

Scotland's Water Map: Understanding water sector links to support decision making for the Hydro Nation Agenda

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Topic: Capacity Building

Abstract

This paper presents research which produced an overview of Scotland's water sector in the form of a map which demonstrates the scope and scale of the sector and shows, in a manner that can be easily understood by a wide range of stakeholders, how the different parts of the sector link together. The map will support the Governments Hydro Nation vision and agenda and will guide the Hydro Nation Forum in the development of the framework that was established in the Water Resources (Scotland) Bill 2012. The methodology applied to the development of the map including the collection of the supporting data is described and justified. The functions and purpose of the map also are described, which are to focus on the decision making processes that influence, manage and control Scotland's water resources to enable their full and sustainable use.

Introduction

The value of Scotland's water and sewerage market is projected to grow to £1.24 bn by 2016/17. Developing future opportunities must take place alongside maintaining current service provision, however the demand on water and waste water services is constantly evolving. An integrated approach to water management requires an understanding of complex interactions that exist between key actors in the sector to allow water management strategies to exploit inter-sectorial links. Successful integrated analysis of the water sector in Scotland will support management activities that are key to responding to the Hydro Nation themes of 1) Governance and international development 2) Environmental protection 3) Economic opportunities 4) Research development. In order to deliver on these objectives an approach is required to illustrate the interconnectedness of stakeholders within the sector.

This paper describes a Scottish Government funded project to support the Hydro Nation agenda by developing an overview of Scotland's water sector in the form of a map. The Scottish Water Sector Overview Map will illustrate the scope and scale of the sector and will demonstrate how different parts of the sector link together to address current and future challenges. The map will be used by the Scottish Government and its stakeholders to support decision making and illustrate the management and control aspects of the water sector. 3D computer graphic technologies have been used to emphasise readability and design to make sure the map supports water policy by offering a clear and immediate picture of the most important linkages within the sector.

The development of the methodology required the identification and application of a range of techniques from the Information and Knowledge Management disciplines combined with Visualisation technologies to enable the elements of the map to be defined to display the interconnectivity of the sector.

Data Collection

Decision and Knowledge Mapping approach applied to sustainable decision making and asset management in the UK water industry (Blackwood et al, 2000, Bouchart, Blackwood, and Jowitt, 2002, Butler et al, 2003, Gilmour and Blackwood 2006, Ashley et al. 2008, Gilmour et al, 2011) were used in the data collection stage. Many organisations were identified who interact within Scotland's water sector including the Scottish Government and Ministers, the Regulators (WICS, DWQR, SEPA), Scottish Water (core and non-core functions), plus a number of other stakeholders ranging from research institutions to private sector businesses. Although the number of enterprises directly working in the sector is small, there are a number of associated sectors involved in water sector activities such as construction firms, engineers and scientific service providers. Scotland's Universities and Colleges are also involved in the water sector through water research and consultancy activities working in partnership with other research institutes across Scotland.

Data was successfully collected through semi-structured interviews with key people in these organisations and the information were then analysed using Information Flow Diagrams supported by Knowledge Classification Tables and Decision Maps. The Information flows were recorded in a series of Information Flow Diagrams (Figure 1) and the contents and purpose of each of the numbered information transfers on the diagram were further analysed in Knowledge Classification Tables to identify what information was transferred and how it was used, thereby providing an understanding of the decision making process.

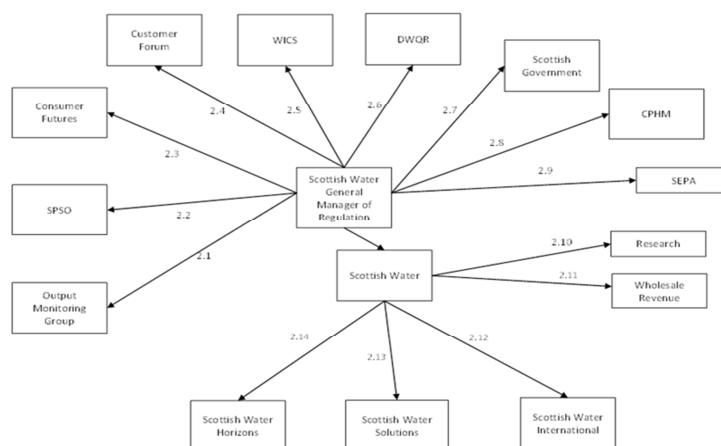


Figure 1: Example of an Information Flow Diagram.

