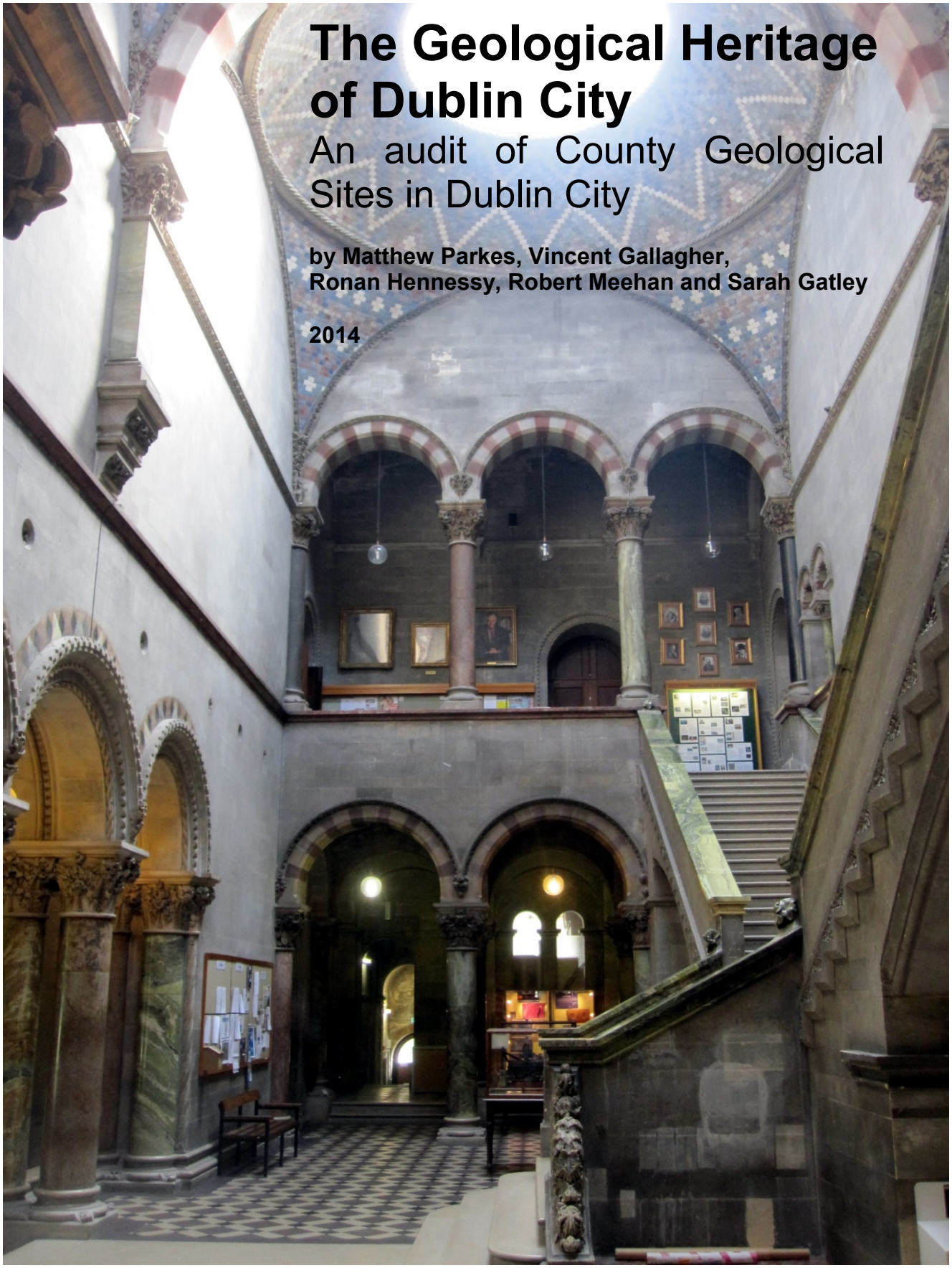

The Geological Heritage of Dublin City

An audit of County Geological Sites in Dublin City

by Matthew Parkes, Vincent Gallagher, Ronan Hennessy, Robert Meehan and Sarah Gatley

2014

An Chomhairle Oidhreachta
The Heritage Council

Comhairle Cathrach Bhaile Átha Cliath
Dublin City Council

GSI
Suirbhéireacht Gheolaíochta Éireann
Geological Survey of Ireland

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The Dublin City Geological Heritage Project was supported by

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This report is an action of the Dublin City Heritage Plan 2002-2006

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Report Summary

Dublin City is not somewhere that one would think of for its geological heritage since the built-up nature of the City allows very little room for what are typically rural sites. The County Council's support for this audit is critical in raising the profile of geological heritage in Dublin City. The geology of the city itself, allows a fresh and innovative approach to geological heritage within the broad spectrum of the County Geological Site classification, particularly in relation to the use of stone in landmark buildings and iconic structures.

This report documents what are currently understood by the Irish Geological Heritage Programme (IGH) of the Geological Survey of Ireland (GSI) to be the most important geological sites within Dublin City. It proposes them as County Geological Sites (CGS), for inclusion within the Dublin City Development Plan (DCDP). The audit provides a reliable study of sites to replace a provisional listing of four sites, based on desk study which was adopted in the current DCDP (2011 -2017).

County Geological Sites do not receive statutory protection like Natural Heritage Areas (NHA) but receive an effective protection from their inclusion in the planning system. However, none of the sites described in this report are considered to be of national importance as best representative examples of particular geological formations or features. However, one of the sites, North Bull Island falls within the existing North Dublin Bay SAC 206 and North Bull Island SPA 4006 where the ecological interest is actually founded upon the underlying geodiversity. The commission of this audit and adoption of the sites within the Dublin City Development Plan ensure that Dublin City follows a now established and effective methodology for ensuring that geological heritage is not overlooked in the general absence of allocated resources for progress at national level. It ensures that Dublin City remains at the forefront of geological conservation in Ireland, and is included within the completion of audits for the Greater Dublin area (Meath, Fingal and Kildare completed, South Dublin, Dun Laoghaire Rathdown and Wicklow in parallel with Dublin City).

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This report is written in non-technical language (with a glossary for unavoidable geological terminology) as a working document for use by the Heritage Officer and the Planning department of Dublin City Council. It will also be made available via the City Council website for the people of Dublin City. A chapter of the report includes recommendations on how to best present and promote the geological heritage of Dublin City to the people of the city. It will also inform the work of the IGH Programme and be made available through the GSI website.

The preliminary sections, summary geological history and accompanying map, timescale and stratigraphical column, in particular, may be used to preface a booklet or as website information in the development of this work, and as seen fit by the Heritage Officer. The contents also provide the essential ingredients for a public-oriented book or other publications on the geological heritage of Dublin City, if the funding can be sourced to produce them.

Dublin City in the context of Irish Geological Heritage

This report ensures Dublin City remains active at the forefront of geological heritage within Ireland, as more than half of the counties have now commissioned such an audit within the scope of the county-based Heritage Plan. It will hopefully encourage the remaining local authorities to follow what is now a tried and trusted methodology. In the absence of significant political and economic resources available at a national level to the relevant bodies for conservation of geological heritage as Natural Heritage Areas (NHA), it represents a significant level of progress in defining and safeguarding Ireland's geological heritage.

It also represents a significant commitment on the part of the local authority, which in this instance is the Dublin City Council, to fulfil its obligations to incorporate geology into the spectrum of responsibilities under the Heritage Act 1995, the Planning and Development Act 2000, Planning and Development Regulations 2001, and the Wildlife (Amendment) Act 2000 and the National Heritage Plan (2002). GSI views partnerships with the local authorities, exemplified by this report, as a very important element of its strategy on geological heritage (see Appendix 1).

The Irish Geological Heritage Programme (IGH) in GSI complements other nature conservation efforts of the last decade, by assessing Ireland's geodiversity. Geodiversity is the foundation of the biodiversity addressed under European Directives on habitats and species by the designations of Special Areas of Conservation (SAC) and more recently on a national scale by the introduction of Natural Heritage Areas (NHA) as the national nature conservation method. As a targeted conservation measure to protect the very best of Irish geology and geomorphology the IGH Programme fills a void which has existed since the abandonment of the Areas of Scientific Interest scheme, listed by An Foras Forbartha in 1981.

The IGH Programme does this by identifying and selecting the most important geological sites nationally for designation as NHAs. It looks at the entire spectrum within Irish geology and geomorphology under 16 different themes:

IGH THEMES

1. Karst
2. Precambrian to Devonian Palaeontology
3. Carboniferous to Pliocene Palaeontology
4. Cambrian-Silurian
5. Precambrian
6. Mineralogy
7. Quaternary
8. Lower Carboniferous
9. Upper Carboniferous and Permian
10. Devonian
11. Igneous intrusions
12. Mesozoic and Cenozoic
13. Coastal geomorphology
14. Fluvial and lacustrine geomorphology
15. Economic geology
16. Hydrogeology

A fundamental approach is that only the minimum number of sites necessary to demonstrate the particular geological theme is selected. This means that the first criterion is to identify the best national representative example of each feature or major sequence, and

the second is to identify any unique or exceptional sites. The third criterion, identifying any sites of International importance, is nearly always covered by the other two.

Designation of geological NHAs will be by the GSI's partners in the Programme, the National Parks and Wildlife Service (NPWS). Once designated, any geological NHAs will be subject to normal statutory process within the Dublin City Planning Department and other relevant divisions. **However, compared to many ecological sites, management issues for geological sites are generally fewer and somewhat different in nature. The subsequent section considers these issues**.

From a national perspective, as a result of extensive comparison of similar sites to establish the best among them, there is now a good knowledge of many other sites which are not the chosen best example, but which may still be of national importance. Others may be of local importance or of particular value as educational sites or as a public amenity. All these various important sites are proposed for County Geological Site (CGS) listing in the County or City Development Plan, along with any clear NHA selections.

Currently, in 2014, a Master List of candidate CGS and NHA sites is in use, having been established in GSI with the help of Expert Panels for all the 16 IGH themes. For several themes, the entire process has been largely completed and detailed site reports and boundary surveys have been done along with a Theme Report, although none of these include Dublin City sites. Therefore, inclusion of all sites as County Geological Sites (CGS) in Dublin City's planning system will ensure that they are not inadvertently damaged or destroyed through lack of awareness of them outside of the IGH Programme in GSI.

The sites proposed here as County Geological Sites (CGS) have been visited and assessed specifically for this project, and represent our current state of knowledge. It does not exclude other sites being identified later, or directly promoted by the Council itself, or by local communities wishing to draw attention to important sites for amenity or educational purposes with an intrinsic geological interest. New excavations, such as major road cuttings or new quarries, can themselves be significant and potential additions to this selection.

It was not possible within the scope of this study to identify landowners except in a few sites, but it is emphasised that CGS listing here is not a statutory designation, and carries no specific implications or responsibilities for landowners. It is primarily a planning tool, designed to record the scientific importance of specific features, and to provide awareness of them in any decision on any proposed development that might affect them. It thus also has an educational role for the wider public in raising awareness of this often undervalued component of our shared natural heritage.

Geological conservation issues and site management

Since **geodiversity is the often forgotten foundation for much of the biodiversity** which has been identified for conservation through SAC or NHA designation, it is unsurprising that many of the most important geological sites are actually in the same areas as SAC and NHA sites. In these areas, the geological heritage enhances and cements the value of these sites for nature conservation, and requires no additional designation of actual land areas, other than citation of the geological interest.

Broadly speaking, there are two types of site identified by the IGH Programme. The first, and most common, includes small and discrete sites. These may be old quarries, natural exposures on hilly ground, coastal cliff sections, or other natural cuttings into the subsurface, such as stream sections. They typically have a feature or features of specific interest such as fossils or minerals or they are a representative section of a particular stratigraphical sequence of rocks. **The second type of site is a larger area of geomorphological interest, i.e. a landscape that incorporates features that illustrates the processes that formed it**. The Quaternary theme and the Karst theme often include such sites. In Dublin City, the underlying terrain has been so modified by human intervention over centuries, that the coast is really the only geomorphological landscape, yet even that is the result of human interference with the natural circulation of sediment in Dublin Bay. North Bull Island is the perfect example, having been formed only since the shipping channels were maintained, and prevented from silting up, by the construction of the North Bull Wall and Great South Wall. The great urban park area of the Phoenix Park is a Quaternary or Ice Age geological landscape, but even that landscape has been very heavily altered by human activity.

It is also important from a geological conservation perspective that planners understand the landscape importance of geomorphological features which may not in themselves warrant any formal site designation, but which are an integral part of the character of Dublin City. A lack of awareness in the past, has led to the loss of important geological sites and local character throughout the country. In Dublin City no Landscape Characterisation Assessment (LCA) was ever completed, as achieved in most other counties, but in the fully urban setting, this would not be an appropriate tool. Architectural Conservation Areas (ACA) provide a more useful tool for planners to help maintain the character of the City.

