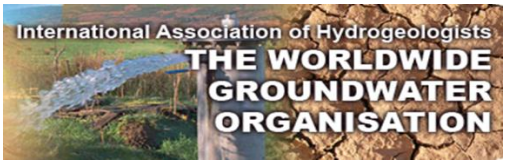
8th September 2014



ENHANCING EDUCATION AND ACADEMIC DEVELOPMENT: The development of courses and production of educational materials

Report to the IAH Council, September 2014

1 Introduction

Many of IAH's core activities relate to educational development, including our academic journal, our books series and our congresses. Moreover, many of our national chapters run short training courses, and there are also usually a number of courses arranged to tie in with the major congresses. One of the priority objectives in the *Forward Look Action Plan* is to enhance IAH's role in education and academic development. Within this objective, the Action Plan proposed a feasibility study to consider options for short courses and for producing educational materials. It is likely that the main targets for our courses are our members and other hydrogeologists, whilst educational materials could be aimed mainly at policy makers, the general public, school children, etc. The *Action Plan* also prioritised the development of a new IAH website and clearly this new website, which was launched in October 2013, offers excellent opportunities for IAH to provide educational services.

A working group was set up in May 2013 to undertake the feasibility study on options for courses and educational materials. In establishing this WG, it was recognised that there would be synergies with the activities of the *Commission on Groundwater Outreach* (CGO) and, therefore, that a member of the CGO should be involved in the WG. The full list of members of the WG (in alphabetical order) are:

- Bruce Misstear, Ireland (IAH Executive)
- Daniel Nkhuwa (African Groundwater Network)
- Suzanne Pierce (USA Chapter)
- Viviana Re (Italian Chapter; Early Career Hydrogeologists Network)
- Andrew Stone (CGO)
- Andrzej Witkowski (Polish Chapter)

This final report on the activities of the WG has been prepared for discussion at the IAH Council meeting to be held in Marrakesh, Morocco, on 14th September 2014. Section 2 of the report considers options for short courses, including webinars, whilst Section 3 deals with educational materials (there are inevitably overlaps between these two sections). Members of IAH were asked their views on education priorities via an on-line questionnaire survey launched in April 2014, and the results are summarised in Section 4. The report concludes with recommendations for the proposed next steps in Section 5.

2 Courses

It is not envisaged that IAH will compete with the role of universities in educating hydrogeologists. Rather, we can help in providing training courses as part of good practice in *continuing professional development* (CPD). It is clear from questionnaire responses collected at the time of the *Forward Look* meeting in 2010, and from more recent feedback from the ECHN, that there is a strong demand

amongst our members for short courses and other training opportunities. In addition, IAH members are sometimes involved in giving talks to policy makers and to members of the public, so some of the proposals below may also be relevant for those situations.

The development of IAH courses can be of great help in recruiting and maintaining IAH membership. The IAH logo on training programme announcements and course materials will help reinforce members' awareness of the IAH role as an advocate for groundwater science as the basis for management and water policy decisions. "Branding" of IAH courses will also help reinforce the status of the organization in the eyes of its members (and potential members) as a dependable source of groundwater science and water management information. The multi-national membership of the IAH is an added advantage in establishing credentials for proposed training courses.

2.1 Options for enhancing the role of IAH in short courses

Some of the options for enhancing our role in providing courses are:

a) Use of webinars for providing courses. These could be webinars organised and run by IAH, or we could consider subcontracting to an existing provider. The US National Chapter is developing links with the National Ground Water Association over webinars and members of the US NC have given webinars through the NGWA site, with the IAH logo displayed. (These talks have been part of a series "Scientific Diplomacy of groundwater".) As well as providing webinars, we could investigate the feasibility of uploading videos or providing streaming of congress lectures and training courses to the IAH website. Given the potential importance of webinars, a survey of on-line training resources was undertaken by a member of the working group, as described in Section 2.2 below.
b) Compile an international panel of experts who would potentially be available to travel to different national chapter countries to give short courses. This panel might include, for example, retired hydrogeologists who are willing to give of their time for free (or for a modest fee), leaving the NC to cover travel, accommodation costs, etc. Costs could be reduced by seeking to take advantage of existing travel plans for the potential trainers. Details of the panel would be included on the website.
c) Our new website should have a separate "Education" banner on the homepage. This webpage could also give links to full-time or part-time masters level courses in hydrogeology. In this respect, the NGWA has a useful webpage giving links to 100 masters programmes in North America: http://www.ngwa.org/information-for/students/pages/leading-hydrogeology-programs.aspx
d) Provide and maintain an up to date list of courses on our website. This would require inputs from all those NCs running short courses.
e) Provide a template for visual aids and handouts to be available for IAH NCs to use when preparing their short courses. This template, which would include the IAH logo, would ensure that the course materials are recognisable as IAH products (but without restricting the communication creativity of the presenters). Moreover, certificates of attendance should normally be issued, as these are important for continuing professional development certification, as well as being part of IAH branding.
f) Based on the practical realities of organizing the registration and on-site logistics for any course, it is likely that many IAH training courses will be developed in partnership with another organization. For this to work well, it could be advantageous for the IAH to develop a business plan template that sets out typical separate and joint responsibilities and provides clarity about disbursement of registration or sponsorship income.
g) Provide additional help to congress organisers regarding the congress short course programmes, including identifying potential training needs.

h) The Polish and Irish NCs, for example, run field-based training courses and again IAH could support these by maintaining an international list of potential international contributors. Neighbouring chapters could be encouraged to organise field-based and other courses jointly.