The interview process identified 253 direct connections between interviewees and 65 other groups/organisations in the sector, and 343 direct and indirect connections with 75 groups/organisations. The data were further analysed to determine which organisations had the greatest number of connections to others in the sector. The following figures show the organisations with the largest number of direct and indirect connections to others in the sector. The direct connections are shown in Figure 2 which highlights the important role of

Scottish Water, the Scottish Government and Research groups in the water sector in Scotland.

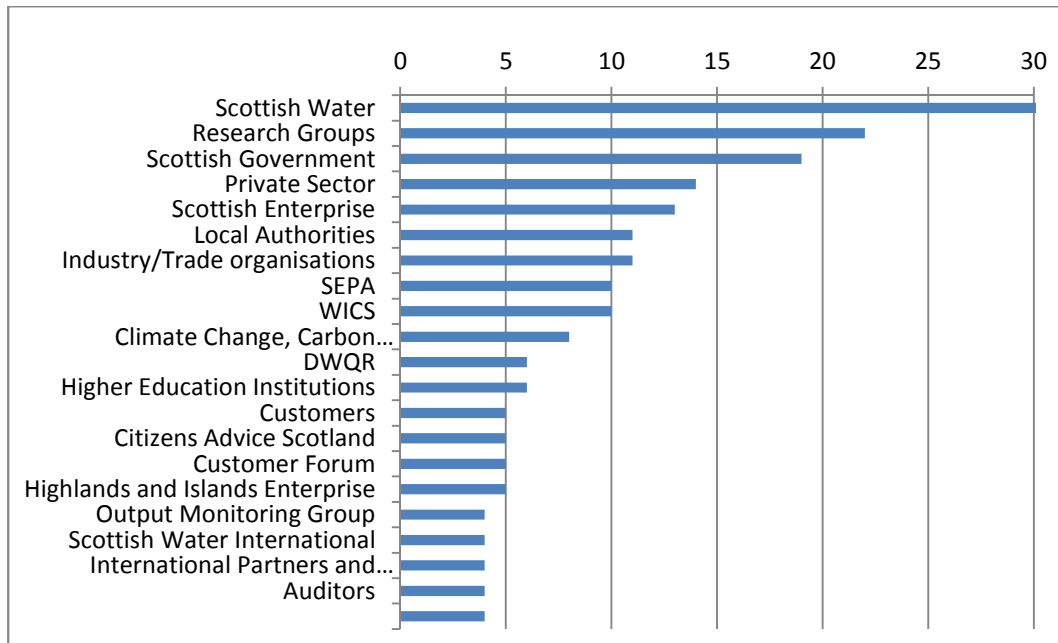


Figure 2: Groups with the largest number of Primary (Direct) connections to other organisations, (only organisations with n > 4 are shown).

The interviews confirmed the extent of the information flows across the sector but also enabled the purpose of the information transfers to be identified and classified in Knowledge Classification Tables. The following categories were used: Reporting/Managing (R/M), Influence and Information sharing (I) or Control (C) activities. Primary information flows were also scored in terms of their importance against the 4 key Hydro Nation agenda themes. This was considered from the point of view of information flowing “IN” or “TO” the interviewee, and information flowing “OUT” or “FROM” the interviewee. The interviewees scored the importance of each to Hydro Nation themes on a 1-5 Likert Scale of importance with 1 being not important, and 5 being extremely important or essential. Figure 3 presents an example of a Knowledge Classification table.

Interviewee	Information Flow	Primary (P), Secondary (S)	Organisation	Flow type IN			Flow type OUT			Hydro Nation Theme importance			
				R/M - IN	I - IN	C - IN	R/M - OUT	I - OUT	C - OUT	Governance and International Development	Environmental Protection	Economic Opportunities	Research and Development
A. Scottish Water Environmental Science and Regulation	4.1	P	SEPA	25	25	50	50	50	0	3	5	3	4
	4.1.1	S	Scottish Water Investment Planning										
	4.2	P	Scottish Government	10	10	80	60	40	0	5	5	5	5
	4.2.1	S	SEPA										
	4.3	P	UK Water Industry Research (UKWR)	60	20	20	10	80	10	1	3	2	3
	4.3.1	S	Water UK										
	4.3.2	S	Global Water Research Coalition										
	4.3.3	S	Higher Education Institutions										
	4.3.4	S	SEPA										
	4.4	P	Local Authorities	20	80	0	5	95	0	2	2	3	1
	4.5	P	SNH	10	40	50	20	80	0	1	3	1	3
	4.6	P	NGOs	10	90	0	90	10	0	3	2	2	2
	4.7a	P	Highlands and Islands Enterprise	0	100	0	0	100	0	1	3	4	4
	4.7a.1	S	SEPA										
	4.7a.2	S	Private Sector										
	4.7b	P	Scottish Enterprise	0	100	0	0	100	0	1	3	4	4
	4.7b.1	S	SEPA										
	4.7b.2	S	Private Sector										
	4.8	P	WICS	10	60	30	60	40	0	2	4	4	4