There are large differences in the management requirements for geological sites in comparison to biological sites. Geological features are typically quite robust and generally few restrictions are required in order to protect the scientific interest. In some cases, paradoxically, the geological interest may even be served better by a development exposing more rock. **The important thing is that the relevant planning department is aware of the sites and, more generally, that consultation can take place if some development is proposed for a site**. In this way, geologists may get the opportunity to learn more about a site or area by recording and sample collection of temporary exposures, or to influence the design so that access to exposures of rock is maintained for the future, or occasionally to prevent a completely inappropriate development through presentation of a strong scientific case.

In other counties, working quarries may have been listed because they are the best representative sections available of specific rock sequences, in areas where exposure is otherwise poor. No restriction is sought on the legitimate operation of these quarries.

However, maintenance of exposure after quarry closure is generally sought in agreement with the operator and planning authority in such a case. At present, no working quarries are included as County Geological Sites in Dublin City. These issues are briefly explored in a set of Geological Heritage Guidelines for the Extractive Industry, published jointly by the GSI and the Irish Concrete Federation in 2008.

A new quarry may open up a window into the rocks below and reveal significant or particularly interesting features such as pockets of fossils or minerals, or perhaps a karstic depression or cave. Equally a quarry that has finished working may become more relevant as a geological heritage site at that stage in its life. It may need occasional maintenance to prevent overgrowth of vegetation obscuring the scientific interest, or may be promoted to the public by means of a viewing platform and information panel.

However, quarrying within the City is extremely unlikely to happen, yet there are frequently large scale excavations for major construction projects, and even smaller single dwelling sites may expose deep foundations. Whilst the National Monuments Acts provide for archaeological recording in these situations, there is no formal legal provision for gathering the important geoscience data made available. The Geological Survey of Ireland has established data gathering systems through urban geology projects in Dublin, but sites can be missed out. An example from South Dublin is the N7 road widening at Rathcoole which exposed the significant contact between the granite and the Carboniferous limestones of Dublin, but this was learnt about in the GSI too late to record or sample the section.

Nationally, specific sites may require restrictions and a typical case might be at an important fossil locality or a rare mineral locality, where a permit system may be required for genuine research, but the opportunity for general collecting may need to be controlled. However, Dublin City's sites are not likely to require such an approach.

The inclusion of a range of specific CGS sites of architectural and public interest creates a new issue to consider, but most of these fall within well regulated or managed regimes of city parks, listed buildings or other planning protocols, so they are primarily sites of great potential for raising awareness of their geological materials or interest, rather than creating the requirement for new specific management concerns.

New exposures in development

One less obvious area where the Local Authority can play a key role in the promotion and protection of geology is in the case of new roads. **Wherever major new carriageways are to be built,** or in other major infrastructural work, it should be a policy within the Planning Department, that **where new rock exposures are created, they be left open and exposed** unless geotechnical safety issues arise (such as where bedding dips are prone to rock failure). The grading and grassing over of slopes in cuttings is largely a civil engineering convenience and a mindset which is difficult to change. However, it leads to sterile and uninteresting roads that look the same throughout the country. Leaving rock outcrops exposed where they are intersected along the road, improves the character and interest of the route, by reflecting the geology and landscape of the locality. Sympathetic tree or shrub planting can still be done, but leaving bare rocks, especially where they show interesting features, not only assists the geological profession, but creates new local landmarks to replace those removed in the construction of the roadway. This can also potentially save money on the construction costs.

In the broader Dublin context, such cuttings have been created at M50 junctions around the city, and on some of the spoke roads, such as the N4 at Lucan. Temporary cuttings were created for the Port Tunnel within the City, but in general there is no room for major new cuttings that may be exposed within the City limits.

Geoparks

An extremely interesting development in geological heritage, not just in Europe but internationally, has been the rapid recent growth and adoption of the Geopark concept. A **Geopark is a territory** with a well-defined management structure in place (such as Local Authority support), **where the geological heritage is of outstanding significance and is used to develop sustainable tourism opportunities**. Initially it was largely a European Geoparks Network (EGN) but since 2004 has expanded worldwide as the Global Geoparks Network (GGN) and is fully assisted by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) [see www.globalgeopark.org and www.europeangeoparks.org]. A fundamental theoretical basis of the Geopark is that it is driven from the bottom up – the communities in the Geopark are the drivers of the project and are the main beneficiaries. The Geopark branding therefore helps promote the geological heritage resource so that the community can benefit from it.

In Ireland there are three members of the Geoparks Network. One is the cross-border Marble Arch Caves Global Geopark in Fermanagh and Cavan [see www.marblearchcaves.net and www.cavancoco.ie/marble-arch-caves-global-geopark]. The Copper Coast Geopark in Waterford also joined the Network in 2001 [see www.coppercoastgeopark.com]. A now well established addition has been the Burren and Cliffs of Moher in County Clare [see www.burrenconnect.ie/geopark]. In addition there are aspirant groups exploring the work and infrastructure required for applications in other areas such as Joyce Country in Mayo and Galway, and the cross-border Mourne-Cooley-Gullion area. At present, Dublin City's geological heritage would not be suitable for the Geopark concept.

Proposals and ideas for promotion of geological heritage in Dublin City

There was little specific inclusion of geological heritage in the Dublin City Heritage Plan 2002-2006, as it is a topic that is often undervalued and poorly known in the wider community. As Dublin City's Heritage Plan is largely concerned with archaeological, historical and architectural heritage, unsurprisingly most is unrelated to geology except in the section covering natural heritage, although many of the aspirational objectives and actions apply in a general way to this audit. This section examines the few existing points in the plan relating to geological heritage and provides specific suggestions as to how these may be implemented, supported or enhanced by this audit of geological heritage sites in the county. However, this is primarily included as acomprehensive record, since the plan itself is dated, and the operating environment for the Heritage Officer is very different in 2014. The later section with specific ideas is more focused on today's needs and capabilities.

OBJECTIVES

1. To compile a comprehensive and accessible working archive for the natural environment
2. To raise awareness & appreciation of the natural environment

Audit Action: This objective is fulfilled by the geological heritage audit in relation to geological heritage of Dublin City.

TARGETS

a. Collect existing data on Dublin City & produce a GIS Map on a website
e. Geological and soil mapping

Audit Action: This target is contributed to by the geological heritage audit and the provision of GIS data in relation to geological heritage of Dublin City.

OBJECTIVES

3. To develop a strategic and co-ordinated approach to the management and conservation of the natural environment

Audit Action: This objective is supported by the geological heritage audit in relation to geological heritage of Dublin City.

TARGETS

a. Devise management plans agreed by stakeholders for discreet sites (i) golf courses, graveyards (ii) rivers, canals, railways (ensuring management plans build upon potential benefit/linkage with adjoining assets)

Audit Action: This target may be aided by the geological heritage audit in relation to geological heritage of Dublin City.

f. Management Plans for Natural Heritage Areas (NHAs), Special Protected Areas (SPAs) & Special Areas of Conservation (SACs)

Audit Action: It should be noted that this audit provides the basis for management plans for County Geological Sites, which should be added to this list in any future version of the Plan, and in practical work within the City planning division.

Specific ideas for projects

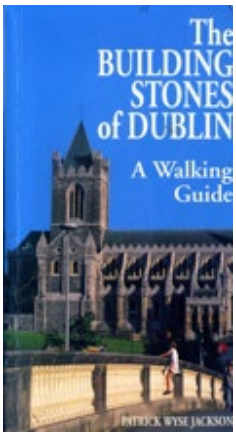
Leaflets

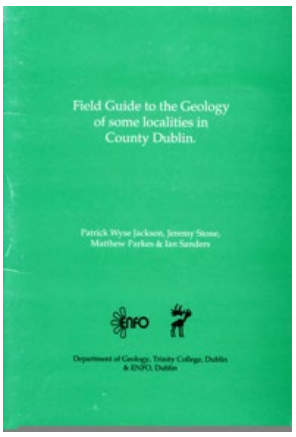
No significant existing leaflets are known apart from some one page guides produced by the Irish Geological Association in the late 1980s. At 51 St. Stephen's Green, once the Museum of Irish Industry, the staff have prepared a simple photocopy leaflet which is given to any visitors who request information but there is no promotion of it. The Irish marble panels in the hallway are mentioned but without great detail.

There is scope for one or two different leaflets. For example, an updated guide to the building stones of Dublin City leaflet would be useful. Any leaflets produced could simply be made available as pdf downloads on the Council's website to avoid large printing costs.

Guides

There are very few existing guides to the geology of Dublin City, apart from some GSI literature produced some time ago. The 1:100,000 map report for Sheet 16 covers Dublin City and is an essential resource. A Guide to the Building Stones of Dublin by Dr Patrick Wyse Jackson is now out of print, although a revised edition is in preparation. Similarly, a field guide to Dublin Geology done in association with an exhibition in ENFO many years ago, was very popular but is out of print, although it is accessible as pdfs on www.geoschol.com.





There is scope for guides at different levels of detail and accessibility to non-specialists. A wide range of leaflets, booklets, books and other media are all feasible, but the research and production of appropriate text and images is a difficult task to do well without appropriate experience, and adequate time and resources. **It is suggested that with only modest editing and reorganisation the main content of this report would distil into a good general short guide to the geological heritage of Dublin City, in a broadly similar style to those books produced for Sligo, Fingal, Waterford, Roscommon and Clare following audits in those counties.**

Signboards

Simple explanatory or interpretive signboards may be advisable at key geological heritage locations, but if these are considered, their locations and individual siting should be very selective, since a proliferation of different interest groups may provoke a 'rash' of panels all over the city. The Planning Section should clearly have a controlling input, in conjunction with the Heritage Office. It is most likely that a panel combining various heritage interests at a place is preferred to single interest panels. It is important to consult with potential partners in the planning stage so that duplication does not occur.

The successful integration of text and graphics on information panels is a fine art, and the IGH Programme can offer input if signs are planned for key visitor localities. The authors of this report are also able to write, review or provide content on geological heritage for any proposed panels.

Museum exhibitions
As a result of the work to produce this report, some material for a panel based exhibition has been largely compiled. With a reasonable amount of extra research covering human dependence on geology and resources, an interesting exhibition can be put together for display in the Dublin City Council Offices, City Library branches or other venues. The model followed was that used for Carlow, Dun Laoghaire-Rathdown and Waterford. Images of those and other similar ones can be seen on the Geological Heritage/Exhibitions section of the GSI website [www.gsi.ie].

New media
There are increasing numbers of examples of new methods of promoting Earth Sciences, via mobile phone applications and other electronic media. Self-guiding apps on specific sites would be one of these, such as those produced by Ingenious Ireland for Dublin city geology. Plans for such products would require some considerable effort to produce and imaginative effort, to link sites across the city, and with other Dublin authority areas in coherent ways. The use of building stones in the city and their sources in the mountains could make a suitable link.

Earth Science Ireland Group and magazine [www.earthscienceireland.org]
The group Earth Science Ireland is an all-Ireland group promoting awareness of Earth sciences and supporting educational provision in the subject. A main vehicle for this initiative is the twice a year magazine *Earth Science Ireland* and this is distributed free to thousands of individuals, schools, museums, centres and organisations. The editors would welcome more material from the Republic of Ireland and on Dublin City's geological heritage. It is anticipated by the authors of this report that they will contribute a summary article distilled from the audit report.

Geoschol website [www.geoschol.com]
Geoschol is an educational project, now essentially represented by a website, which was largely aimed at producing educational materials on geology for primary schools. A four page pdf summarising the geology and some highlights of the whole of Dublin is already part of the available material (see Appendix 6). The audit report should make it easy to create new specific leaflets for each of the Dublin local authorities. Working links to the Heritage section of Dublin City Council's website, as well as to other heritage websites, should be established.

Geological Heritage Research Archive
If the Heritage Officer wanted to do something similar to that produced in the Burren and Cliffs of Moher Geopark, with downloadable (or links to) free access papers, then a lot of groundwork is already provided by the reference lists in this audit. Making available technical references of direct relevance to Dublin City geology and geomorphology will assist many users and researchers into the future. However, consideration should be given to making this a combined Dublin archive if it is desired, since the geology knows no administrative borders, but is linked throughout the four authority areas.

Urban geology in monuments, architecture and sculptures

Dublin is a city built from stone and other Earth materials. This audit provided the opportunity to look anew at the concept of geological heritage **in a city** as opposed to the more normal range of County Geological Sites in the countryside of other counties that have been audited to date. The original Master Site List included only three sites for auditing in Dublin City, and all were somewhat unusual sites, given that most of the city is urban, built-up land.

The audit process involved looking at sources for building stones used in making Dublin, in the Wicklow, Dun Laoghaire Rathdown and South Dublin audits, but in the City, there is an opportunity to look at their actual use in landmark buildings. In addition there are historical buildings in the City that were constructed with Irish and other building stones, precisely as demonstrations of their utility and beauty as materials for construction. We have appraised these as a part of the audit, to include a selection of the best as County Geological Sites.

