03 – Hydrology and Communities: A Hydrogeological Study of Irish Holy Wells

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Abstract
As part of efforts to improve water management in Ireland there is a need to promote greater awareness of groundwater issues amongst the general population. One means by which hydrogeologists can engage and educate local communities about groundwater issues is by addressing topics of direct interest to them, such as holy wells. In Ireland there are more than 3,000 holy wells, many of which are sites of devotion, especially on the pattern or saint's day. Some of these holy wells are visited by pilgrims seeking a particular cure for an ailment (eye cures, backache, toothache are common examples). Many have been associated with a more generic power of healing and wellbeing. Whilst Irish holy wells have been the subject of scholarly study in disciplines such as archaeology, history, geography and cultural studies, very little attention has been given to their hydrogeological settings. This paper describes the results of a hydrogeological characterisation of Irish holy wells, based on a GIS analysis supplemented by field surveys of more than 200 wells. It was found that holy wells occur in most types of geology in Ireland, and are common in the less productive as well as in the regionally important aquifers. Importantly, however, they occur more frequently in areas classed as having extreme or high groundwater vulnerability to pollution; this is consistent with the observation that many holy wells are in fact springs or shallow wells constructed around springs or groundwater seepages. Many holy wells have been lost through neglect or through various development projects, and there is a need to preserve important wells as part of our geological as well as our cultural heritage. The current high levels of interest in holy wells amongst certain communities may warrant a move towards some more formal protection of these wells as a community resource.

1. INTRODUCTION

A holy well can be regarded as a well or spring at which religious devotions are, or have been, practised. Given the fundamental importance of water to human existence, it is not surprising that water is widely venerated and that holy or sacred wells are found across the globe (Misstear *et al.*, 2017). What is unusual about Ireland is the large number of these wells. Based on mapping carried out by the Ordnance Survey in the nineteenth century, there are (or were) believed to be about 3,000 holy wells in the Republic of Ireland. Many of these have reputations for healing, commonly cited cures being eye problems, toothache and warts; indeed, Bord and Bord (1985), in an account of holy wells in Britain, mention 75 cures! Foley (2010) and others point out that faith in the healing properties of the water and its religious significance are key elements of the water cure.

Holy wells are studied by a range of disciplines, from archaeology, heritage and religious studies, to history, geography and cultural studies, including the arts: notable books include those by Logan (1980), Healy (2001), Foley (2010) and Ray (2014). There are also a number of books that give accounts of holy wells in individual counties: e.g. Branigan (2012, Dublin), French (2012, Meath), Houlihan (2015, Clare) and Broderick (2016, Waterford). However, the hydrogeological characteristics of these wells have not been studied previously. To address this knowledge gap, this current research aims to answer questions such as: What are the geological settings of Irish holy wells, and are they more common in certain geologies than others? And do the water

chemistries of holy wells vary from the water chemistries of other wells in similar hydrogeological environments, but which are not regarded as holy wells? This paper will primarily address the first research question. In doing so, we will also consider the value of holy wells as a community resource.

2. GEOLOGICAL AND HYDROGEOLOGICAL SETTINGS OF IRISH HOLY WELLS

An analysis of the distribution of holy wells according to their geology, aquifer category and groundwater vulnerability has been carried out within a geographical information system (GIS). The GIS tool used was ArcMap 10.3. A shapefile containing basic information on 2996 holy wells was provided by Maynooth University; the data were from a National Monuments Service database. The geological and hydrogeological layers were downloaded from the Geological Survey of Ireland (GSI) Groundwater Mapping website (https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx). All the shape files were in raster format. In viewing the results the reader should note that there were no grid references for 320 of the wells in the holy wells database file, and so these were eliminated from the analysis. Furthermore, in each determination of the number of wells falling within a particular geological or hydrogeological category, some of the wells were not picked up – this number varied from 48 to 107 wells, representing only 1.8% to 4% of the total.