2.2 Survey of on-line training resources (Webinars)

As on-line training is potentially important for IAH, both for our members and in getting across the objectives of the Association to a wider audience, including the public and policy makers, a survey of on-line training resources was undertaken by working group member Suzanne Pierce.

2.2.1 Methods

In the case of Google and Twitter, searches were completed for the 10-year period from January 2004 through January 2014. An initial list of keywords from *Hydrogeology Journal* was used to evaluate search volumes on terms. These terms were grouped using the automatic knowledge capture tool provided by *Google Keyword Planning* which separates terms based on relevance. These term Groups included: "*Groundwater"* (13 terms, including "*groundwater flow*", "*groundwater monitoring*", "*groundwater management*", etc); "*Rocks"* (6 terms, including "*sedimentary rocks*", "*igneous rocks*", "*fractured rocks*", etc); "*Models"* (5 terms, including "*conceptual models*", "*numerical modelling*", "*statistical modelling*", etc); "*Other terms"* (79 terms, including "*climate change*", "*agriculture*", "*health*", etc).

The Grouped terms were used in combination with the following list of terms for training, to evaluate existing resources and key organizations that have developed the resources: "*webinar*"; "*training*"; "*online"*; "*course"*; "certification". In particular, *Google Adwords* analysis tools for trend and keyword planning were employed. The trend analysis tool was used to evaluate the use of key terms in searches related to groundwater and online training for the past decade (January 2004–January 2014).

Twitter feeds were evaluated using search terms "#groundwater webinar". This search identified a set of common communicators that leverage social media to communicate about groundwater training resources.

2.2.2 Results

Table 1 shows examples of the kinds of sites that appear in a search using the terms "groundwater" AND "webinar". In this case nearly 129,000 results were returned spanning a wide range of possible webinar training course types. In the first few pages of the search results, webinar features included:

- a wide range of topics at both introductory and highly technical professional levels;
- live (or synchronously) and on demand (asynchronously) broadcasts. Given the time zone span of IAH membership, on-demand recorded presentations rather than real-time presentation webinars would appear to be preferable;
- paid and unpaid versions;
- a large span in timing, from a few minutes to a series of videos provided over the course of several months.

The organizations offering the webinars are also wide ranging with non-profit organizations, commercial consulting groups, and government entities all including webinars.

Interestingly, Google considers groundwater-related searches and use of keyword terms to be a very small set of results. However, in analyzing the search returns, the number of topics and pages exceeds the level at which analysis could be done manually : in other words, while from Google's perspective there are not many results, there are still too many records so as to make it impractical to review them without the aid of algorithms and applications. Part of the reason is that there are a very large number of sub-topics embedded within the more general heading of groundwater training/education. For example, the topical analysis and sub-groupings that the keyword terms from *Hydrogeology Journal* were divided into include a sub-group called "other" that lumps over 79 terms into one category because each term receives very few search requests, but they are all related to groundwater science. This reflects a challenge that will need to be addressed to improve communication about groundwater, because the numerous sub-topics confuse non-scientists and make it difficult to create a cohesive set of core facts or pieces of information that should be understood for a basic level of groundwater literacy.

The analysis of the search terms through time provides an additional level of insight, particularly in relation to the geographic occurrence of groundwater searches and the overall downward trend in information seeking about groundwater globally. Figure 1 shows results of the trend analysis and closer inspection within the Google analysis application indicates that spikes in interest for groundwater occur with media coverage and events. Frequently, these events are driven by pollution or impacts to groundwater systems (such as spills and/or disasters) that raise concern among communities about safety.

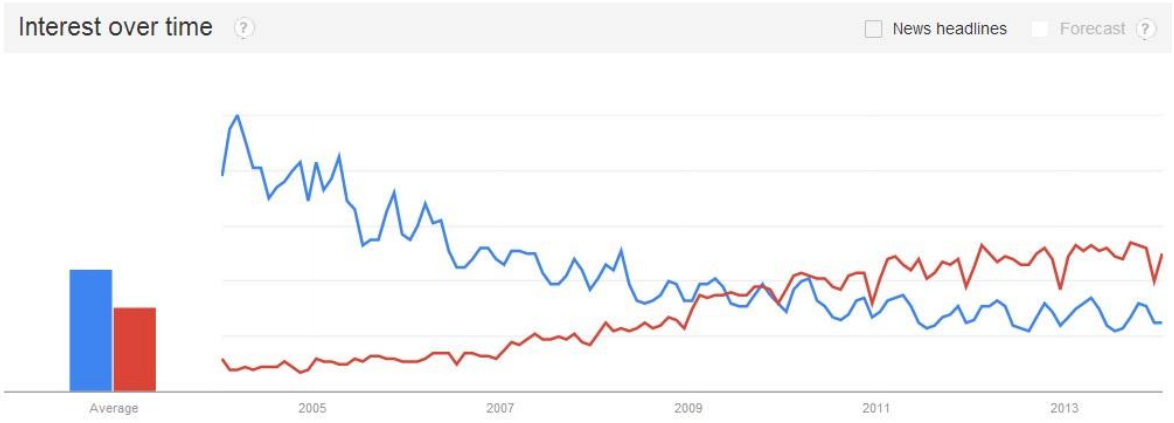


Figure 1. Trend analysis for searches on groundwater (blue) and webinar (red) completed using Google trend analysis for the 10-year period between January 2004 and January 2014.