In addition, the long tradition of erecting monuments to the great, the good and the powerful has left us with a variety of significant monuments scattered throughout the city. Whilst we have only selected one, aside from the thousands of grave monuments in Glasnevin Cemetery, as a County Geological Site in this audit, the remainder provide some significant opportunities for the promotion of our geological heritage. Too often the stories told about such monuments simply focus on the person commemorated and ignore the medium. It is as if an art curator ignored telling us whether a painting was in oils, watercolour, pastels or whatever medium.

A few of the newly considered sites are not even sculpted rocks. In common with our prehistoric ancestors who erected monolithic stones for now uncertain purposes, modern architects still sense that the right stone in a prominent place can make a powerful statement, however it is read by the viewer.

This large boulder of vein quartz outside Landsdowne House was considered but not ultimately included as a CGS, yet it remains a landmark on the road to Ballsbridge from the City.

As a consequence of this new look at the City, we have expanded the original three sites on the CGS list to encompass some eleven sites. The listing is simply a measure of their special interest through the use or demonstration of rocks as building stones. All have existing management routines in place and the listing places no additional responsibility on the owners or managers of these buildings. It does flag them, such that their potential is highlighted, and the opportunities for geological heritage promotion that they present may be enhanced by the CGS listing. None would be deemed to be under any risk or threat because of their historical importance, but the listing would ensure no excuse of ignorance could be applied for premeditated destruction under some future development proposal.

There are many other areas of great potential interest that were outside the scope of this audit process, but which would repay research and documentation. Such things as the various small quarries within the city, which first provided building stones for urban buildings, and then were remodelled into parks and squares, are interesting parts of Dublin's history. The sources of clay and the brick pits which fuelled the construction of cheaper housing are a fertile area for study. The provenance of the setts used to pave the streets and the role of the canals and railways in bringing material from afar into Dublin would also prove interesting.

A summary of the Geology of Dublin City

AGE (Million Years Ago)	ERA	PERIOD	EVENTS IN DUBLIN CITY	IF THIS TIMESCALE WERE A DAY LONG ...
2.6	Cenozoic	Quaternary	Several ice ages smothering Dublin City, followed in the last 10,000 years by the spread of vegetation, growth of bogs and arrival of humans. Ice deposits till across most of Dublin. Rivers of Liffey, Poddle and Dodder begin flowing soon after deglaciation.	The ice ages would begin 38 seconds before midnight
66		*Tertiary*	*Erosion, weathering of rocks and denudation of land surface.* *No record of rocks of this age in Dublin City.*	The Tertiary period begins at 11.40 pm
145	Mezozoic	*Cretaceous*	*Erosion.* *No record of rocks of this age in Dublin City.*	11.15 pm
201		*Jurassic*	*Uplift and erosion.* *No record of rocks of this age in Dublin City.*	The age of the dinosaurs, starting at 10.55 pm
252		*Triassic*	*Desert conditions on land.* *No record of rocks of this age in Dublin City.*	10.42 pm
298	Palaeozoic	*Permian*		10.30 pm
359		Carboniferous	Land became submerged, limestones with some shales and sandstones deposited in tropical seas across all of Dublin City. Limestones remaining today are mostly impure and unbedded.	Inundation of land by sea around 10.10 pm
419		Devonian	*Caledonian mountain building.* *No record of rocks of this age in Dublin City.*	Begins at 9.52 pm
443		*Silurian*	*Shallow seas, following closure of the Iapetus Ocean.* *No record of rocks of this age in Dublin City.*	Starts at 9.42 pm
485		*Ordovician*	*Closure of Iapetus Ocean.* *No record of rocks of this age in Dublin City.*	Begins at 9.28 pm
541		*Cambrian*	*Opening of the Iapetus Ocean.* *No record of rocks of this age in Dublin City.*	Starts at 9.11 pm
2500	Proterozoic	*Precambrian*	*Some of Irelands oldest rocks deposited in Mayo and Sligo.*	Beginning 11.00 am
4000	Archaean		*Oldest known rocks on Earth.*	Beginning 3.00 am
4600			*Age of the Earth.*	Beginning 1 second after midnight

The Geological Timescale and Dublin City

1) Paragraph summary

Dublin City is underlain by Carboniferous limestone, originally deposited on the sea floor about 340 million years ago. It is generally known as 'Calp'; a dirty limestone, which occurs in beds with thin beds of black shale separating them, which made it easy to extract in blocks for rough building purposes. At some time since the limestone was uplifted, to become land and then eroded down again. Following erosion over perhaps several hundred million years, the last two million years have had most impact on the landscape in Dublin City with glaciers blanketing much of the bedrock with till. Alluvial deposits from the River Liffey and other rivers have also hidden the bedrock.

2) Simple summary

Dublin City itself is within a wider context of geology in the Dublin region, and best described in that context. To the south are the Wicklow and Dublin Mountains made of granite that was formed over 400 million years ago. Large faults have moved the granites up and the Dublin area down relative to each other, the Rathcoole Fault being the main southern boundary to the basin. Northward there are blocks of older rocks such as at Howth and Donabate-Portrane-Lambay. During the Carboniferous Period there was a lot of extensional block faulting, meaning some blocks remained as higher areas and others subsided. The irregular subsidence within the Dublin Basin meant that a variety of limestone forming environments developed but the main type was in deeper water. This consists of beds of 10-50 cm thick limestones that formed as sudden influxes of material to the basin. In between, slow sedimentation of black muds formed thin shale beds. The resulting limestone is known as 'Calp' and although the quarried blocks come out as rough blocks for building, the shale meant that the rock was dirty, contributing to Dublin's reputation as a dirty town.

The Pleistocene Period or Ice Age began after 2 million years ago and several cold periods interspersed with warm periods saw glaciers form across Ireland, and smother Dublin City. The rock they ground down was deposited as till in thick blankets over the entirety of the city area. Meltwater deposited sands and gravels along the Liffey and Dodder. Since glaciation, coastal processes have meant the deposition of beaches and, in more recent times, human activities have meant that tidal currents have been altered in Dublin Bay and North Bull Island has formed as a result.

3) Extended summary

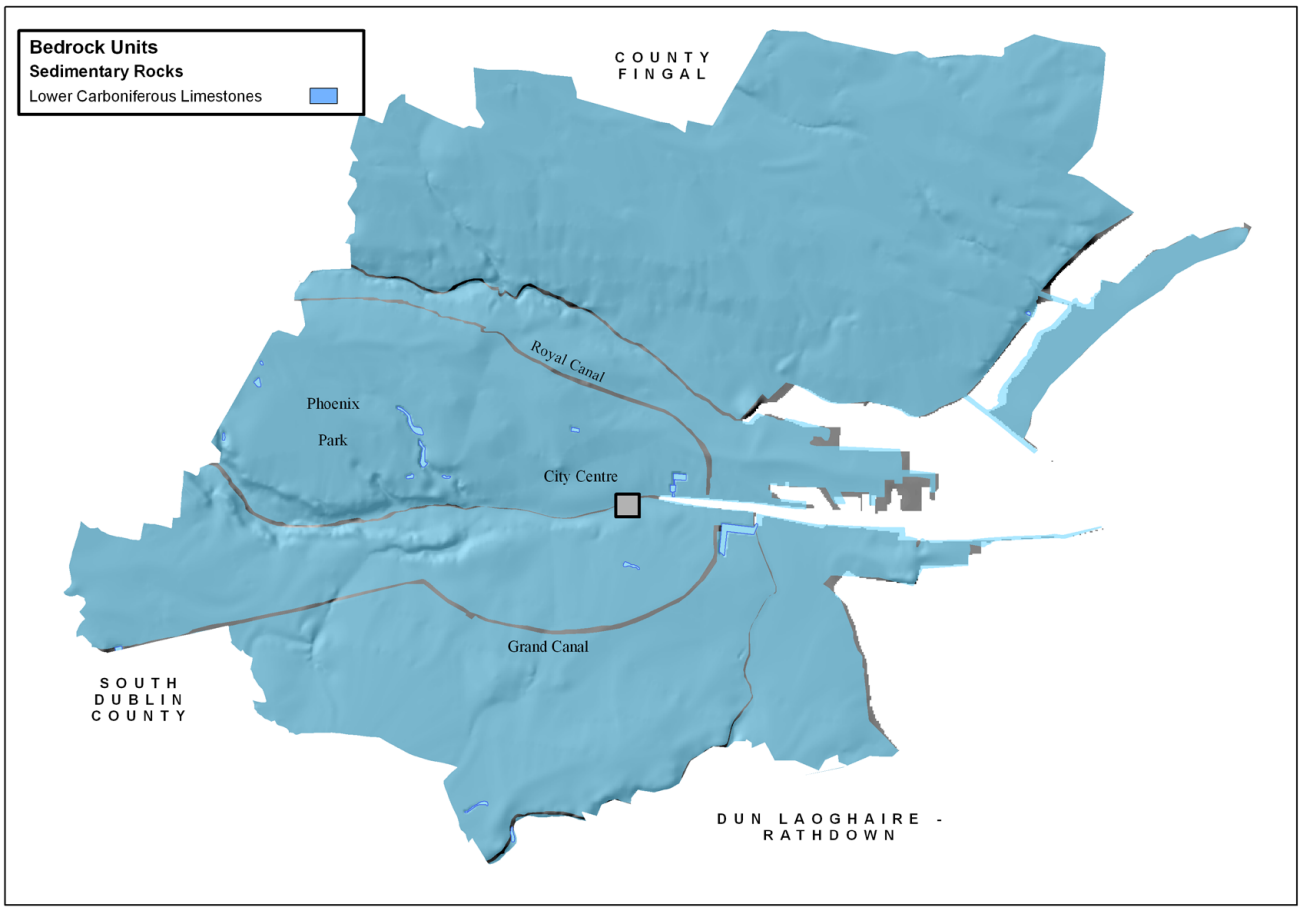
Dublin City itself is within a wider context of geology in the Dublin region, and best described in that context. To the south are the Wicklow and Dublin Mountains made of granite that was formed over 400 million years ago. Large faults have moved the granites up and the Dublin area down relative to each other, the Rathcoole Fault being the main southern boundary to the basin. Northward there are blocks of much older rocks such as at Howth and Donabate-Portrane-Lambay. During the Carboniferous Period there was a lot of extensional block faulting, meaning some blocks remained as higher areas and others subsided. The irregular subsidence within the Dublin Basin meant that a variety of limestone forming environments developed but the main type was in deeper water. This consists of beds of 10-50 cm thick limestones that formed as sudden influxes of material to the basin. In between these periodic influxes of lime sediment from shallower water areas, slow sedimentation of black muds formed thin shale beds. The resulting limestone is known

as ‘Calp’ and although the quarried blocks come out as rough blocks for building, the shale meant that the rock weathered and became blackened, contributing to Dublin’s reputation as a dirty town.

The Pleistocene Period or Ice Age began after 2 million years ago and several cold periods interspersed with warm periods saw glaciers form across Ireland, with ice flowing across the lowlands of Dublin City. As a result the ice ground down and deposited till in thick blankets over the entire city area. The ice sheet which covered Dublin City moved from northwest to southeast. The entire city area was submerged.

During deglaciation the Liffey, Dodder, Tolka and Poddle Rivers would have formed wide meltwater channels, meaning that much of the land flanking them is underlain by sands and gravels. Terraces along each river bear testament to these processes. Meltwater channels, now dry, fed into the deglacial Liffey through the Phoenix Park and the surrounding area.

Since the Ice Age, during the Holocene, the modern drainage pattern was superimposed on the deglacial channel network, meaning some areas of haphazard drainage among the boulder clay and underlying rock are well expressed in places like Donnybrook. At this time alluvium also formed across the river floodplains across Dublin City. Since glaciation, coastal processes have meant the deposition of beaches and, in more recent times, human activities have meant that tidal currents have been altered in Dublin Bay and North Bull Island has formed as a result.



A simplified geology map of Dublin City outlining the main geological units.

Geological heritage versus geological hazards

Ireland is generally considered to be a country with very low risk of major geological hazards: there are no active volcanoes, Ireland's location on stable tectonic plates mean earthquakes are relatively rare and its recorded human history is not peppered with disastrous landslides, mudflows or other geological catastrophes. There are of course risks of one-off events, and this section briefly looks at the specific record and nature of geological hazards in Dublin City and the relationship of the County Geological Sites to those hazards.

The difference between human timescales and geological timescales can be difficult to comprehend but, for many geological processes, there are periods of sudden activity encompassing major events, and then quiet periods in between. The sites in this audit represent some evidence of past geological environments and processes, such as the building of high mountain chains, deep intrusion of massive granite bodies, volcanic eruption, glacier erosion of the land surface and so on. However, a few sites represent the active geomorphological or land-forming processes of today. These sites are generally coastal or riverine in Dublin City. They are dynamic environments and can be subject to constant or intermittent, sometimes sudden, change.

Landslides and bog flows
The Geological Survey of Ireland has been compiling national data on landslides in the past decade. However, there are no records for Dublin City.

Flooding
There are two types of flooding which need consideration.

River flooding occurs inland when the rainfall exceeds the capacity of the ground to absorb moisture, and the river channels cannot adequately discharge it to the sea. The OPW website, www.floods.ie, can be consulted for details of individual flood events in Dublin City. Many events are recorded across the entire city. In urban settings where rainfall exceeds the capacity of the local drains, much of this is due to the extensive loss of soakage due to paving of gardens and greenspace, along with planned higher level of development within the city confines.