2.1 Distribution of holy wells by lithology

The distribution of holy wells according to the 27 bedrock units defined by the Groundwater Division of the GSI is shown in Figure 1. The largest number of wells is found in the Dinantian Pure Bedded Limestones (515), Devonian Old Red Sandstones (332) and Dinantian Upper Impure Limestones (237). The following bedrock units contain fewer than 10 holy wells: Westphalian Shales (4), Permo-Triassic Sandstones (1), Permo-Triassic Mudstones and Gypsum and Westphalian Sandstones (zero in both units). In the case of the Permo-Triassic units, in particular, it should be noted that these are restricted to very small areas within the Irish Republic.

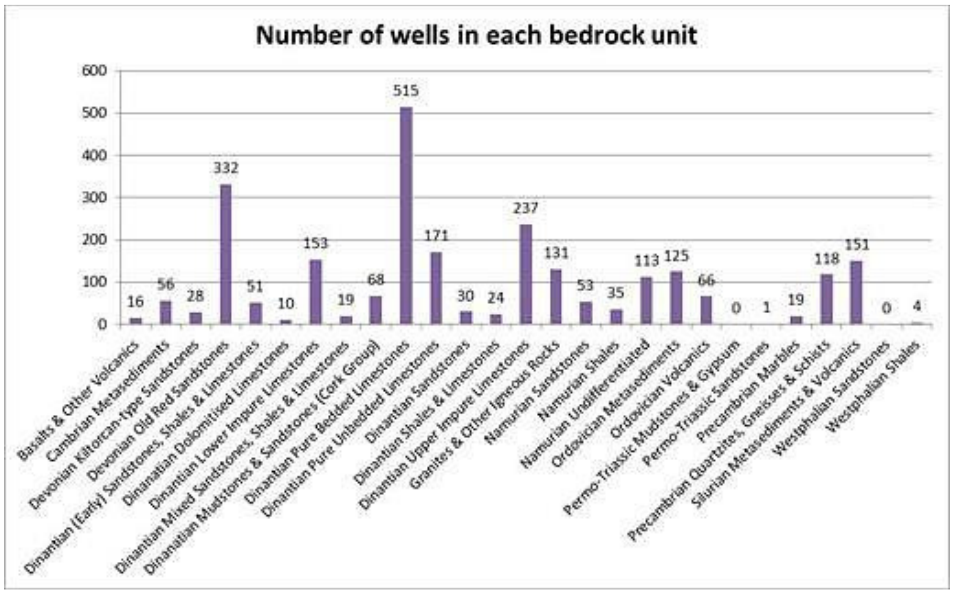

Figure 1: *Distribution of holy wells according to bedrock unit (n = 2,526)*

In view of the relatively small number of wells found in some bedrock categories, the GIS analysis was repeated after grouping the 27 bedrock categories into 5 main lithological groups, and adding sand and gravel

deposits as a sixth group. These are the same lithological groupings used by Tedd *et al*. (2017) in their analysis of natural background groundwater chemistry in Ireland. The results of this analysis are shown in Figure 2, where the percentage areas covered by each lithological grouping are shown alongside the percentage wells in each lithology. It can be seen that the distribution of holy wells is approximately in line with the areas of covered by each lithology.