Analysis of regional interest indicates that *groundwater* searches emerge predominantly from African countries (Ethiopia, Nigeria, and South Africa), Australia, the United States, India, Canada, Iran, New Zealand, and Ireland. Whereas interest related to *webinar training* is dominated by the United States, Canada, Australia, India, New Zealand, the United Kingdom, Singapore, Ireland, South Africa, and the Philippines.

Neither topic is a high volume search topic by Google standards, but a few observations can be made in relation to the top searches using related terms. In the case of *groundwater* the most common related search was "what is groundwater?" and "aquifer" which could indicate that very basic level webinars that present the basics of groundwater systems could be helpful. Secondarily, contamination, pollution, and groundwater quality figure prominently in searches with flow and recharge following. Surface water also makes an appearance as a search commonly paired with groundwater keywords.

In the case of *webinar* searches, users tended to also seek information for free training, online training, 'how to' videos, and live webinars. This may indicate that online offerings that are free of charge, describe skills and build capacity, while also providing access to live instructors, can provide value to people who are interested in the topics.

Regarding the search of Twitter feeds, Appendix A shows the explicit list of 28 top influencers with links to training opportunities. IAH is not included in this list!

Table 1. Examples of webinar sites from a search using keywords "groundwater" and "webinar". The original search results exceed 129,000 sites.

Site/Group	Group / Topics	Free	On Demand	Web Address	Description
The Groundwater Foundation	Groundwater General	Yes	Yes	http://www.groundwater.org/get-informed/opportunities/webinars.html	Various topics are addressed in a library of educational webinars available on-demand.
Environmental Simulations Incorporated	Models	No	No	http://www.groundwatermodels.com/	ESI specializes in software, consulting, and training for groundwater modeling. These modules are more technical and teach modelling skills over a longer duration.
Water Diss	Groundwater General	Yes	Yes	http://waterdiss.eu/eseminar-groundwater	Recordings of webinars related to "Opportunities for European Groundwater Management"
MIOXmarketing	Quality and models	Yes	Yes	http://youtu.be/39KKzZaCF9c	A YouTube groundwater treatment webinar that is Part II of III in the MIOX Webinar Series: Challenges in Municipal Water Treatment and the MIOX Solution
National Groundwater Association (NGWA)	All Topics	No	No	http://info.ngwa.org/servicecenter/Meetings/Index.cfm	NGWA's Webinars usually last one hour, unless otherwise specified on the Web site. Access to the recorded session can be purchased after the original showing.
environmental-expert.com	Various, but primarily Modeling & Rocks	No	No	http://www.environmental-expert.com/events/training-geostatistical-methods-for-geological-modeling-and-hydrogeology-15674	Training: Geostatistical Methods for Geological Modeling and Hydrogeology
QED Environmental Systems	Various, but Modeling & Rocks	Yes	Yes	http://www.qedenv.com/webinars/	Maximize Wellfield Efficiency with LFG Wellhead and many other topics that are recorded and accessible on demand. All files appear to be active and available with a large set of technical recordings.
Schlumberger Water Services	Models	Yes	No	http://www.swstechnology.com/groundwater-modeling-webinars/visual-modflow-flex-free-webinar	MODFLOW-USG Webinar Series Announced to present introductory information for groundwater modelling and present software products of the company.
Water Matters	Groundwater	Yes	Yes	http://www.water-matters.org/pub/webinar/groundwater-policy-2	Webinar: Groundwater Policy II - Sustainable Groundwater Governance
Groundwater Protection Council	All	Yes	Yes	http://www.gwpc.org/resources/webinars	Recognizing that it has become increasingly difficult for state agency representatives to travel to conference and training events, GWPC has begun to offer more content in the form of webinars. Recently, GWPC has completed two webinars focused on source water protection.
Regensis	Models and Quality	Yes	No	http://blog.regenesis.com/event/new-complimentary-groundwater-remediation-webinar-announced-data-intensive-review-enhanced-reductive-dechlorination-projects-bioremediation-chlorinated-solvents/	New Complimentary Groundwater Remediation Webinar Announced – A Data-Intensive Review of Enhanced Reductive Dechlorination Projects for the Bioremediation of Chlorinated Solvents
UNESCO-IHE	Groundwater General	Yes	Yes	http://www.slideshare.net/groundwatercop/presentation-lm-kc2reduit-27592674	First Webinar by IW:LEARN Groundwater Community of Practice that is part of a larger effort.
The Water Channel	All Topics	Yes	Yes	http://www.thewaterchannel.tv/webinar	With support from IFAD, TheWaterChannel started a series of Webinars on three themes related to rural poverty alleviation. Organised together with partners UNESCO-IHE and Cap-Net.