Coastal flooding can occur in any urban area if various conditions occur together, such as unusually high tides, heavy rainfall leading to river channels being full to capacity or more, along with storm or weather conditions pushing water onshore. Low lying coastal areas such as Ringsend have suffered repeated coastal flooding, and will inevitably do so again.

Sea level rise, coastal erosion and sedimentation
Geological processes can operate at very different scales, some fast and some slow. Looking at things with a geological perspective means that inevitably sea level will rise and and fall relative to the land surface over time, but whether that happens in human life timescales is what raises concerns. Certainly, small changes to coastal situations, like building cliff defences or groynes for sedimentation traps can have very rapid effects, with impacts further along a coast when such changes are made.

Whether human influences on the environment, especially the atmospheric gas components such as carbon dioxide, are affecting climate and causing enhanced changes

above natural ones is a different question. However, it is important that for any proposed development in the coastal zone, that different scenarios are considered and modelled, as change through time is a geological fact, not a possible effect.

Both of the above issues are of greater import than as threats to the geological heritage described here, but the problem is one for society and politicians to grasp. However, the geological perspective is often ignored or unknown, hence the issue being raised here.

Radon

Radioactive minerals and gases at higher concentrations can be carcinogenic. Radon can seep into homes and workplaces and can be carried in water supplies. A map showing the areas predicted to be at particular risk from radon in Ireland, called High Radon Areas, can be seen on the EPA website at http://www.epa.ie/radiation/#.VRu9OVROPcs. The Radiological Protection Institute of Ireland was formerly responsible for this but has been merged with the EPA.

Glossary of geological terms

Geological term	Definition
Alluvial Deposit	unconsolidated clay, silt, sand and gravel, deposited by a body of running water.
Alluvium	a term for unconsolidated clay, silt, sand and gravel, deposited by a body of running water.
Appinite	plutonic igneous rock formed from hydrous magma of mantle origin, dioritic in composition, i.e. rich in hornblende, also containing plagioclase feldspar and/or alkali feldspar, with or without quartz.
Beach	a landform along the coast of an ocean, sea, lake, or river which consists of loose particles, often composed of rock, such as sand, gravel, shingle, pebbles, or cobbles.
Bedrock	a general term for the rock, usually solid, that underlies soil or other unconsolidated, superficial material.
Borehole	a narrow shaft bored in the ground, usually vertically, which is used for the extraction of water, gas or hydrocarbons, or for mineral exploration.
Boulder Clay	unconsolidated, unsorted glacial deposits consisting of boulders and cobbles mixed with very finely ground-up rock or silt. Also known as till.
Braided River	a river that consists of a network of small channels separated by small and often temporary islands called braid bars.
Calp	dark grey, fine-grained, muddy limestone
Channel	a landform consisting of the outline of a path of relatively shallow and narrow body of fluid, most commonly the confine of a river,river delta or strait.
Crag and tail	a steep resistant rock mass (crag), with sloping softer sediments (tail) protected from glacial erosion or deposited as glacial debris on the crag's 'downstream' side.
Dimension stone	stone that is quarried and cut to specific shapes and sizes
Dune	a mound or ridge of drifted sand, occurring along the sea coast or in deserts.
Floodplain	a flat or nearly flat land area adjacent to a stream or river that experiences occasional or periodic flooding.
Flute (glacial)	smooth gutter-like channels or furrows made by the abrasive underside of a glacier moving across a rock face.
Fluvial	pertaining to a river or stream.
Glacial	of or relating to the presence and activities of ice or glaciers.
Glacial striae	markings left on the surface of pebbles / boulders / bedrock by moving ice sheets.
Glaciofluvial	pertaining to the meltwater streams flowing from wasting glacier ice and especially to the deposits and landforms produced by such streams.
Grading	a sorting effect with the coarsest material at the base of the bed and finest grained material at the top.
Granite	a coarsely crystalline intrusive igneous rock composed mostly of quartz and feldspar.
Gully	a deep valley created by running water eroding sharply into bedrock or subsoil
Hummock	a small hill or knoll in the landscape, which may be formed by many different processes.
Ice margin	the edge of an ice sheet or glacier
Interglacial	the time interval between glacial stages, or pertaining to this time
Irish Sea Till	clay-rich till found along the eastern seaboard of Ireland, and occurring as much as 12km inland, which was deposited by an ice stream which occupied the Irish Sea Basin during the last glaciation.
Limestone	a sedimentary rock consisting chiefly of calcium carbonate ($CaCO_3$), primarily in the form of the mineral calcite.
Lithology	the description of rocks on the basis of such characteristics as colour, composition and grain size.

Lodgement	process by which debris is released from the sliding base of a moving glacier/ice sheet and plastered or 'lodged' onto the glacier bed; also describes tills emplaced by this process (i.e. lodgement till).
Meander	a bend in a sinuous watercourse or river which forms when moving water in a stream erodes the outer banks and widens its valley, and the inner part of the river has less energy and deposits fine sediment.
Meltwater	water from melted snow or ice.
Meltwater channel	a channel cut by glacial meltwater, either under, along or in front of an ice margin.
Misfit stream	a stream which is too small to have eroded the valley in which it flows, as is often the case with streams now flowing in meltwater channels.
Moraine	any glacially formed accumulation of unconsolidated debris, in glaciated regions, such as during an ice age.
Outcrop	part of a geologic formation or structure that appears at the surface of the Earth.
Outlier	area of younger bedrock completely surrounded by older bedrock
Outwash Plain	an area of meltwater deposition produced at the leading edge of a glacier.
Sandur	a plain formed of glacial sediments deposited by meltwater outwash at the terminus of a glacier
Spring	the point where an underground stream reaches the surface.
Terrace	terraces are remnants of the former floodplain of a stream or river, formed by the downcutting of a river or stream channel into and the abandonment and lateral erosion of its former floodplain
Till	unconsolidated, unsorted glacial deposits consisting of boulders and cobbles mixed with very finely ground-up rock as sand, silt or clay.

Data sources on the geology of Dublin City

This section is a brief summary of relevant GSI datasets, to assist any enquiry concerning geology and to target possible information easily. The GSI has very many datasets, accumulated since it began mapping Ireland's geology in 1845. A Document Management System (DMS) is freely available to any person at the GSI Customer Centre, into which about half a million documents and maps have been scanned. This means that any user can visit the GSI Customer Centre themselves and search on screen for data of relevance to them. High quality colour and black and white print-outs can be made or data supplied on CD (nominal charge), or via USB keys etc. **Data is available free of charge**. It is planned to make this resource available online within the next few years, although many subsets are already available within existing online data sets.

Key datasets include:

1:100,000 Map Report Series

All historical, modern and other mapping has been compiled into very useful maps and reports that describe the geology of the entire country. Sheet 16 includes Dublin City.

19th century 6 inch to the mile fieldsheets

These provide an important historical and current resource, with very detailed observations of the geology of the entire country.

19th century one inch maps and Memoirs

Information from the detailed 19th century mapping was distilled into one inch to the mile maps, of which parts of Sheets 112, with the eastern edge of Sheet 111 cover Dublin City. Each sheet or several sheets were accompanied by a Memoir which described the geology of that area in some detail. These still provide valuable records of observations even though interpretations may have changed with better geological understanding. Memoirs are in the Customer Centre library and scanned on the DMS.

Historical geological mapping is now available via a website:
http://www.geologicalmaps.net/irishhistmaps/history.cfm

Open File Data

Each Mineral Prospecting Licence issued by the Exploration and Mining Division (EMD), currently of the Department of Communications, Energy and Natural Resources, carries an obligation on the exploration company to lodge records of the work undertaken, for the common good. These records are held by the Geological Survey and are available as Open File Data, once a period of time has expired. They may include geological interpretations, borehole logs, geophysical and geochemical surveys and so on. Licences relate to numbered prospecting areas, and these are available on a map from EMD. See also www.mineralsireland.ie. However, the city is not an area for which licences would normally be issued due to practical and political reasons.

MinLocs Data

The MinLocs Database records all known mineral occurrences, however small, from GSI records, such as from 19th century fieldsheets and Open File data.

Historic Mine Records

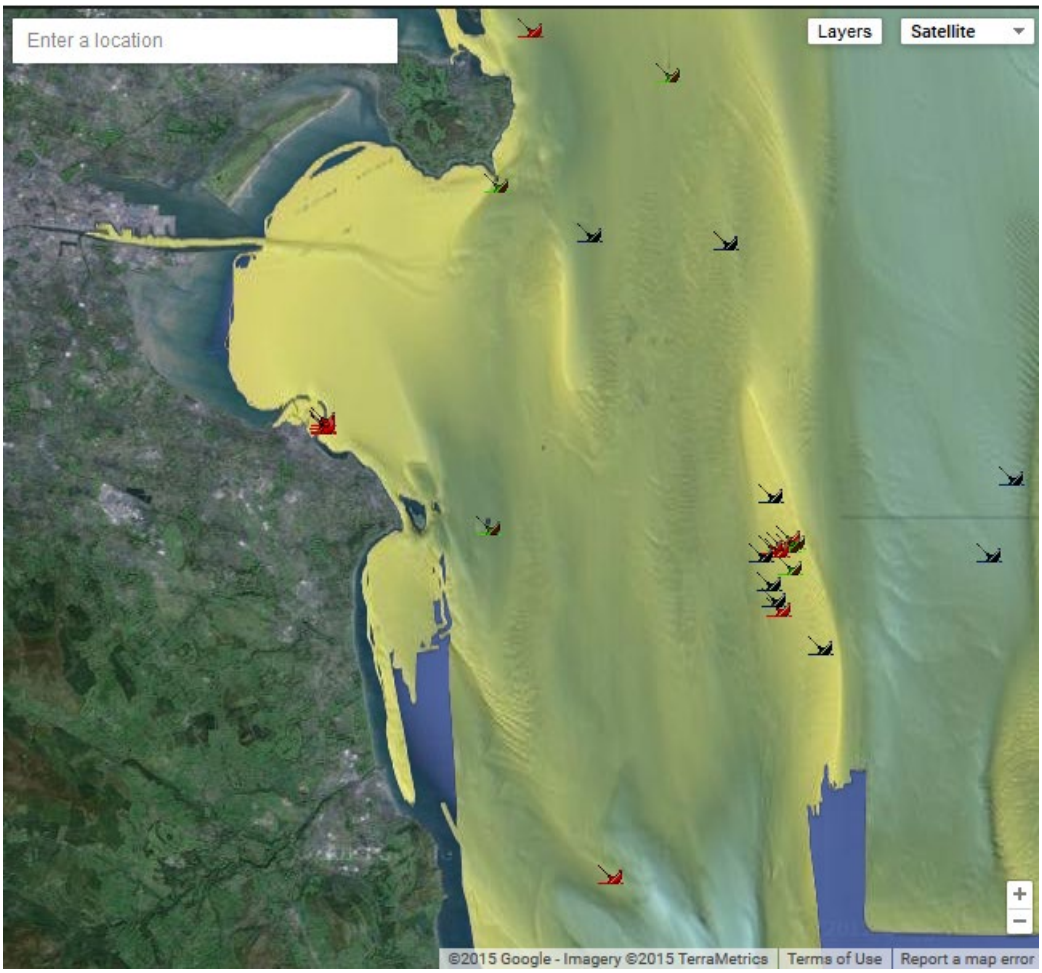
Abandonment plans and varied other material exists for the various mining ventures in the country. In Dublin City, various 18th century mining ventures are known but sparse, extant

GSI records include only Clontarf Lead Mine. Such records have been compiled and expanded in an article by Des Cowman in the Journal of the Mining Heritage Trust of Ireland, Number 1, 2001.

Subsoils Mapping
Since a Groundwater Protection Scheme has been completed by GSI (2012) for the entire country, a modern map of the subsoil types and depths across Dublin City exists, as well as the previously completed bedrock mapping. This provides a significant resource in general terms as well as for groundwater protection. Customised output is possible. Furthermore, detailed compilation of glacial geology datasets will provide more data from late 2014.

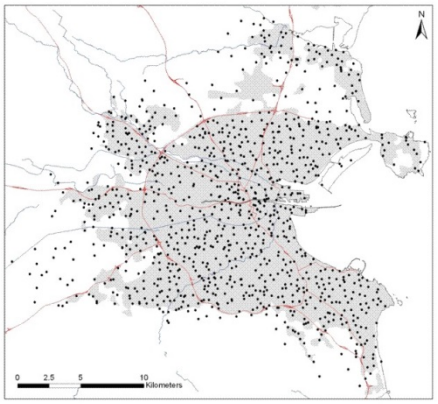
Digital mapping of many different datasets is now available via an easy to use public viewer on the GSI website: www.gsi.ie

Infomar data
The Infomar Programme in the GSI is mapping the seabed in targeted areas of the inshore coast of Ireland. The graphic below shows offshore in Dublin Bay, with some of the many wrecks identified by the survey. Infomar data is freely available for analysis and further processing from the Infomar data via the GSI website.
http://www.gsi.ie/Programmes/INFOMAR+Marine+Survey/
See also www.informar.ie



Dublin SURGE Project (Soil Urban Geochemistry)

GSI has carried out a chemical survey of the topsoil around Dublin city and county in 2012. It involved taking and analysing samples of soil from areas that are publicly accessible (e.g. public parks and school grounds). The aim of the survey was to acquire important information about Dublin soils that will help to better manage the environment.
See https://www.gsi.ie/Surge.htm



Shortlist of Key Geological References

This reference list includes a few **key** papers, books and articles on the geology and geomorphology of Dublin City that are recommended as access points to Dublin City's fabulous geological heritage.