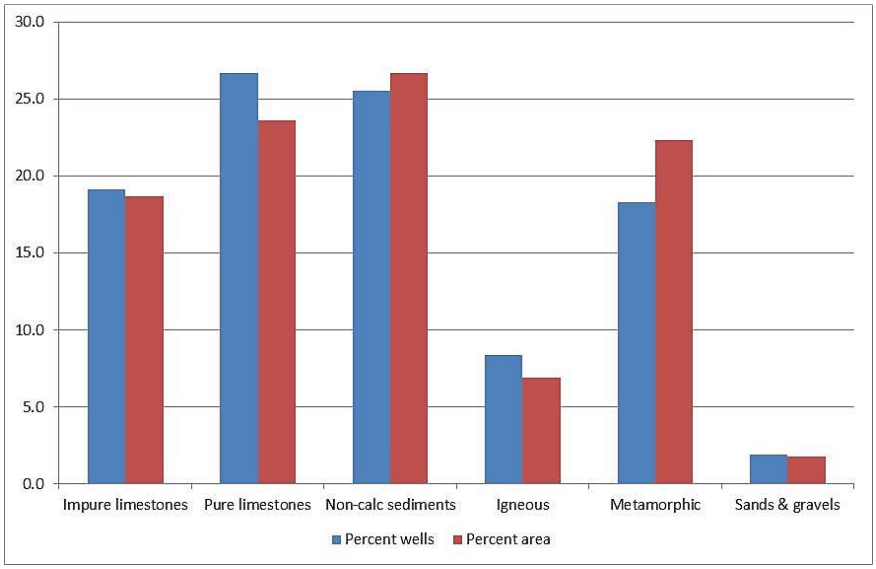

Figure 2: *Percentage of holy wells in the main lithological groupings (n = 2,618)*

2.2 Distribution of holy wells by aquifer category

In Ireland, aquifers are classed according to their relative groundwater productivity in terms of well and spring yields; the area covered by a particular aquifer is also taken in account, as is the dominant flow characteristic. There are three main aquifer categories: regionally important, locally important and poor, with a total of nine subcategories (Geological Survey of Ireland, 2009). The distribution of holy wells by aquifer category is illustrated in Figure 3. The largest proportion of wells are found in the locally important (Ll) and Poor (Pl) groups, which again is in line with the dominance of these aquifer types in Ireland. In other words, one is as likely to find a holy well in a poorly productive aquifer as in a regionally important aquifer.

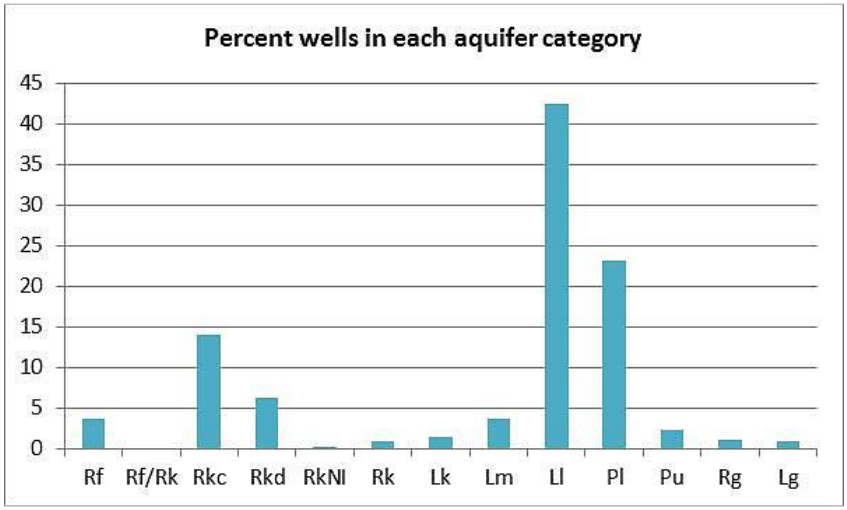

Figure 3: *Percent wells in each aquifer category (n = 2,664)*

2.3 Distribution of holy wells by groundwater vulnerability category

The vulnerability of groundwater to pollution is determined mainly based on the thickness and especially permeability (hydraulic conductivity) of the subsoils that cover Ireland; recharge type as well as the presence of karst features are also taken into account (Department of the Environment *et al*. 1999; Misstear and Daly, 2000). In Figure 4, the data are normalised by presenting the number of holy wells per 250 km^2 within each vulnerability class. It is evident from the figure that holy wells occur more frequently in the X and E Extreme vulnerability categories (where bedrock outcrops, or is found at less than 3 m below the ground surface) compared to the Low vulnerability category (where the subsoils are greater than 10 m in thickness). This result is unsurprising when viewed against the results of the field surveys, described below, which indicate that the majority of Irish holy wells are shallow wells or springs.