2.2.3 Conclusions from survey of on-line training resources

The webinars reflect a wide range of topics, but lack any cohesion. In fact, the webinars cover such a wide number of topics across numerous organizations in a 'catch-as-catch-can' fashion. Each organization has a motivation for posting the webinars (e.g. to educate, to present a commercial product, or provide information about a timely topic). Because of this, it would be difficult for someone interested in learning about hydrogeology from the novice stage up to the expert level to self-create a sequence through these various webinar resources to develop the necessary knowledge base. It could be useful for an organization like IAH to develop a review of available resources, identify any gaps in the core topics, and provide a sequence for self-directed learners. In fact, a future step could be to categorize existing training resources into the keyword groupings to provide a sense of how well covered the existing topics are and help with a gaps analysis.

An on-line survey of IAH members was subsequently undertaken to understand the educational priorities of our membership further, and the results are discussed in Section 4 below. To find out more about non-member (and non-specialist) educational needs, a future action might include a *Google Adwords* campaign, using high impact search terms. This could be conducted for a short period of time to understand what set of searches is most common because this may provide insights into training topics that would be more broadly appealing to non-subject matter experts.

This search and analysis represents an initial evaluation of the current landscape in online training groundwater resources that are available. It is by no means comprehensive, but the results do provide insights into the types of searches, web resources, and key topics that may augment groundwater related training. One key consideration is the lack of a central location that can direct people who are interested in finding groundwater-related training options. The creation of IAH web pages that curate webinar and other groundwater training information could be very helpful.

3 Educational materials

The WG recognised at the outset of their work that there is a huge amount of educational material already available on groundwater topics, aimed at the general public or at policy makers, as well as at groundwater professionals. Whilst there may be strong reasons for IAH to provide our own authoritative (and IAH-branded) materials on key issues relating to groundwater (see Section 3.3 below), and this may involve a certain amount of overlap with materials already out there, we clearly should not attempt to duplicate all of the existing materials. Therefore, before deciding on priority areas for IAH action, it was decided to undertake a brief review of what educational materials are currently available, focusing on web-based sources. This review was carried out mainly by WG member Viviana Re and comprised Google-based web searches using keywords in English, Spanish, French and German (we also acknowledge the input of Judith Flügge for the latter). The Google search through English was carried out in August 2013, whilst the searches in the other languages were carried out in November 2013. For the UN and other international organisations, most of the materials available in English are also available in French and Spanish.

3.1 Review of existing educational materials

3.1.1 Presentations and lectures

Numerous presentations (PDF and PPT format) on groundwater and related topics (hydrogeology, water management, governance, law) are available for download. Most of them are related to university lectures and/or project presentations. Some relevant examples are:

- Training package developed by MetaMeta Communications on *Participatory Groundwater Management* (http://www.groundwatermanagement.org/)
- *GW Mate lectures* slide share: http://www.slideshare.net/globalwaterpartnership/17-s-foster-gwp-iwmi-ws
- *IWRM lectures* prepared as part of an e-learning module on Integrated Water Resources Management, which include several groundwater-related lectures: http://www.iwrm-education.de

3.1.2 Groundwater education materials

Good examples of websites with groundwater educational materials are:

NGWA: http://www.ngwa.org/Fundamentals/teachers/Pages/Classroom-materials.aspx
http://www.epa.state.il.us/water/groundwater/publications/education-brochure.pdf
USGS: http://water.usgs.gov/education.html
GRAC: http://www.grac.org/educationlinks.asp
NCGRT: (including videos, lectures, papers, information sheets etc....): http://www.groundwater.com.au/fact_sheets
AGWT: http://www.agwt.org/about

Information on European groundwater projects from UNESCO (IHE and IHP) is available in French as well as English, and in Spanish for projects in Latin America. As for German, some examples of useful websites are:

- *WVGW*: http://www.wvgw.de/index.php?id=553
- *Wasserforscher*: http://wasserforscher.de
- *The German Association of Hydrogeologists* (FH-DGG, www.fh-dgg.de) offers a "groundwater model box" for rent: http://fh-dgg.de/grundwasserkoffer.html, including working sheets: http://fh-dgg.de/tl_files/fh-dgg/documents/GW-Koffer_Arbeitsblaetter.pdf

3.1.3 Online articles & issue papers

Apart from scientific journals (not considered in this review), it is easy to find online articles about groundwater, either related to general topics or case studies. Some excellent web sources are:

- *NGWA*: http://www.ngwa.org/Professional-Resources/publications/Pages/wiley.aspx
- *USGS* (Selected groundwater issues): http://water.usgs.gov/ogw/issues.html
- *hydrology.nl*: http://www.hydrology.nl/cpwcpublications.html
- *Groundwater governance thematic papers* (IAH Involved in these through the GEF project) http://www.groundwatergovernance.org/resources/thematic-papers/

As well as English language sources, many articles about groundwater can be found in both Spanish and French. In general, most of these articles deal with specific case studies and applications, rather than wider topics (as found in the English language websites). In addition, many references can be found on the websites of the French and Spanish National IAH Chapters, dealing with both local case studies and general groundwater related issues.