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Full Geological references

See Appendix 2 for the full reference list of all papers, books, articles and some unpublished reports etc relating to the geology and geomorphology of Dublin City that could be traced.

Quaternary References

The references in Appendix 3 all cover the Quaternary, or Ice Age, geology of Dublin City. They are split into references specifically covering sites or features in Dublin City, and a section of national or regional papers which have some data from or on Dublin City included.

Further sources of information and contacts

Sarah Gatley of the Geological Survey of Ireland, who is the Head of the Geological Heritage and Planning Programme, can be contacted in relation to any aspect of this report. Charles Duggan, the Heritage Officer of Dublin City Council is the primary local contact for further information in relation to this report.

Web sites of interest

www.gsi.ie - for general geological resources
www.geology.ie – the website of the Irish Geological Association who run fieldtrips and lectures for members, including many amateur enthusiasts
www.earthscienceireland.org - for general geological information of wide interest
http://www.iqua.ie - for information, fieldtrips, lectures etc in relation to Ireland's Ice Age history
http://www.progeo.se/ - for information about ProGEO the European Association for the Conservation of Geological Heritage

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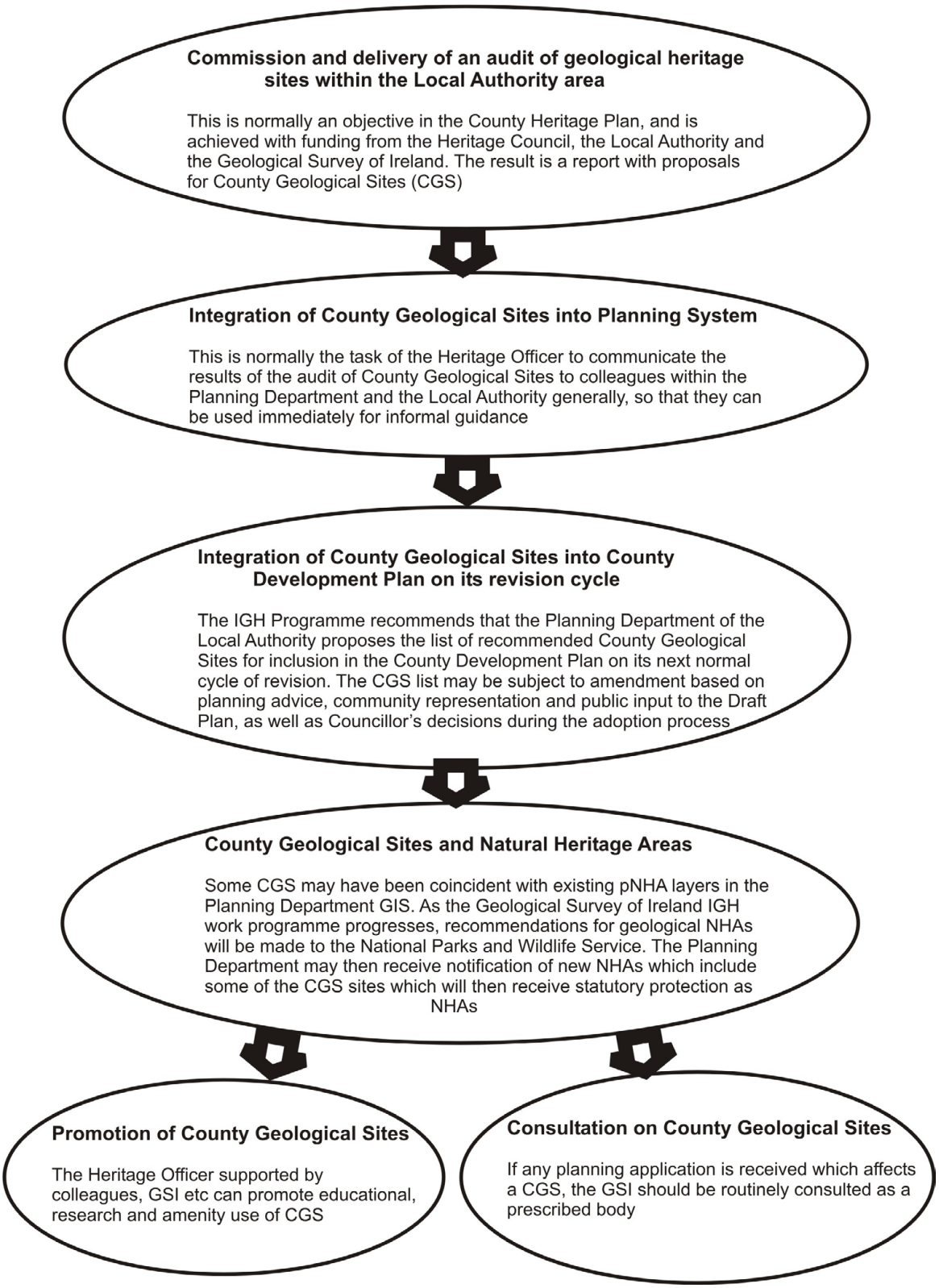
Appendix 1 – Geological heritage audits and the planning process

This appendix contains more detail on the legal framework behind geological heritage audits conducted by County Councils, and the process which operates as a partnership between the Geological Heritage and Planning Programme of the GSI and the local authority Heritage Officer.

Geology is now recognised as an intrinsic component of natural heritage in three separate pieces of legislation or regulations, which empower and require various branches of Government, and statutory agencies, to consult and take due regard for conservation of geological heritage features: the Planning and Development Act 2000 [*e.g*. Sections 212 (1)f; Part IV, 6; First Schedule Condition 21], the Planning and Development Regulations 2001, the Wildlife (Amendment) Act 2000 (enabling Natural Heritage Areas) and the Heritage Act 1995. The Planning and Development Act 2000 and the Planning Regulations, in particular, place responsibility upon Local Authorities to ensure that geological heritage is protected. Implementation of the Heritage Act 1995, through Heritage Officers and Heritage Plans, and the National Heritage Plan 2002, allow County Geological Sites to be integrated into County Development Plans.

The chart below illustrates the essential process, established by the Irish Geological Heritage Programme in GSI, over the course of numerous county audits since 2004.

County Geological Sites - a step by step guide



Appendix 2 - Bibliography – Geology of Dublin City

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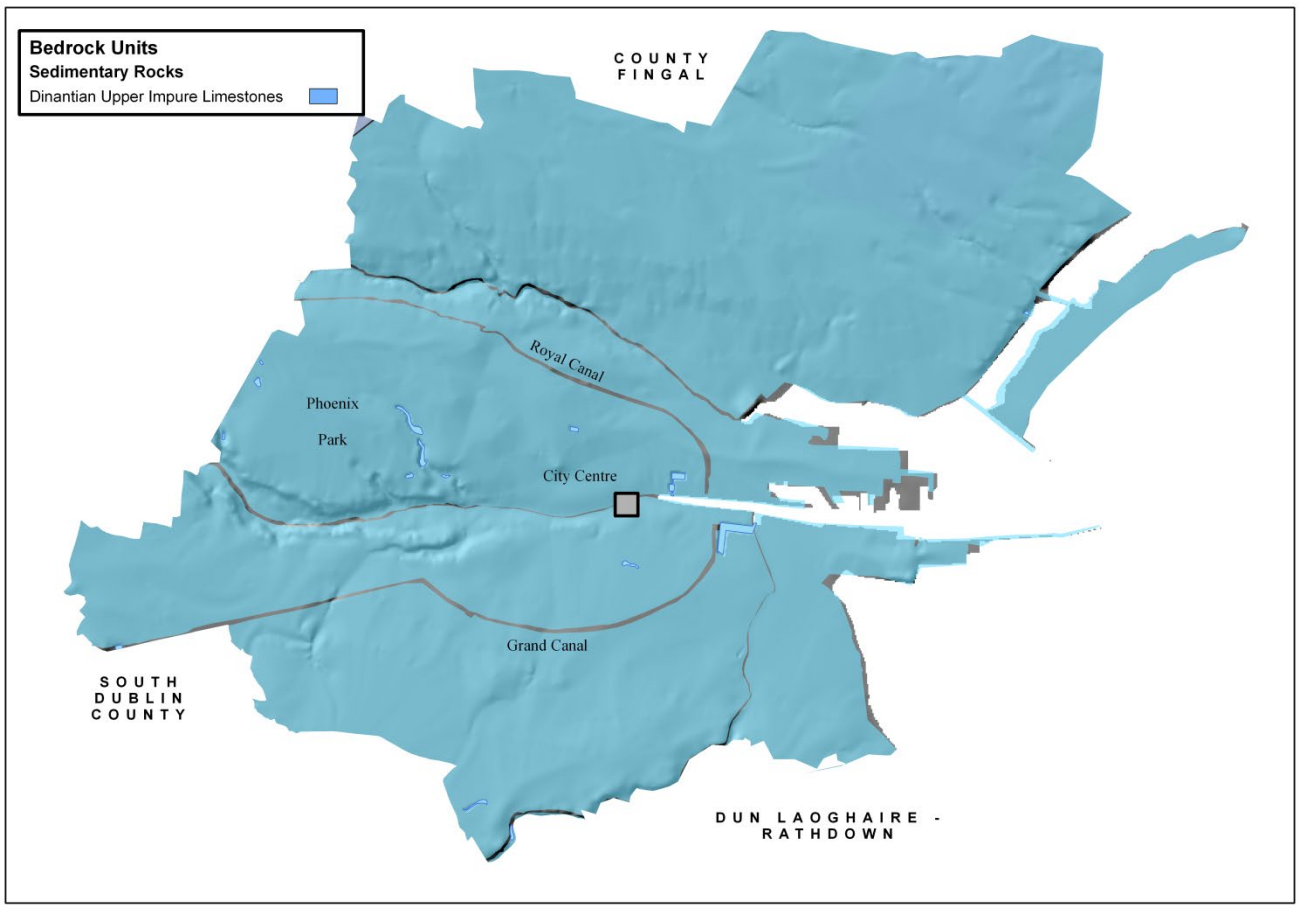
Appendix 4 – Rejected sites

A range of sites had been previously flagged for consideration in the IGH Master Site List, but none were assessed as unsuitable for County Geological Site status in this audit. Similarly a range of additional sites were assessed in the audit, based on the authors' expert knowledge of Dublin City's geology and mining heritage. Other sites were visited on spec during fieldwork.

None of the original sites on the GSI list were rejected during this audit.

Appendix 5
A detailed geological map of Dublin City



Appendix 6 - Geoschol leaflet on the geology of the whole of Dublin

DUBLIN

AREA OF COUNTY: 921 square kilometres or 356 square miles

COUNTY TOWN: Dublin

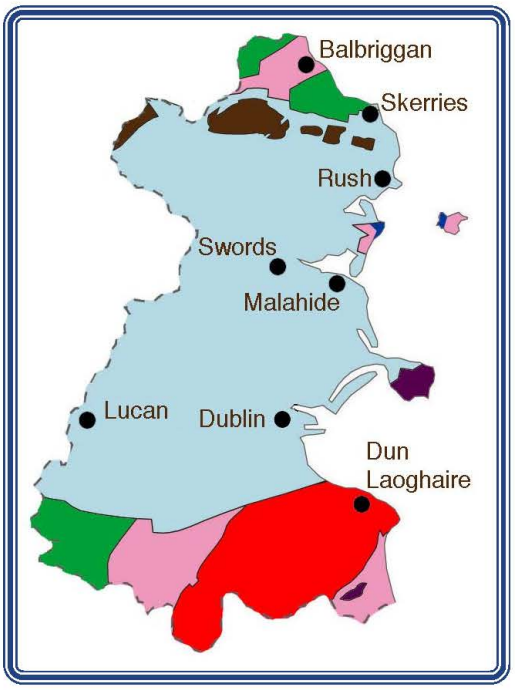
OTHER TOWNS: Balbriggan, Dun Laoghaire, Lucan, Malahide, Rush, Skerries, Swords

GEOLOGY HIGHLIGHTS: Howth Head quartzites, Granite mountains, volcanic rocks at Portrane and Lambay, Carboniferous limestone along north Dublin coast, Killiney metamorphic rocks and glacial deposits

AGE OF ROCKS: Cambrian to Carboniferous; Quaternary

Folded Carboniferous limestone at Loughshinney, north County Dublin

These limestones were folded into tight folds during a period of mountain-building when Africa collided with Europe.