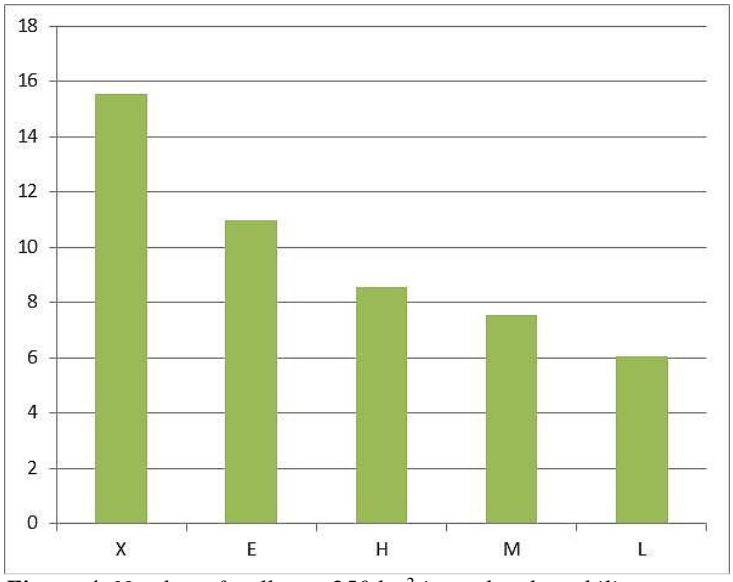

Figure 4: *Number of wells per 250 km^2 in each vulnerability category (n =2,608)*

2.4 Field surveys

Field surveys have been carried out of 215 holy wells across the 26 counties. These range from wells on small islands and along shorelines, to wells in river valleys or on hills. At each well basic information such as location (Irish grid reference, ITM reference and latitude/longitude), accessibility and details of the well are recorded, including dimensions of the well and well house, depth to water and depth of water. Features of hydrogeological interest are also noted, e.g. whether the spring or well corresponds to a change in topographic slope, or the presence and characteristics of any bedrock outcrops nearby. Measurements of electrical conductivity (EC), temperature and pH of water samples are made on site, and water samples are also collected for subsequent analysis in laboratories – unfiltered samples for anion analyses and filtered and preserved samples for cations and trace element analyses. Of the 215 sites visited, 27 wells were dry, abandoned or otherwise inaccessible for sampling.

A hydrogeological report – typically six pages long - is then prepared for each well. This includes the information collected during the field survey plus data and maps on the well geology (subsoils and bedrock), groundwater vulnerability and aquifer class obtained using the GSI online mapping resource. It is intended that these reports will provide a useful data resource on holy wells, to complement other databases (see Section 4 below).

Four holy wells were selected for periodic monitoring and sampling over a two-year period. These represent a range of hydrogeological conditions: St Brigid's well at Tully in County Kildare is sourced from the mid-Kildare sand and gravel aquifer; St Moling's well in St Mullins, Co Carlow, taps a weathered granite aquifer; St Kieran's well at Castlekieran in Co Meath comprises three springs that issue from a karst limestone aquifer; and Bride's well near Kilcock, also Co Meath, is sourced from an impure limestone aquifer, and has a reputation as a warm water well.

The chemical analysis work is ongoing. The analyses include major cations and anions, minor ions such as iron and fluoride, plus a wide range of trace elements. Nitrate is included as one of the anions for analysis, since it is a useful indicator of anthropogenic pollution. The trace elements being determined include those elements that have been identified (based on an extensive literature review) as being beneficial for health, and those that are potentially harmful when present in excess concentrations. The cation and trace element analyses are being carried out using ICP-MS (inductively coupled plasma mass spectrometry) equipment in the Geochemistry laboratory in Trinity College Dublin. Whilst it is too early to present the hydrochemical results, what is clear is that there is a large variation in the hydrochemical characteristics of Irish holy well waters. For example, EC values range from 43 to about 60,000 $\mu S\ cm^{-1}$, the latter sample taken from a well that gets inundated with sea water; the median EC value for 188 one-off samples is 477 $\mu S\ cm^{-1}$.