3.1.4 Videos

A search for "groundwater" on *youtube.com* gave around 36,900 results. Among the videos it is possible to find documentaries, lectures and "tutorials" (e.g. how to sample, how to use hydrogeological equipment, etc). Websites with videos include:

- *IGRAC movies*: (uploaded 5 years ago): Groundwater, the hidden source of life; Groundwater, climate and global change; Groundwater and sustainable Use; Groundwater without borders
- *FAO water channel*: Water Cycle (part1): Surface Water and Groundwater
- *GEF Secretariat, IFAD, UNESCO, UN DESA UNEP, YouTube channels*: have some videos - mainly interviews, conference lectures and some animations related to groundwater
- *Worldwaterweek* channel: interview done in the Water Cube during the WWW.

Moreover, the *Water Channel* (http://www.thewaterchannel.tv/en/home) is an open source site supported by UNESCO-IHE, UNESCO-IHP, CAP-NET, MetaMeta Communications, Nymphaea, and IFAD. The website contains thematic videos, video lectures and lab videos. It is a platform for webinars and, in collaboration with various partners, produces videos and DVDs. The website contains videos in different languages and a dedicated Arab Water Channel (http://www.thewaterchannel.tv/en/videos/thearabwaterchannel). Subjects of interest for IAH are contained in:

- *Videos*: there is a section dedicated to groundwater containing nearly 50 videos related to groundwater issues: (http://www.thewaterchannel.tv/en/videos/categories/viewcategory/15/groundwater)
- *Webinars* (foreseen in collaboration with IFAD): Groundwater Buffers for Climate Change Adaptation;
- *DVDs*: Water Management in Motion, a set of 6 DVDs containing videos and learning materials covering important issues under 6 themes: IWRM; Climate Change; Water Pollution, Water Quality and Waste Water; Rainwater Harvesting, Recharge, Retention and Reuse; Groundwater Management; Water, Sanitation and Hygiene.
- *Online water training*: Groundwater Management in IWRM (http://www.cap-net.org/node/2076/)

With Spanish and French search words, a *youtube.com* search for "*agua/s subterranean/s*" gave around 12,500 results, while "*eau souterraine*" gave 4,040. As with the English language sites, in the French and Spanish languages it is possible to find videos with documentaries, lectures and tutorials, plus short videos presenting projects (and projects results) implemented in Africa and Latin America. Web sources include:

- *FAO water channel, GEF Secretariat, IFAD, UNESCO, UN DESA UNEP, YouTube* channels also have some videos available in different languages (Spanish and French among the others). The same for the Water Channel, as indicated in the previous document
- (In German): *FWO Mediathek*: http://www.fwu-mediathek.de/result?first=1&rtype=1&pid=iism54bovcqv9ua8h8mq837mj6

3.1.5 Others

Several websites of companies, research institutes and agencies dealing with water have a section with key facts about groundwater. For example:

IWMI: http://www.iwmi.cgiar.org/issues/groundwater/overview/summary-groundwater/
Water Wiki: http://waterwiki.net/index.php/WaterWiki.net:About
WWF (Water Stewardship Initiative): is planning to include a section on groundwater: http://wwf.panda.org/what_we_do/how_we_work/conservation/freshwater/water_management/

In German:

- *Wasserwissen*: http://www.wasser-wissen.de/
- Maps (German) BGR:
  http://www.bgr.bund.de/DE/Themen/Wasser/Informationsgrundlagen/informationsgrundlagen_node.html
  http://www.bgr.bund.de/DE/Themen/Wasser/Informationsgrundlagen/Anwendungen/anwendungen_inhalt.html?nn=1542276

3.2 Options for enhancing the role of IAH in providing educational materials

Arising from the above review, there are many opportunities for IAH to consider:

1) Prepare issues papers on groundwater-related topics of strategic importance to achieving the objectives of IAH, including the advancement of public education about groundwater science and to promote the sound utilization, management and protection of groundwater resources. Potential topics for thematic papers are discussed in Section 3.3 below.
2) Prepare lecture materials available for download from the IAH website (users could be asked, prior to downloading, to indicate for what purpose these will be used, and be given some instructions on how to use the materials, e.g. retaining the IAH logo and slide design, how to cite the source of materials etc). The CGO is interested in offering training to IAH members about how-to communicate effectively with non-experts and how to elevate groundwater awareness among other professions, end-users and the public. To that end the CGO is in the process of developing education support in the form of generic PowerPoint presentations explaining basic hydrogeological concepts including groundwater hydraulics, aquifer protection etc.
3) Create an *IAH YouTube* channel and promote a TED lecture on groundwater by leading IAH scientists.
4) Become a supporter of selected websites, such as the Water Channel.
5) Prepare high quality (IAH-copyrighted) images and schematics that people can download and which can be included in lectures and presentations.
6) Prepare (IAH-branded) groundwater advocacy materials such as banners, logos, stickers.
7) Prepare promotional materials such as IAH desktop calendar and screensavers with some key facts and figures about groundwater. In this respect, the *Managed Aquifer Recharge* (MAR) network produced a calendar some years ago. As a more recent example, the FAO calendar for December 2013 can be found at:
   http://www.fao.org/nr/water/art/2013/calendar/LW_web_Cal12-01.jpg
8) Prepare a mobile phone app.
9) Prepare a list of the "Seven wonders of the hydrogeological world" along the lines of the Australia list prepared by the Australian NC (http://www.iah.org.au/seven-wonders/). This could be a good way of educating members of the public and raising awareness of hydrogeology

For each of the above options, the main target audience would need to be identified.