Geological Map of County Dublin

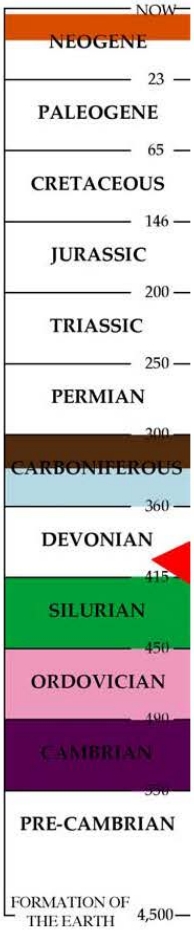
Purple: Cambrian; **Pink:** Ordovician & Silurian; **Green:** Silurian; **Dark blue:** Ordovician volcanic rocks; **Light blue:** Lower Carboniferous limestone; **Brown:** Upper Carboniferous shales; **Red:** Granite.

Geological history

The oldest rocks in Dublin occur on Howth Head where Cambrian shales and quartzites crop out. These were deposited in an ocean 500 million years ago [Ma] that separated two continents. It slowly closed so that during the Ordovician period (490-450 Ma) the crust was unstable and volcanoes began to erupt at what is now Portrane and Lambay producing a distinctive green flecky rock called Andesite. These rocks were deposited in a shallow ocean than contained many organisms including corals and trilobites. Later during the Devonian period (405 Ma) further disruption caused the granite of the Dublin mountains to be injected deep within the surface crust. As it did so it baked the rocks through which it moved and metamorphosed them into schist which can be seen at Killiney. The molten granite magma slowly cooled and formed the pale rocks that were once used as a building material in the city. Some muddy sediments were deposited in the Silurian sea, but any

Ordovician limestones form the cliffs at Portrane while a range of other rocks types are found on Lambay Island.

Devonian rocks have now been eroded away. During the Lower Carboniferous the area was covered by a warm shallow tropical seas where corals, crinoids, brachiopods, lived. Later rivers carried muds and sands that overlie the limestone in north Co. Dublin. During the Ice Age a glacier flowed down the Irish Sea and carried rocks from Scotland including a distinctive bluish microgranite from Ailsa Craig, and this ice met with ice flowing from the Irish Midlands. When it melted it deposited glacial till or boulder clay which is well-exposed along Killiney beach.



Geological timescale showing age of rocks in Dublin.

Dublin fossils

The oldest fossils from Dublin are those contained in the Cambrian slates and shales on Howth Head - there are no shells to be seen, instead only the traces and burrows preserved in the rocks. These are called trace fossils, and include *Pucksia machenri*. The Ordovician limestones at Portrane contain many fossil corals and brachiopods preserved in silica (glass) and geologists have extracted them by dissolving away the limestone that surrounds them. On the coast at Malahide and Portmarnock fossils of crinoids, brachiopods and bryozoans can be seen in the black Carboniferous limestones. In the mid-1800s a large number of skeletons of Giant Irish Deer (*Megaloceros giganteus*) which became extinct only 10,000 years ago were dug up from Ballybetagh Bog, close to Enniskerry, near the Wicklow border.

Mining and Building Stones

Lead mining in the 1700 and early 1800s took place in very small mines at Clontarf and Killiney. A well known mine at Ballycorus in south Dublin provided some lead, but soon ran

Christ Church Cathedral: Dublin's oldest stone building. Built in 1192 of black Calp Limestone quarried locally, imported cream-coloured Dundry Limestone and later roofed with green slates from Westmoreland, England.

out of ore. The lead smelter built on site was kept going by ore brought from Glendalough and other Wicklow mines. There was a big chimney built about 1.5 km away up a hill, to carry away toxic fumes. Some of the lead condensed on the inside of the tunnel and was collected every few months. The chimney has lost the brick top but is still a well known landmark.

Over 100 different stone types have been used for buildings in Dublin, but of these few have been quarried in the County. The most famous Dublin stone is Calp Limestone which is a black muddy limestone that was used for Christ Church Cathedral and the Old Library in Trinity College. Dalkey Quarry provided granite blocks for Dun Laoghaire pier, and many buildings used Leinster Granite from near Blessington or Limestone from Milverton near Skerries. The harbour at Dun Laoghaire is so big it shows up easily on satellite images. The rock to build it came from Dalkey Quarry and was carried down by a small railway. Dalkey and many smaller quarries also provided the granite building stone seen all over Dublin in larger houses and structures. Today many buildings are constructed of concrete or blocks which is produced from Carboniferous limestone quarried at Feltrim and Belgard near Clondalkin.

Geology museums and information

- Geological Museum, Trinity College, Dublin 2 (wysjcknp@tcd.ie); National Museum of Ireland (www.museum.ie); Geological Survey of Ireland (www.gsi.ie)

Suggested reading

- Patrick Wyse Jackson: *The Building Stones of Dublin* (1993) Country House.
- Patrick Wyse Jackson and others: *Field Guide to the Geology of some localities in County Dublin* (1993) TCD & ENFO.

Map adapted with permission from Geological Survey of Ireland 1:1,000,000 map 2003.
Image credits: Mike Simms 1; Matthew Parkes 3; Patrick Wyse Jackson 4.

Text by Patrick Wyse Jackson & Matthew Parkes

Section 2 - Site Reports

Site reports – general points
The following site reports are brief non-technical summaries of the proposed County Geological Sites for Dublin City. These have been specially prepared for this Report in order to make the information accessible to planners and others without geological training. For most sites more detailed reports and information files are held in the IGH Programme in the Geological Survey of Ireland. These are available for consultation if required. Further sites may become relevant as IGH Programme work develops.

Each site report has primary location information, a mention of the main rock types and their age, and a short description of the key aspects of scientific interest. A section outlining any particular management or other issues specific to the site is included, along with one or two low resolution photographs exemplifying the site. **A CD accompanying this report will include further pictures of most sites at higher resolution, should they be required for a glossy booklet or leaflet for the general public**. Grid references are given for a central point in the site generated from the GIS mapping (a shapefile) of the site boundary. They are only indicative of the location, but the site extent is best shown on the included maps.

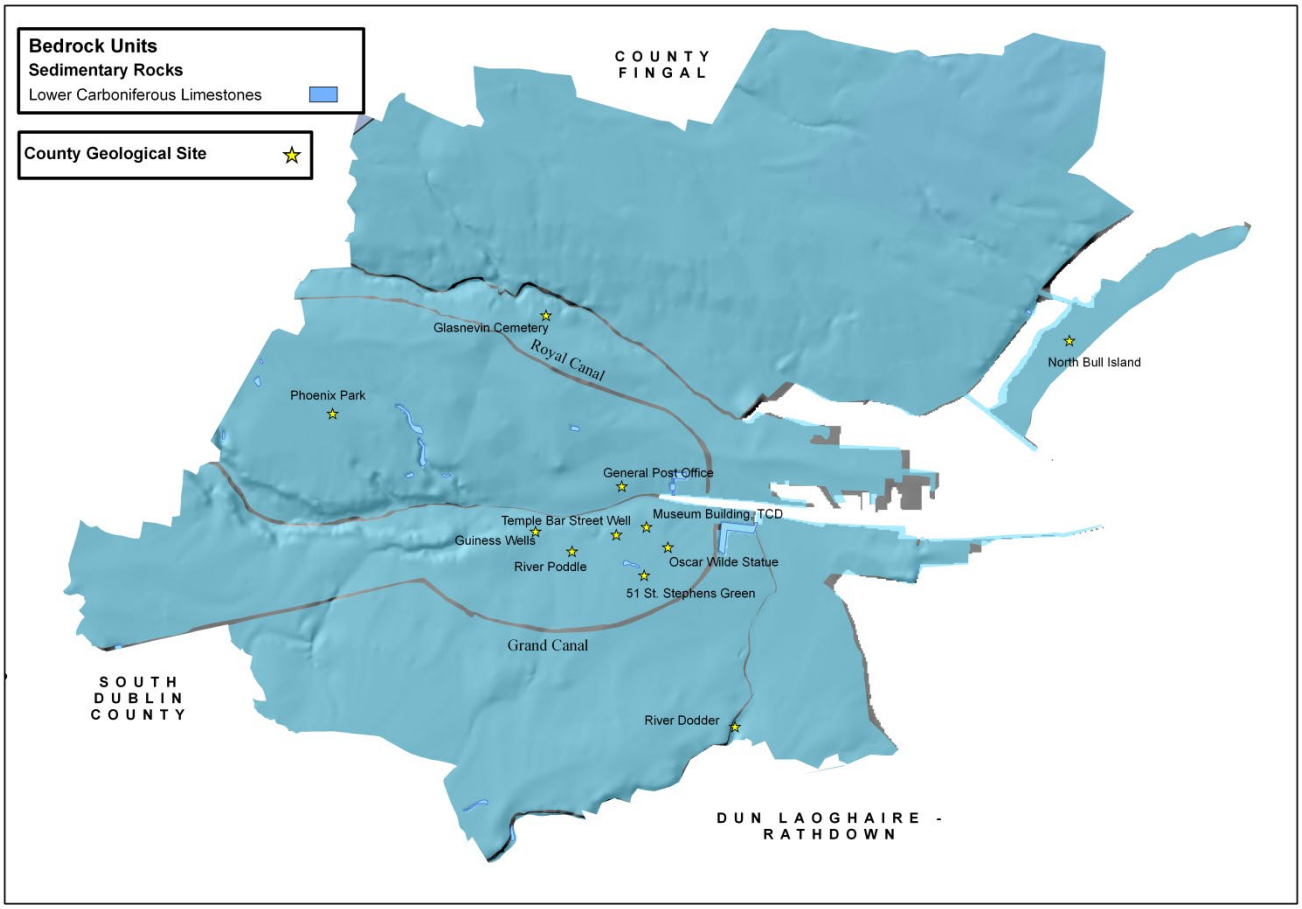
Irish Transverse Mercator (ITM) is the geographic projection co-ordinate system now in use for Ireland, and has been applied to all site localities in the site reports. It is the standard co-ordinate system for OSi maps, including the new Discovery map series, but a coordinate conversion tool is available on the OSi website at: http://www.osi.ie/calculators/converter_index.asp?alias=/services/gps-services/co-ordinate-converter#results.

A series of maps are provided with an outline of the site boundary. It is important to note that these boundaries have no legal or definitive basis. They are indicative only of the limits of exposure or of geological interest, and not based on detailed field and boundary surveys, which were outside the scope of this contract. Boundaries are drawn to include the geological or geomorphological interest of the site, but are extended to the nearest mappable boundary, such as a field boundary, stream, road or edge of forestry. On a few sites, such as in open mountain terrain, it is impractical to find a boundary within a reasonable distance and an arbitrary line may be defined. County Geological Sites are non-statutory and so this is not problematic. If any such site is fully assessed for NHA status in the future, such a boundary may require small revisions.

For sites that have been recommended or which will be recommended for NHA designation detailed site boundary maps will become available to the Local Authority, through NPWS as the designation process is undertaken. Some areas may already be available if they are proposed NHAs (pNHA), under the Wildlife (Amendment) Act 2000. Areas which have been designated as Special Areas of Conservation (SAC) under European Habitats Directives will also have statutory boundaries already determined. The geological interest may be included within these wider areas of nature conservation.

In terms of any geological heritage site designation as NHA, due process of site reporting, boundary survey and very importantly, consultation with landowners where they can be readily identified, will take place before GSI finalises

recommendations with NPWS on the most important sites to be designated. Any landowner within areas or sites identified in this report with concerns over any aspect of this project is encouraged to contact Sarah Gatley, Head of the Heritage and Planning Programme, in the Geological Survey of Ireland, Beggars Bush, Haddington Road, Dublin 4. Phone 01-6782837. Email: sarah.gatley@gsi.ie



Simplified Geological Map of Dublin City with site locations indicated.

DUBLIN CITY - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Phoenix Park**
Other names used for site	
IGH THEME	**IGH7 Quaternary, IGH14 Fluvial and Lacustrine Geomorphology, IGH16 Hydrogeology**
TOWNLAND(S)	**Chapelizod, St. James, Castleknock**
NEAREST TOWN/VILLAGE	**Dublin**
SIX INCH MAP NUMBER	**18**
ITM CO-ORDINATES	**711450E 735735N ('The Phoenix', in centre of park)**
1:50,000 O.S. SHEET NUMBER	**50 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
This site forms an extensive, 707 hectare natural landscape within the confines of the City of Dublin.

Geological System/Age and Primary Rock Type
The park itself is situated on Lower Carboniferous limestone bedrock, which can only be seen in outcrops nowadays at the edge of the Quarry Lake at the north end of the Park. The topography of the park itself is Quaternary in age, having been deposited at the base of a southeastward-moving ice sheet during the last Ice Age.

Main Geological or Geomorphological Interest
The surface form of the Phoenix Park has resulted directly from the last Ice Age and the geological history of the River Liffey, in that the northern portion of the Park shows a crag-and-tail landscape form, with much of its central portion being comprised of low, almost indistinguishable glacial flutes. The Knockmaroon Gate area shows some good examples of deglacial sand and gravel hillocks, and the geometry of the deglacial drainage system and its meltwater channels helps explain much of the Parks hydrology.