Once all the hydrochemical data are available, it is intended to compare values for the different parameters to the natural background values established in the study by Tedd *et al*. (2017). The objective here will be to test whether there are any apparent differences between the chemistry of water taken from holy wells, and groundwater samples collected from other wells. In addition, samples have also been collected from five former spa wells during the field surveys, and will be included in the comparisons.

3. COMMUNITY INVOLVEMENT: the Irish holy well as a therapeutic landscape

As noted previously, there are (or were) more than 3,000 holy wells spread fairly evenly across the island of Ireland. They are to be found in most Irish communities, both rural and urban, and range in both their size and degree of preservation. While there has always been a strong pilgrimage tradition around some of the wells, especially on the pattern or saint's day, they are also sites of regular everyday devotion (Foley, 2010). This was highlighted during the field surveys when there were many encounters with individuals or groups at holy wells. The primary reason people visit wells is linked to their associated therapeutic power, for both physical and mental healing. Geographers and anthropologists have documented the different histories of holy wells and their variable healing properties (Foley, 2011; Ray, 2014). From a physical health perspective, and as noted in the introduction, different holy wells have a reputation, often reflected in their names, for cures of particular ailments, with eye cures, warts, backache, toothache being especially common examples. In the case of eye cures, there are a number of *tobar na súil*, or with variant spellings like *tobernasool*, dotted around the country. One objective of the ongoing hydrogeological and water chemistry research described above is to help to begin to explore patterns and spatial relationships with those healing stories.

More commonly, wells have been associated with a more generic healing power. Health geographers in particular have identified holy wells as classic examples of what they term therapeutic landscapes, defined by Gesler (2003) as 'places that have achieved lasting reputations for providing physical, mental and spiritual healing' and discussed as such in a number of recent Irish publications (Foley; 2010, 2011, 2013). The traditional healing reputation of the well was initially associated with the water itself, which was drunk in-situ or taken away for consumption elsewhere, either domestically or even in some cases, given to emigrants on their departure as part of the Irish diaspora (Ray, 2014). But equally, it was the places themselves that were part of the cure. Many wells are located in quiet rural landscape settings, often with calm natural surroundings within woods or by lakes or rivers. This idea of a calming place effect was also a reason why they were identified as therapeutic landscapes. Seen like this, mental health was also a significant part of their healing reputations for stress reduction, attention-restoration and socialisation, all recognised in contemporary healthy psychology as key ways in which nature works to promote human health and wellbeing. A classic example would be *Tobar na nGealt*, or the 'well of the insane', near Camp, Co. Kerry, a holy well setting long associated with the treatment of mental illness.

In terms of community involvement, holy wells can be identified as important local assets, both in terms of cultural heritage and local place memory. Some wells, like St Brigid's well at Liscannor in Co Clare, are popular with tourists. Yet, while many local enthusiasts, from a range of different perspectives, both spiritual and secular, do sterling work in maintaining sites and organising community events like walks and patterns, they are still neglected in significant ways. This is in part to do with their locations and ownership, but also how they are viewed in the 21st century. Many are on private land and in effect inaccessible. There are no requirements for owners to preserve or maintain them and many of the 3,000 wells listed on the various official monuments records have long since disappeared or been filled in or ploughed over. French (2012) noted that of the 130 or so holy wells in County Meath only three wells were protected in the County Development Plan – and none was mentioned in the Meath Archaeological Survey.