3.3 Thematic papers

The CGO has access to a wide range of materials and is well-placed to advise on what additional materials are needed by IAH for informing policy makers, members of the public, etc. Potential topics suggested by the CGO include:

- Hydraulic fracturing and groundwater
- Agricultural chemicals and groundwater quality
- Assessing groundwater resources in arid areas
- Aquifer recharge and recovery technology
- Urbanization impacts on groundwater
- Smartphones and groundwater data collection

An additional list of potential topics has been suggested by Stephen Foster, who contacted the IAH Executive independently of the activities of this working group. He pointed out that the on-going global water resource policy dialogue is almost entirely conducted around the following strategic topics:

- Water security and climate change
- Water resources and food security
- Water and energy
- Water in global urbanisation
- Water for health and poverty mitigation
- Water in ecosystems and biodiversity.

Dr Foster considers that IAH in particular (and the professional groundwater community more generally) is at a disadvantage in trying to influence water policy from not having a clear position on groundwater in each of these topic areas, with a cadre of persons available to articulate that position.

There is some overlap between Dr Foster's list and the list suggested by the CGO, e.g. with regards to urban impacts on groundwater. For this topic, and the two last-named topics on Dr Foster's list, IAH already has much material as a result of past and present commissions, congresses and the Burdon network – and it would not involve much effort to generate and publicise an authoritative IAH position. But for the former three of the listed topics, it would take a significant effort to establish a well researched and robust Association position.

For any of the proposed thematic topics a short (3-4 page) document would probably be most effective.

4 Questionnaire survey

Following the investigations of course and educational materials described in Sections 2 and 3, it was decided to survey our members to find out more about their educational needs and interests. Kellie Nicholson of the Secretariat helped in formatting and launching the questionnaire "IAH and education: Have your say". The on-line questionnaire went live on 25th April 2014 and continued open until 31st May 2014. The *Survey Monkey* tool was used. A number of emails were sent to members asking them to participate in the survey, and an article in the IAH Newsletter also advised readers about the survey. There were 63 responses in total. The responses (including summary statistics) are included in the pdf file *Summary of 2014 IAH Education Questionnaire Survey Responses*, which forms Appendix B to this report (but as a separate document).

Some observations on the survey results are included below:

Q1 Which of the following should be of highest priority for IAH in enhancing its role in education services?

- Organising webinars
- Facilitating short courses run by our national chapters and at IAH congresses (see Q4 below)
- Providing details of international hydrogeology education (including Masters programmes) on our website
- Providing downloadable lecture materials on the IAH website
- Preparing IAH thematic papers (see Q6 for details, below)

Responses (63)

All five items received some support, with almost equal highest scoring going to: organizing webinars; facilitating short courses; and providing downloadable lecture materials.

Q2 Do you have any other suggestions? Ideas could include, for example, an IAH YouTube channel (or similar); additional support for young authors to publish their work; an IAH calendar; screensaver; mobile phone app; IAH templates for talks.

Responses (40)

As expected, there were a lot of suggestions, with many respondents liking the idea of a YouTube channel (or equivalent). An events calendar also received good support.

Q3 What topics should be prioritised for webinars?

Responses (37)

There is demand for webinars at various levels, ranging from fundamentals of hydrogeology to more specialised topics such as pumping tests, hydrochemistry, regional groundwater flow - and on to cutting edge research. There is also interest in webinars on topical subjects such as fracking and groundwater flooding.

Q4 How could IAH centre improve its support for short courses run by national chapters and at congresses? This could be by advertising through IAH website; by compiling a list of experts who may be able to help NCs in running delivering courses.

Responses (32)

Better advertising through the IAH website is mentioned in several responses. There is also support for IAH compiling a list of experts for assisting with courses. Financial support is also suggested.

Q5 What topics are of most interest to you for short courses or for downloadable lecture materials? (Questionnaire included space for respondents to input three suggestions).

Responses (42)

A huge range of topics is included in the responses, from basic materials suitable for school-age children to specific hydrogeological topics such as courses on field measurement techniques. Clearly, it will be essential to identify the target audience in every case.

Q6 What should be the priority topics for IAH thematic papers? Note: thematic papers of 3 to 4 pages would focus on groundwater-related topics of strategic importance to achieving the

objectives of IAH, including the advancement of public education about groundwater science and to promote the sound utilization, management and protection of groundwater resources.

- Groundwater and energy
- Groundwater security and climate change
- Groundwater resources and food security
- Groundwater and hydraulic fracturing
- Groundwater in urban environments

Responses (62)

Of the five topics proposed, *Groundwater security and climate change* and *Groundwater resources and food security* received most first preferences and the highest rankings overall. Interestingly, *Groundwater and hydraulic fracturing* received the lowest first preferences and lowest ranking score, despite being a current "hot topic".

Q7 Other suggestions for thematic paper(s).