Figure 3: Example of a Knowledge Classification Table

Across the sector, the primary type of information flow (both in and out) was influence/information sharing at 65%, followed by reporting/managing at 25% and control/regulation at 10%. The Hydro Nation theme “Economic Opportunities” received the highest average

score (2.5), with the other themes falling closely behind. Figure 4 shows the perceptions of the importance of the economic theme within the communications to or from a range of organisations in the water sector.

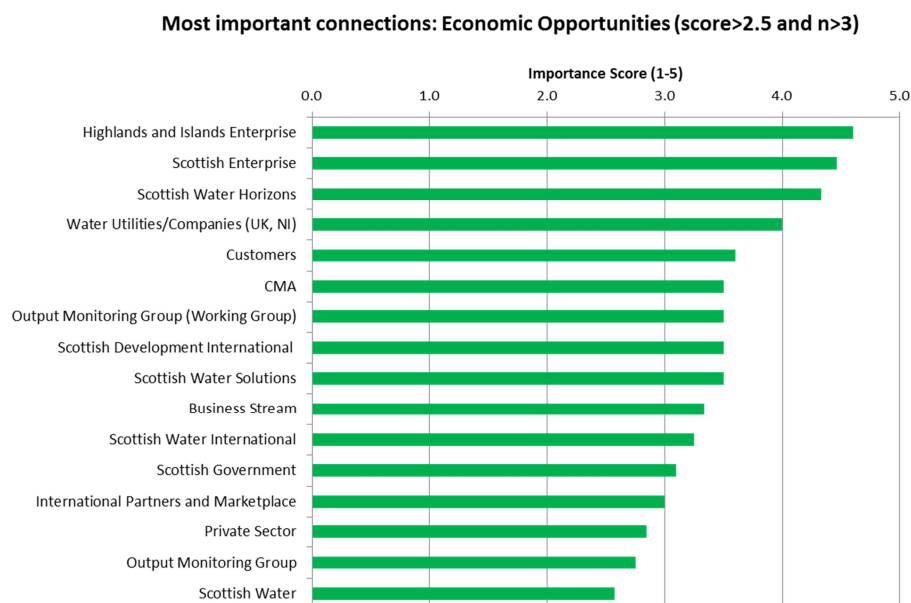


Figure 4: Scoring by Organisation of the importance of the Economic Activities Theme.

Data Visualisation – Scotland’s Water Map

Maps were developed to convert the data (IFD, KCT and charts) into a more visual form which is engaging and visually compelling. The interactive maps were created in a similar fashion to the interactive visualisation and modelling tools previously developed by the Abertay team to support decision-making and understanding in sustainable urban planning and the Water industry (Isaacs, et al 2011, Falconer et al. 2012). This previous research had identified opportunities for exploiting the benefits of 3D visualisation in order to increase the engagement of the types of stakeholders that the water map’s visualisation will be targeting. Existing examples of 2D visualisation solutions that are related to water industry visualisation were reviewed. Most notable was the “Israel’s Water Ecosystems Map” 2010. While this type of flow chart based map is informative, it lacks the necessary visualisation metaphors needed to highlight the important connections between all of the involved water industry stakeholders. The focus of the Israeli Water map is more towards grouping all of the stakeholders under specific industry sector labels (e.g. supply and collection, environmental and industry) rather than showing interactions, connections and decision making structures.

Two interactive web based maps were produced. Figure 5 shows the map of the spatial distribution of the component stakeholder organisations of the water sector. The menu of icons on the right presents the spatial distribution of different categories of services such as renewables, business etc. Additionally the filtering of these categories by SME is also possible. A navigation panel (bottom left) allows the user to scroll across or rotate the map and to zoom in to view any location in more detail. Finally the map icons on the bottom right transform that data into a density of water sector activity per local authority area and water research activity across all Scotland’s HEI’s.