But many other holy wells become important sites for community activity around the pattern day; places like Ardmore have a week-long festival dedicated to St Kevin, and Lady's Island in Co Wexford has seen gatherings of as many as 20,000 pilgrims on the pattern day in August, while St. Mullins in Co Carlow has a

pattern that links the holy well to a large community event in the nearby graveyard; indeed St Moling's well is an example of a holy well with a long history of pilgrimage: it was visited by several thousands of pilgrims in the plague year 1348 (Clyn, 2007). Sometimes large gatherings at a holy well have had a political as well as religious focus: about 10,000 people attended the pattern celebrations at St Kieran's well in Castlekieran, Co Meath, in 1917 to listen to a speech by Countess Markievicz (a stone plaque commemorating this event was erected near the entrance to the site in 2016). Yet their traditional catholic associations and a wider disregard as sites of superstition and ignorance have seen them begin to disappear from view, both literally and metaphorically.

4. COMMUNITY INVOLVEMENT: citizen science and Irish holy wells

In developing initiatives to try and reverse that disappearance, and to begin to better document holy wells in comprehensive ways, there are a number of important recent initiatives, to which this research will contribute. Last year, US-based scholar, Celeste Ray initiated a project, 'Ireland's Holy Wells: County by County', within which members of the public are encouraged to upload details of holy well sites through an open online database (http://ihwcbc.omeka.net/instructions). This website is still live, and Dr Ray would welcome additional submissions. In some ways this project mirrors work organised by the Heritage Council in their Dúchas.ie website. This site is a repository of scans from the state-funded Schools Collection from 1937-8, which recorded oral histories about holy wells alongside more general folklore material (https://www.duchas.ie/en/cbes). This involved 50,000 schoolchildren from 5,000 primary schools across the Irish Free State collecting information on folklore in their area, and the information from the Schools' Collection comprised 450,000 pages in bound volumes. Both of these initiatives are important examples of how citizen science can help an organised and updated documentation of holy wells. There are also county council led initiatives to document wells, such as in Donegal and Meath that are part of wider commissioned heritage projects.

Apart from enhancing our understanding about the hydrogeology of holy wells, it is hoped that the documentation from the present research will help increase awareness amongst communities about groundwater issues more generally. Being out of sight and therefore out of mind, there is a low level of awareness about groundwater both in Ireland and internationally. Indeed, many international water policy documents largely ignore groundwater, even though it provides about half of the world's drinking water, and sustains the flow of rivers through dry periods. Engaging with communities about how their well or spring functions should help promote a wider awareness of issues such as the need to protect groundwater resources from pollution. (During sampling of a holy well at Templetown in the Cooley peninsula, the lead researcher was most impressed by the level of engagement and insightful questions asked by a group of primary school children who were visiting the well at the same time).

Yet documentation will only act as one part of a wider aim to preserve and encourage people to visit and use holy wells. The recent example of the reduction of a large holy well site at Warrenstown (Co Meath) or ongoing issues with the safety of water drunk from wells, via pollution prevention, remain problematic. There is no national organisation with a brief to manage holy wells.

5. CONCLUSIONS

The hydrogeological studies have demonstrated that holy wells occur in all aquifer categories. Of most significance to communities and to the heritage value of the wells, is the finding that these mostly shallow wells or springs are more commonly found in areas of Extreme or High vulnerability to pollution than in areas with a good protective cover and Low vulnerability. Hence it is clear that many of these wells will be susceptible to pollution from local agricultural or waste disposal activities.

While the initiatives documented in Section 4 above do document wells in a random way, part of the initiative of this research is to produce a more standardised database model, with links to other resources, which might act as a model to help with a concerted push for a more formal protection model that might be developed in conjunction with the Heritage Council, holy well groups and private landowners. Many holy wells, and the stories about them, have been lost through neglect or through various development projects and there is a need to preserve important wells as part of our geological as well as our cultural heritage. The current high levels of interest in holy wells among certain communities may warrant a move towards some more formal protection of these wells as a community resource.

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