This geometry also helps explain the position of many of the ponds in the Park (Glen Pond, Fish Pond, the Zoological Gardens Pond and the pond in the Peoples Park), which are all dammed meltwater channels. Other ponds have occurred because historical bedrock outcrops were quarried extensively (the Machine Pond, Quarry Lake), and Citadel Pond seems to be the only depression dug out specifically to form a pond feature.

The terraces along the River Liffey in the Park's southernmost extreme have given rise to shallow, alkaline soils promoting rare plants. The solid geology of the Park is also linked to its architectural history, as local materials were used to build many of the residences and, in particular, it is likely that much of the material in the boundary wall came from the Quarry Lake. Much of the park is underlain by an extensive drainage network several hundred years old, and formed from clay pipes; thus reflecting the low permeability of the glacial till there.

Site Importance – County Geological Site; recommended for Geological NHA
The complexity of the site in terms of its glacial form, as well as the historical manipulation of the deglacial landscape in the damming of the meltwater channels, and the fine terraces at the southern end, mean that the site worthy of a recommendation for Geological NHA status.

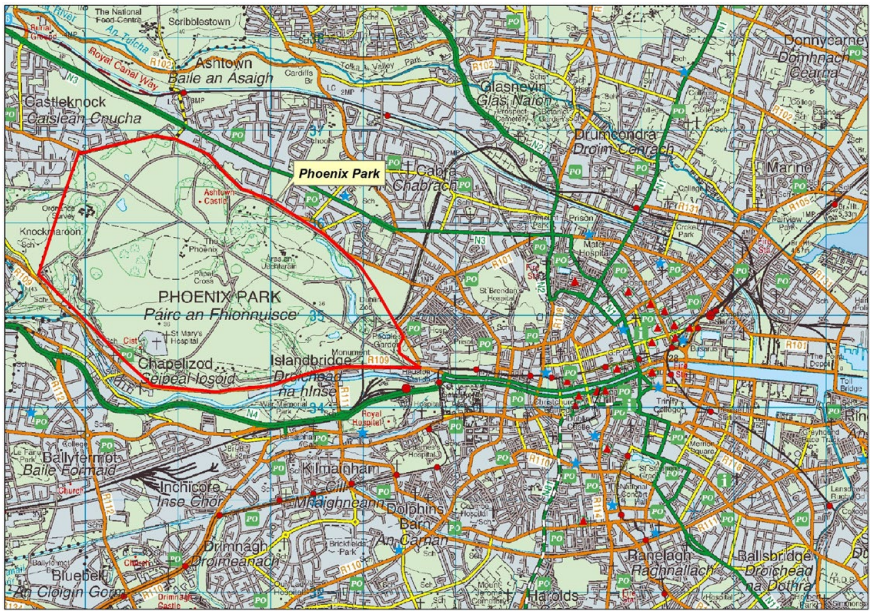
Management/promotion issues
The Commissioners of Public Works are responsible for policy, management and funding of the Phoenix Park. An educational signage/leaflet programme could include information on aspects such as the fact that the Quarry Lake and the Machine Pond are disused quarries, and the significance of the Liffey Terrace at the southern extreme of the Park, the glacial flutes near the Papal Cross, the Furry Glen and other meltwater channels, and the overall network of man-modified pond structures within the Park.

The gentle undulations in the area of the Fifteen Acres are subtle glacial flutes, smeared and etched by the base of the ice flowing over the Park area during the last glaciation.

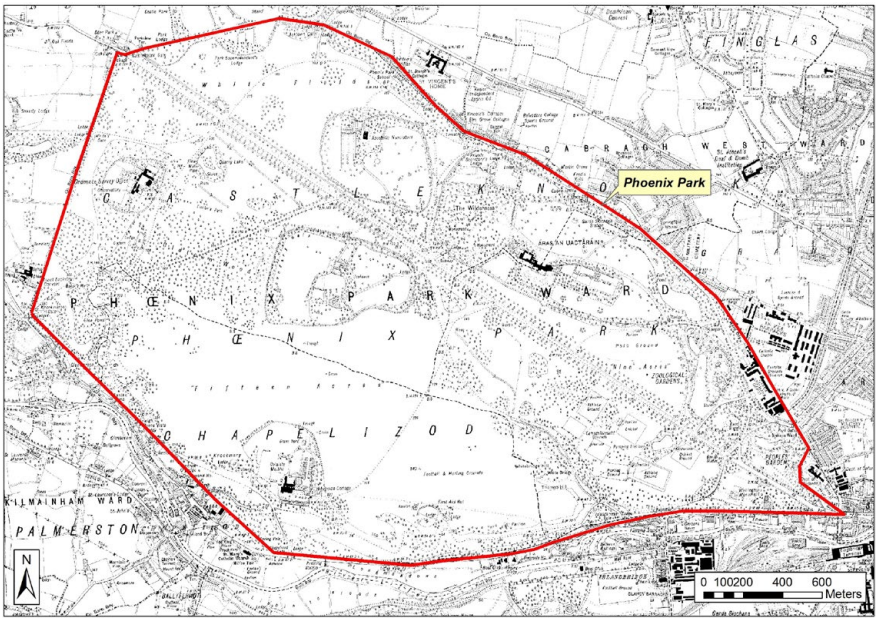
The upper reaches of the Furry Glen, just south of the Ordnance Survey Offices. See the misfit stream in the base of the channel.

The sloping ground of Bishops Wood shows the flank of the meltwater channel clearly. An alluvial flat (floodplain) hosts park benches within the Peoples Garden.

Left: The outwash terrace at the southern extreme of the Park forms part of the bank of the huge Liffey River that would have existed 14,000-15,000 years ago, during deglaciation.
Right: The area south of the Quarry Lake being inundated with water, as the sluice gate along the lakes southern shore has just been opened to lower water levels.


Phoenix Park
PHOENIX PARK
Páirc an Fhionnuisce
Ashtown
Baile an Asaigh
Castleknock
Carsiean Crucha
Glasnevin
Glas Naíon
Drumcondra
Drom Conrach
Donnycarney
Domhnach Ceanna
Marino
Cabra
An Chabrach
Knockmaroon
Chapelizod
Seipeal Iosóid
Islandbridge
Droichead na hInse
Ballyfermot
Baile Formaid
Inchicore
Inse Chór
Kilmainham
Cill Mhaighneann
Dolphins Barn
An Carnán
Drimnagh
Droimeanach
Bluebell
An Cloigín Gorm
Ranelagh
Raghnallach
Ballsbridge
Droichead na Dothra


Phoenix Park
N
0 100200 400 600
Meters


Phoenix Park
CASTLEKNOCK
PHŒNIX PARK WARD
PHŒNIX PARK
CHAPELIZOD
KILMAINHAM WARD
PALMERSTON
N
0 100200 400 600
Meters

The distribution of deglacial meltwater channels within the Phoenix Park.

DUBLIN CITY - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**River Dodder**
Other names used for site	
IGH THEME	**IGH 8 Lower Carboniferous, IGH 14 Fluvial and Lacustrine Geomorphology**
TOWNLAND(S)	**Clonskeagh, Donnybrook East, Roebuck**
NEAREST TOWN/VILLAGE	**Donnybrook**
SIX INCH MAP NUMBER	**22**
ITM CO-ORDINATES	**717510E 731025N (weir in river)**
1:50,000 O.S. SHEET NUMBER	**50 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
A weir built on natural exposures of thick limestone beds in the channel of the River Dodder.

Geological System/Age and Primary Rock Type
The beds of limestone are of Carboniferous age, from approximately 340 million years ago.

Main Geological or Geomorphological Interest
Natural exposures of Carboniferous limestone within Dublin City are quite rare. Even man-made exposures such as quarries are uncommon. There was one adjacent to this site behind the cottages on Beaver Row but it is not apparent now. A much larger quarry a short distance away at the Donnybrook end of Beaver Row is now occupied by a Dublin Bus garage (for example). The natural rib of rock which has been built up slightly to create a weir has caused a deflection of the river and some bank steepening below Beaver Row, on the downstream side, with a cliff of dipping limestone beds visible from the opposite bank.

The limestone beds themselves are dipping at around 30 degrees to the south east. They are up to around a metre thick. When the river is in low flow it is possible to access them from the Riverside Walk, but the river responds rapidly to rain and the rocks can be nearly completely obscured by water.

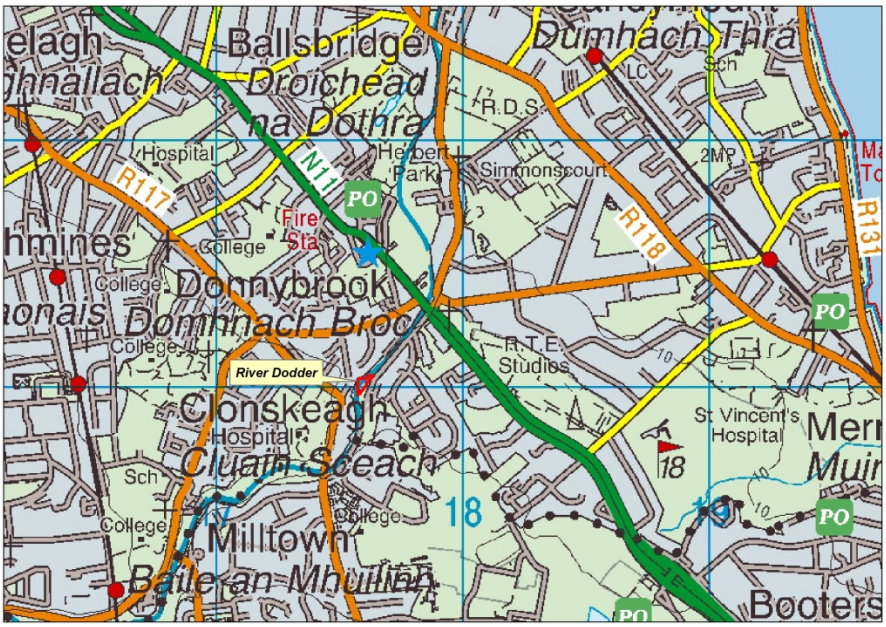
Site Importance - County Geological Site
Within the constraints of Dublin City's sparsely visible geology, this is a valuable resource deserving of CGS recognition.

Management/promotion issues
There is an existing short and local riverside walk, which allows a visitor to get very close to the rocks. It could perhaps be enhanced by an explanatory sign, especially if it was done within the context of a wider riverside trail along the Dodder, and featured in promotional media for such a project. It has good educational potential for physical geography students if resource materials were made available to local teachers.

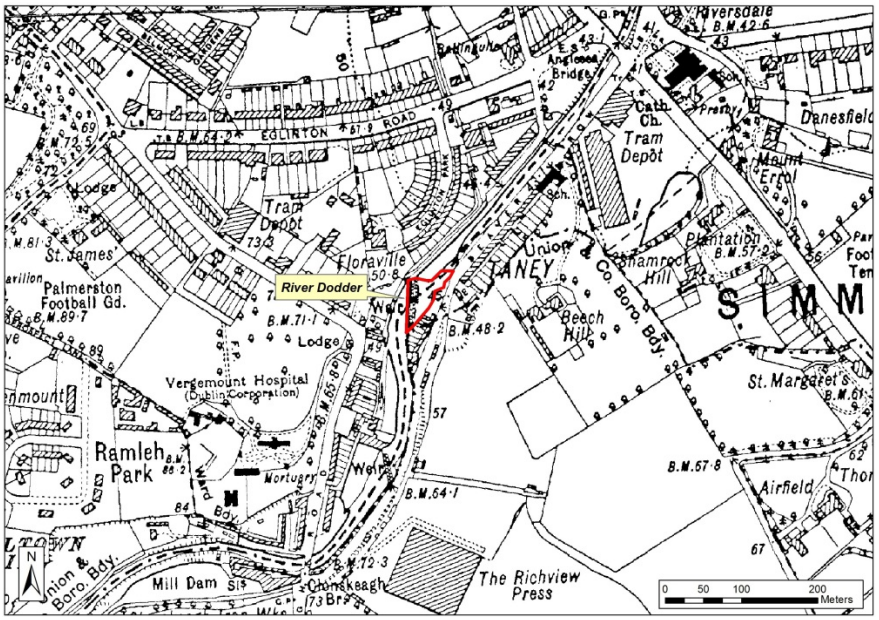
The site viewed from Beaver Row.

Thick beds of natural limestone have formed a barrier to the river flow, built up as a weir.

The beds on the east bank are apparently dipping to the right but are also dipping away from the viewer.


