can be obtained from Companies House, alongside business website information.
 - Addition of new businesses by cross referencing the existing list with Scottish Water contractors, industry body member lists, SE/HIE water sector business lists
- B. Review of laboratory capabilities (LABORATORIES_PRIVATE.csv; LABORATORIES_PUBLIC.csv)
 - Confirmation and update of laboratory capabilities and locations by reference to UKAS accreditation schedules
 - Addition of new laboratory capabilities by search of UKAS accredited labs in Scotland, and general internet search
- C. Review of HEI expertise and available facilities (HIGHER_EDUCATION.csv)
 - Confirmation of available facilities and contact details provided on University websites.
 - More detailed review on a less frequent basis of in-house expertise and review of publically available staff directories at HEIs to identify areas of expertise.
- D. Review of specialist facilities (ADDITIONAL.csv)

- Communication with key stakeholders to identify changes to sites or location of new sites. These will include stakeholders in:
 - o Hydro Nation Water Innovation Service
 - o Scottish Water Horizons
 - o Other private and public sector parties

The code files for the new interactive water map include separate documentation for web developers. This additional documentation provides the technical details of the app implementation in case the code needs to be reviewed, modified or upgraded by a professional web developer.

A secure host organisation is recommended to provide a long term home for Scotland's Water Sector Map and underlying databases. The host organisation should have capabilities for carrying out map updates, and providing secure data storage. Short term hosting on Abertay's own server will be provided until an alternative host organisation is identified.

5.2 Interactive Wheel: Sector interconnections

A master data file records the outputs of all sector stakeholder interviews, listing the organisations they interact with in Scotland's water sector, and the relative importance of those connections to the four Hydro Nation themes (Governance and International Development, Economic Opportunities, Environmental Protection, Research and Development). Primary connections are re-coded to groups as shown in Appendix 1. The purpose of grouping is to rationalise the data into a manageable number of units particularly for similar types of connections or multiple departments within the same organisation, while maintaining individual connections where no obvious grouping is possible, or the organisation is of sufficient profile or sector importance to be listed individually. For example, UKAS, CRYPTS and Laboratory proficiency schemes are grouped as "Auditors". This grouped data can then be sorted in MS Excel using pivot tables to calculate the total number of mentions for each grouping, as well as the average influence scores for each of the Hydro Nation themes. An overall relative influence score is then calculated as the total number of mentions multiplied by the sum of average influence scores. A sum of influence scores under each of the themes is also calculated to provide an indication of how actors across the sector are influencing each theme.

The interactive wheel reads updatable data from five csv files.

- Interviewees.csv - Codes the name of the interviewee organisation (INTER_ID), and the total number of primary connections (Amount)

- **Organisations.csv** - Codes the primary connections by number (CMTE_ID) and name (CMTE_NM) and relative influence score (Amount)
- **Themes.csv** - Codes the Hydro Nation themes by number (THEME_ID), name (THEME_NAME), short code (THEME) and total of relative influence scores for each theme (Amount)
- **OrgThemeConnections.csv** - Codes the primary connections (ORG_ID) , and relative influence score (INFLUENCE) for each of the Hydro Nation themes (THEME_ID, THEME_NAME, THEME)
- **InterThemeConnections.csv** - Codes the interactions of each interviewee organisation (INTER_ID) by primary connection ID (CMTE_ID, CAND_NAME)

A follow on Developer's Report provides the relevant datasets used in developing the maps.

6.0 APPENDICES

APPENDIX 1: Example of groupings of connections within the sector for the Interactive Wheel

The condensed sheet contains only primary connections, and condenses similar connections into relevant groups. The connections included in the groupings are those mentioned by stakeholders as primary connections during interviews.