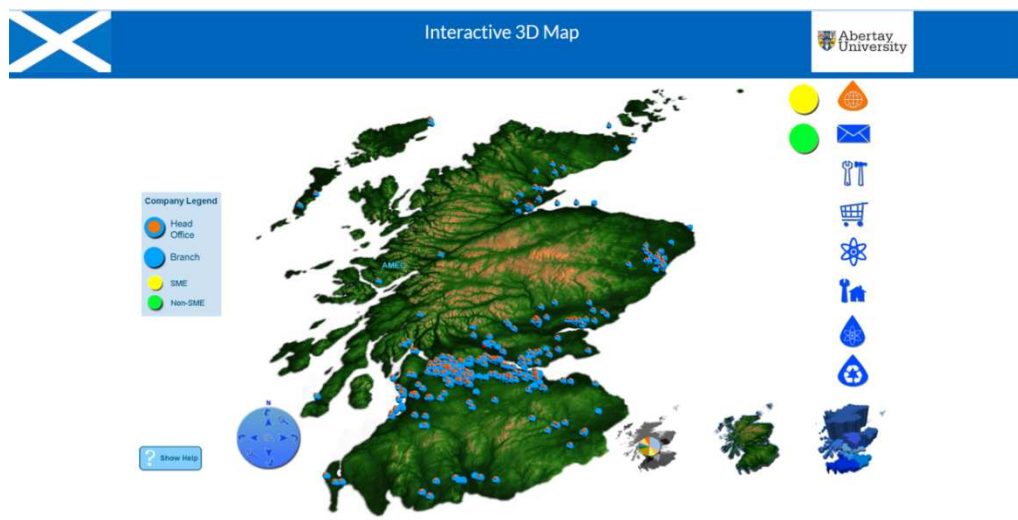


Figure 5: 3D Interactive Map of the spatial distribution of the water sector

Figure 6 presents and explains the functionality of the second map which provides a conceptual representation of the information flows between the parts of the sector.

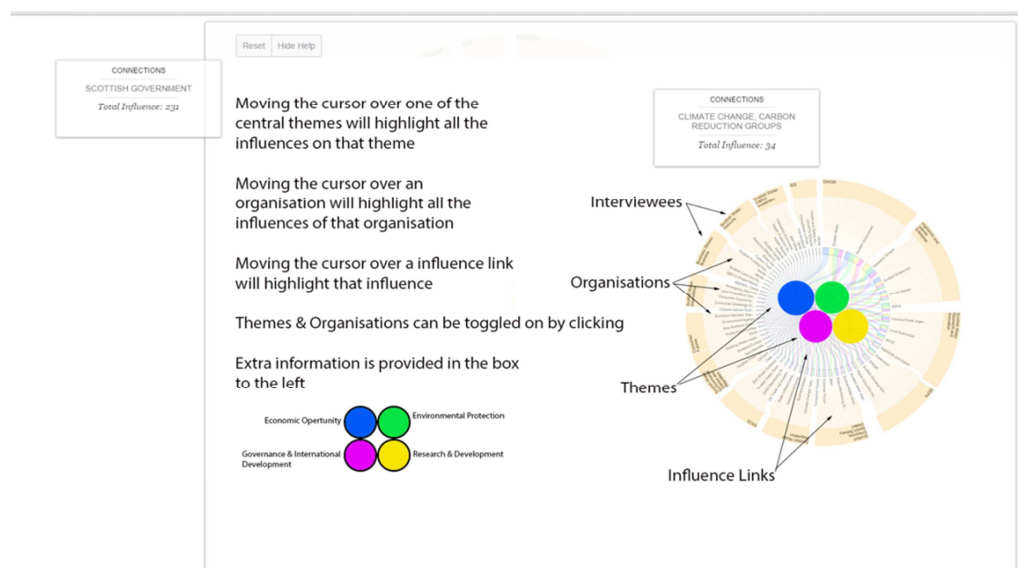


Figure 6: Interactive Map of Sector Linkage.

The user can either view the connectivity amongst the water sector organisations for each Hydro Nation theme by selecting that theme from the icons in the centre of the map. Alternatively an organisation can be selected to reveal its network of communications in terms each of the Hydro Nation themes. An example of the later is shown in Figure 7 which again highlights the important influence of Scottish Water on all four themes.

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