Responses (15)

Unsurprisingly, there was a variety of other suggestions for thematic papers; conceptual hydrogeological models were mentioned in a few responses.

5 Recommendations

This feasibility study report has identified many possible options for enhancing the role of IAH in training courses and in providing additional educational materials. The on-line questionnaire survey provided support for IAH to increase its educational services, and helped to identify members' educational needs and interests. One key feature in implementing any recommendations will be to identify the target audience in each case – for some items the target audience will be mainly our own members, whereas for other actions, the target audience may include all or any of the following: the general public; schoolchildren; university students; policy makers; water engineers and other non-hydrogeology professionals working on groundwater issues.

Based on the feasibility study and member survey, the WG recommends that priority actions should now include:

a) Developing a separate *Education and Training* banner on the IAH website home page.
b) Preparing a list of hydrogeology degree courses available internationally, with links to course information from the IAH Education web pages. (An article could be placed in the next IAH Newsletter asking educational institutions if they would like their hydrogeology course listed on the IAH website – inclusion on such a list would not imply endorsement of any particular course, so a disclaimer would be added).
c) Listing short-courses, field courses and webinars organized by national chapters on the IAH Education webpages.
d) Developing an IAH YouTube channel (apparently there are no direct fees for this). The channel could then show recordings of e.g. keynote talks from IAH congresses as well as, in time, dedicated educational lectures and films on groundwater topics.
e) Linking in with existing webinar providers to provide IAH-branded talks. (In this respect, the US national chapter already has links with NGWA, for example).
f) Conducting a *Google Adwords* campaign for a short period of time, using high impact search terms to understand what set of searches is most common, since this may provide insights into training topics that would be appeal to non-specialists.

g) Compiling an international panel of experts who would potentially be willing to contribute to short courses organized and run by national chapters. The panel members' expertise and contact details would be made available on the IAH Education web pages. Again, an article could be placed in the IAH Newsletter asking for such volunteers.
h) Preparing IAH-branded educational materials (lectures, illustrations, etc) and making these available for download from the website. (In this regard the CGO is already preparing some generic PowerPoint presentations on groundwater topics).
i) Developing short thematic papers on key strategic topics to help IAH increase the awareness of groundwater issues amongst policy makers and water managers, and the wider public.

The above action list have is in approximate order of priority and/or ease of implementation. The action list is not exhaustive, and other potentially useful actions are listed throughout the report. Nevertheless, this list does provide a good starting point. The next things to consider are: how can these recommendations best be implemented, and what are the costs involved?

Regarding implementation, it is proposed that a small expert group be established, a group that would be within or closely aligned to the Early Career Hydrogeologists Network (where there is clearly a lot of enthusiasm surrounding educational activities). The expert group would report directly to the IAH Executive. It would also liaise with the Commission for Groundwater Outreach to ensure that there is no duplication in activities.

The costs involved in implementing most of the actions identified above would be mainly a) administrative costs associated with updating and maintaining the Education webpages, and b) support costs for members of the expert group to meet and discuss actions. The Action Plan arising from the 2010 Forward Look initiative identified a budget of €4,000 for undertaking the education feasibility study (listed as two items in the Action Plan: €2,000 for the study of short courses and €2,000 for the study into educational materials). The activities of the current WG on Education have been mainly carried out by email so have been cost-neutral to date. However, some provision for meetings of the new expert group would be advisable. It is therefore proposed that the €4,000 budget included in the Action Plan be allocated for the implementation of this report's recommendations, including the additional secretariat costs for maintaining the educational webpages and the costs to support the expert group. The budget could also be used to partly fund the production of some educational materials and the organization of webinars. It is proposed that the budget should support the educational activities for an initial 3-year period.

Appendix A
Rapid Twitter Analysis

Results for #groundwater webinar (through January 2014) - Top / All /

1. **NGWA @ngwatweets** Jan 21

   NGWA **Webinar**: **#Groundwater** and Salt Town Hall: Restoring the Equilibrium After Severe Weather Events. Feb.19 **@2** pm ET http://ow.ly/ssYqo

2. **ON24 @ON24** Jan 10

   Hosting webinars? Learn how to get the most out of your **webinar**. Download Webinars for Dummies here: http://bit.ly/18meprV

3. **Water Well Journal @WaterWellJournl** Jan 16

   RT **@ngwatweets**: Free member **webinar** - Mar.3 - 'Get Ready for the **#NGWA** Congressional Drive-in' http://ow.ly/sx8Bf . **#groundwater**

4. **Geoscience Center CI @CenterGeoCI** Jan 13

   RT **@ngwatweets**: NGWA **Webinar** **#Groundwater** & Salt Townhall, Restoring Equilibrium After Severe **#Weather** Feb.19, 2pm ET http://ow.ly/ssYfU

5. **Kings Basin Water @KingsWater** Jan 8

   GRA Jan 22nd **webinar** to focus on CV-SALTS' salt & nutrient management planning efforts: http://grac.org/snmp4.asp **#groundwater** **#agriculture**

6. **Water Well Journal @WaterWellJournl** Jan 7

   RT **@REGENESISEnviro**: **#Remediation** **Webinar**: Register for chlorinated solvents in **#groundwater** **webinar** on Jan 14th! http://bit.ly/1cyRJp