Group	Who is included in the grouping
Scottish Government	Scottish Government, Q&S, Energy Unit, Flooding, Regulatory, WSU, SG Health, Housing, Ministers Energy Sector, Press Office, SWG, Ministers
Scottish Water	Scottish Water (Core Business), SW Board, SW Business Improvement Group, SW Cap Investment, SW Cap invest delivery, Investment Planning, Commercial Team, Environmental Innovation Group, Environmental Reg and Climate Change; Executive Leadership Team, Innovation Leadership group, Innovation Panel, Internal Capital Maintenance Group, Internal Capital Programme Group, Investment Planning, Operations, Planning Portfolio Team, Regulation, Research and Innovation, Specialist Services Team, Water Innovation Group, Wholesale Revenue, SW (Infrastructure and Equipment), SW (Licence and Supply), SW Consumer Issues, Parent Company, SW PMT, SW Policy and Regulation, Q&S IV Project Monitoring Team
Scottish Enterprise	Scottish Enterprise, Account manager, Appraisal and Evaluation Team, Commercial Team, Energy and Low Carbon Sector Team, Innovation Specialists, Sustainability Specialists, Water and Waste Water subteam
Highlands and Islands Enterprise	Highlands and Islands Enterprise, Highlands and Islands Enterprise Energy and Low Carbon Team
Local Authorities	LA (Env Health), LA Planning, LA Roads, Local Authorities, COSLA, COSLA Flooding, COSLA Regulatory, COSLA Statutory
SW Horizons	Horizons, Horizons Board
SW International	International, International Consulting Team, International Board
SW Solutions	Solutions, Solutions Joint Venture, Solutions Board
Private Sector	Private Sector, Contractors, Consultants, Design Consultants, Equipment Manufacturers, Commercial partnerships, Developers; Isle Utilities, Stakeholder groups (Business), Offshore Industry customers, Renewables developers
Industry/	
Trade organisations	Association of Consulting Engineers (ACE); Civil Engineering Contractors Association (CECA); Scottish Environmental Technology Network; Institute of Chartered Engineers (ICE); VIBES; Scotland Food and Drink; Federation of Small Businesses; Scottish Environmental Technology Network, British Water; International Water Association ; IWA Steering Group, Institute of Water, Water UK
Scottish TUC	Scottish TUC
Non Water Utilities	Digital Broadband providers, British Telecom, Electric and Gas Utilities; Wireless Infrastructure Group
Water Utilities/ Companies (UK, NI)	English and NI Water Utilities, Water Companies
Research Groups	CAMERAS, UKWIR, GWRC, UKWRIP, UK Water Co R&D Network, WSSTP, TSB, Research Councils, ESKTN, SNIFFER, IW Science Panel, CIRIA, Research UNESCO, CENSIS
CREW	CREW
Interface	Interface
Climate Change, Carbon reduction groups	Zero Waste Scotland, Carbon Trust, Resource Efficient Scotland
Customers	Customers, Drinking Water Customers, Industrial Sector Customers, Public Sector Customers, Horizons Customers, Commercial Sector Companies
Public/ Communities	Public/Communities, Public, Landowners, Small Communities Supply Network
Scottish Development International	SDI, SDI Aid Funded Business Unit, SDI Int Field Staff Unit
Drinking water inspectorate	DWI (UK/NI), NI and UK
NHS	NHS and NHS Highland
Auditors	Auditors, UKAS, Laboratory Environmental Analysis Proficiency Scheme, CRYPTS proficiency Scheme
International Partners & Marketplace	International Marketplace and Partners
Consumer Groups	Consumer Challenge Group (Ofgem), Consumer Council for Water
English Markets	English Markets
NGOs	NGOs



Scotland's centre of expertise for waters

CREW Facilitation Team

James Hutton Institute

Craigiebuckler

Aberdeen AB15 8QH

Scotland UK

Tel: +44 (0)1224 395 395

Email: enquiries@crew.ac.uk

www.crew.ac.uk



Scottish
Government
gov.scot

CREW is a Scottish Government funded partnership between
the James Hutton Institute and Scottish Universities.