7. **REGENESIS @REGENESISEnviro** Dec 23

Learn more about our chlorianted solvents in **#groundwater** **webinar** presenter, Doug Davis. http://bit.ly/1cyRJpM

8.  **Groundwater CSV @GroundwaterCSV** Dec 8

   RT **@WaterWired** **Webinar**: '**#Groundwater** & International Law: Current Status & Recent Developments' 11 Dec 1630-1800 CET http://is.gd/7JhDSl

9.  **Tim Sowecke @timsowecke** Dec 6

   @Trihydro: **WEBINAR**: New **#Wyoming** **#Groundwater** Baseline Sampling Rule - Impacts to Your Drilling Program. Join us 12/9 http://bit.ly/1bIZezt

10.  **Alvar Closas @alvarclosas** Nov 21

    #Webinar Incorporating Climate Information and Stakeholder Engagement in **#Groundwater** planning n Management https://wrrc.arizona.edu/node/12605

11.  **Mark Eisner @Alwi_Eisner** Oct 28

    .MT **@WaterWellJournl**: **@USGS** **webinar** on **#groundwater** depletion and streamflows: http://water.usgs.gov/coop/StreamflowDepletion_Announcement.pdf …

12.  **Alvar Closas @alvarclosas** Oct 23

    webinar this friday on **#groundwater** global perspectives **@TheWaterChannel**, http://thewaterchannel.tv/en/webinar

13.  **Michael E. Campana @WaterWired** Oct 21

    25 Oct **Webinar**: **#Groundwater** in Global Perspective: Unveiling what local studies fail to notice http://is.gd/mpkBUw **@TheWaterChannel**

14.  **Amy Galford @amy_galford** Sep 10

    Listening to **webinar** on "Strategies to Protect Groundwater Wells and Springs in PA" from **@agsciences** https://meeting.psu.edu/water1 **#Groundwater**

15.  **NGWA @ngwatweets** Jul 31

    NEW: **#Groundwater** and Salt Town Hall: Restoring Equilibrium After Severe Weather Events.(**webinar**) 2 pm ET. Aug. 14. http://ow.ly/nvwKY

16.  **Environmental Expert @enviroexpert** Jun 3

    FMC Corporation Announces **#Soil** and **#Groundwater** Educational **Webinar** Series http://ow.ly/lD78q

17.  **Water Well Journal @WaterWellJournl** May 28

    RT **@ngwatweets**: Will you be attending this upcoming **webinar**? **#Aquifers** of the United States. June 5. http://ow.ly/lsCzk . **#groundwater**

18.  **Mike Jones @GroundwaterMike** May 14

    .**@ngwatweets** Wellfield Asset Management Course http://ow.ly/kZoil Sounds great. Potential as **#groundwater** **webinar** outside USA?

19.  **Barrington Hills, IL @BarrHills_IL** Mar 11

    Missed the **@BacogNews** **#groundwater** **webinar**? Check out their page page and learn about your drinking water! http://bit.ly/XEfQAt

    from Barrington, IL

20.  **YSI, a xylem brand @YSIinc** 26 Apr 2012

    Trees as tools to treat common **#groundwater** contaminants focus of NGWA **Webinar** on Environmental Expert http://shar.es/rLIbb

21. **WatrHub Inc. @WatrHub** 24 Apr 2012

    How can trees treat common **#groundwater** contaminants? Find out during **@ngwatweets**'s **webinar** on June 5th! http://ow.ly/atMDe

22. **NGWA @ngwatweets** 18 Apr 2012

    Upcoming **webinar** - Introduction to the Phytoremediation of Common **#Groundwater** Contaminants (#845)

23. **NGWA @ngwatweets** 4 Apr 2012

    Attn hydrogeologists! Check out this **Webinar** in April - Life Cycle of **#Groundwater** Data - Register by Apr.17 & save $! http://ow.ly/9NAjC

24. **YSI, a xylem brand @YSIinc** 16 Nov 2011

    Hydraulic Fracturing: Fresh Facts & Critical Choices **#Webinar** Series. **#fracking** **#groundwater** http://bit.ly/rWkIlB

25. **YSI, a xylem brand @YSIinc** 9 Nov 2011

    EPA's Plan to Study Potential Impacts of **#Fracking** on Drinking Water Resources. **Webinar** Nov. 10. **#groundwater** http://bit.ly/sxPrCw

26. **REGENESIS @REGENESISEnviro** 9 Nov 2011

    Don't miss our **webinar** briefing on "New Technology Advancements" tomorrow, for more information visit http://ow.ly/7o1xc **#groundwater**

27. **Cameron Tana @HydroCam** 6 Oct 2011

    Just finished free **#Groundwater** Vistas modeling **webinar** with Jim Rumbaugh. Another session at 5 pm PDT http://bit.ly/o90Bxp

28. **Geosyntec News @Geosyntec** 14 Feb 2011

Peter de Haven and Jamey Rosen Present NGWA **#Groundwater** Data Management **#Webinar** http://bit.ly/h8XgVQ

You've reached the end of the Top Tweets for **#groundwater webinar**. View all Tweets.

Appendix B
IAH and Education – Have Your Say

(The questionnaire survey responses are included as a separate document)