Ballsbridge
Droichead na Dothra
Dumhach Thra
Donnybrook
Domnach Broc
Clonskeagh
Cluain Sceach
Milltown
Baile an Mhuilinn
River Dodder
R.T.E. Studios
Simmonscourt
Herbert Park
Hospital
St Vincent's Hospital
Fire Sta
R.D.S.
N11
R117
R118
R131
PO
Booters


River Dodder
N
0 50 100 200 Meters


River Dodder
EGLINTON ROAD
Tram Depot
Floraville
Palmerston Football Gd.
Vergemount Hospital (Dublin Corporation)
Ramleh Park
Mortuary
Lodge
Mill Dam Sl
Clonskeagh
The Richview Press
Tram Depot
Mount Ercol
Plantation
Shamrock Hill
Beach Hill
St. Margaret's
Airfield
Union & Boro Bdy.
N
0 50 100 200 Meters

DUBLIN CITY - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**North Bull Island**
Other names used for site	Bull Island, *Oileán an Tairbh*
IGH THEME	**IGH13 Coastal geomorphology**
TOWNLAND(S)	**Raheny, Clontarf**
NEAREST TOWN/VILLAGE	**Dublin**
SIX INCH MAP NUMBER	**15, 19**
ITM CO-ORDINATES	**722772E 736610N (centre of island)**
1:50,000 O.S. SHEET NUMBER	**50 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
North Bull Island, about 5 km long and 800 m wide, is located in Dublin Bay, lying roughly parallel to the shore off Clontarf (including Dollymount), Raheny, Kilbarrack, and facing Sutton.

Geological System/Age and Primary Rock Type
The island, as well as the beach known as Dollymount Strand running its entire length, is a very recent, and inadvertent, result of human intervention in the bay in the last 200 years.

Main Geological or Geomorphological Interest
In times past, Dublin Bay had a long-running problem with silting, notably at the mouth of the River Liffey. After years of primitive dredging, a more effective attempt to maintain a clear channel was begun in 1715, when the first piles were driven of the Great South Wall, completed in 1830. It was during this period that the building of a North Bull Wall was also proposed, and when it was seen that the South Wall did not solve the silting problem, the authorities responsible for Dublin Port commissioned studies on the matter. In 1801 the survey highlighted the potential creation of the North Bull sandbank.

The Bull Wall was completed in 1825. Over the succeeding years, the natural tidal effects created by the walls deepened the entry to the Liffey from 1.8 m to 4.8 m. Much of the silt now scoured from the river course was deposited on the North Bull, and a true island began to emerge, with people venturing out onto the growing beach. The island is primarily a sand structure. The southeast facing side is a flat beach, backed by marram-grass-anchored dunes, scrub and marsh. On the northern side of the Bull, between the island and the mainland, is a large linear saltmarsh complex backed by mudflats all of which are covered at high tide. Several of the city's small rivers and streams enter the bay here, and the city's second largest river by volume, the River Tolka, has its estuary facing the city end of the island, into which the Wad River, and a combination of several smaller watercourses, also flow.

Site Importance - County Geological Site
The sand flats and the associated beach, dune, lagoon and slack features, make North Bull Island a textbook locality for the recognition of coastal deposition features. The island is already a proposed SAC (SAC 000206, North Dublin Bay), SPA and NHA for biodiversity reasons and the geodiversity of an active sedimentation system should be highlighted in any promotion of this. It is also one of only two reserves in Ireland under the UNESCO Man and Biosphere Programme.

Management/promotion issues
The location of the features of interest makes them easily accessible, and North Bull Island Bay is a popular recreational area given the number of fine beaches and walks around its perimeter. Information boards are worthy additions to the site, and explain the features' associated habitats, flora and fauna. The coastal geological processes involved in the formation of the feature has been, and should continue to be, highlighted within future literature produced on the island.

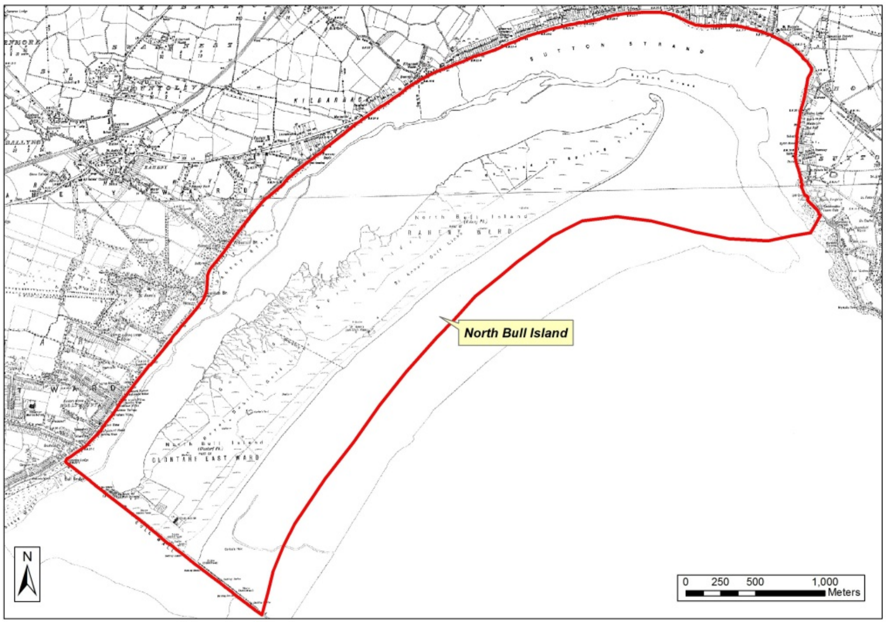
Some of the marshes and tidal mudflats on the western side of North Bull Island.

Dunes in the central portion of North Bull Island.

Dollymount Strand, looking north.


North Bull Island
DUBLIN HARBOUR
DUBLIN CITY
Baile Átha Cliath
DUBLIN BAY


North Bull Island
N
0 250 500 1,000
Meters


North Bull Island
N
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Meters

A promotional map of North Bull Island showing the various coastal geological features associated with the site.

DUBLIN CITY - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**River Poddle**
Other names used for site	'An Póitéal', also referenced by the 'Dark Pool' and 'Dubh Linn'. Also known as 'The Dirty River', or 'An t-Abhainn Salach', or 'The Sáile'
IGH THEME	**IGH14 Fluvial and Lacustrine Geomorphology**
TOWNLAND(S)	**Kimmage, Terenure, Harolds Cross West, Larkfield, Tonguefield, Argos, Mount Jerome, Cherry Orchard, St. Catherines, St. Lukes, St. Nicholas, St. Audoens**
NEAREST TOWN	**Dublin**
SIX INCH MAP NUMBER	**18**
ITM CO-ORDINATES	**715058E 733662N (where runs under Patrick Street)**
1:50,000 O.S. SHEET NUMBER	**50 GSI BEDROCK 1:100,000 SHEET NO. 16**

Outline Site Description
This site comprises a river which flows northwards through Dublin City and into the Liffey; most of its course has been diverted underground.

Geological System/Age and Primary Rock Type
The river flows across low permeability glacial till along its course, having formed in post-glacial times over the last 11,000 years.

Main Geological or Geomorphological Interest
The river is interesting in that the majority of its course within the city is underground. After flowing through Kimmage and Mount Jerome, the river is split at "The Tongue" at Mount Argus monastery in Harold's Cross, with one third of the flow forming the second section of the City Watercourse, heading for Crumlin Road and Dolphin's Barn, and two thirds continuing along a form of the original river bed. In the 1990s, changes were made in the Kimmage area, including the addition of a large fountain to the river.

The line of the two Poddle flows later recombine and pass under much of the south city centre in a culvert. The final stages of the river's flow are complex, with related waters separating and joining. Linked flows include the Tenter Water, and the river is joined by the Commons Water from the Coombe, and ultimately Crumlin. The present main course is itself a diversion, the Abbey Stream, of the original course, which ran further east. Nowadays, much of the lower course of the Poddle is in a large brick tunnel under the city streets and Dublin Castle, and while access is restricted, it is walkable. The confluence of the Poddle and the Liffey is visible at low tide at a grated opening in the Liffey walls at Wellington Quay.

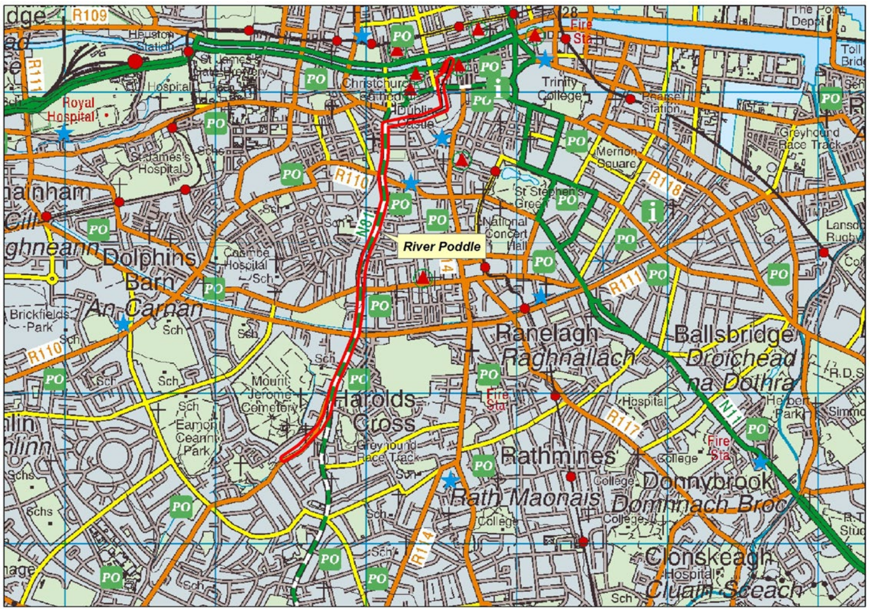
Site Importance – County Geological Site
This is a site that is important historically in not only the subsurface channelisaton, making it very unusual in Ireland, but also in the derivation of the Dublin placename, and in the lore associated with the Poddle. A large, dark pool once existed at the confluence of the rivers Poddle and Liffey; this pool was described in Irish as *dubh linn*, which means *dark pool* or *black pool*. The city name, Dublin, is an anglicisation of this Irish phrase. This historic pool existed under the present site of the Coach House and Castle Gardens of Dublin Castle. During the ninth century, Vikings established themselves as Kings of Dublin, and based their settlement around the confluence of the two rivers.

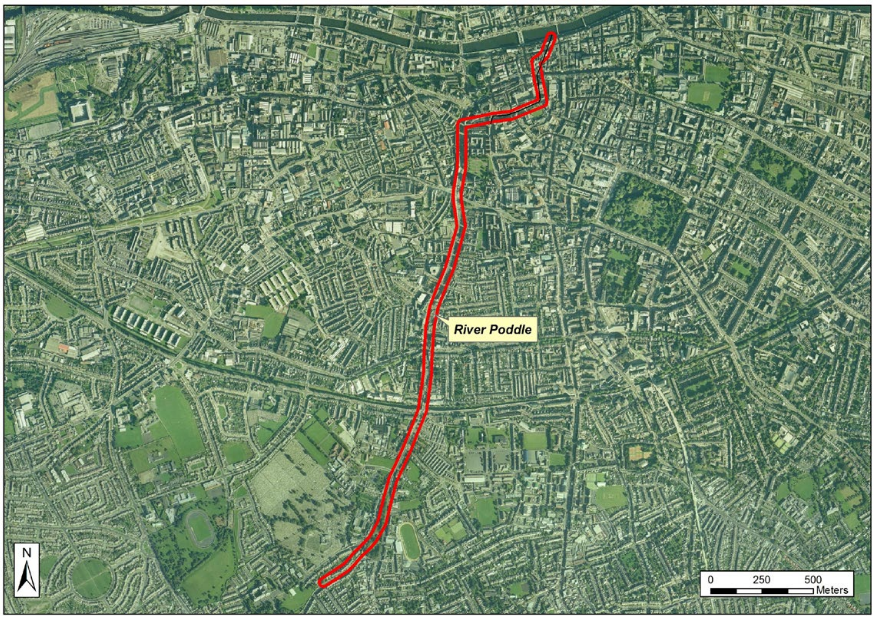
Management/promotion issues
The grating along the Liffey is very worn and dirty and would be well served to be replaced with a modern, stainless steel grate. The name 'Poddle' could also be spelled out in stainless steel letters above this along the walls of Wellington Quay, and a signboard provided along the north side of the river opposite this.

The Poddle adjacent to Kimmage Cross Roads.

Two views at Gandon Close. Looking up the culvert to the Close (L) and the river disappearing from surface, underground (R).

The main culvert under Dublin Castle.


River Poddle
R109
R110
R111
R114
R117
R118
Royal Hospital
St James's Hospital
Christchurch Cathedral
Dublin Castle
Trinity College
Merrion Square
St Stephen's Green
National Concert Hall
Coombe Hospital
Dolphins Barn
An Carnan
Brickfields Park
Mount Jerome Cemetery
Harolds Cross
Greyhound Race Track
Eamonn Ceannt Park
Ranelagh
Raghnallach
Ballsbridge
Droichead na Dothra
Rathmines
Rath Maonais
Donnybrook
Domhnach Broc
Clonskeagh
Cluain Sceach
Greyhound Race Track
Fire Sta
Hospital
College
PO
Sch


River Poddle
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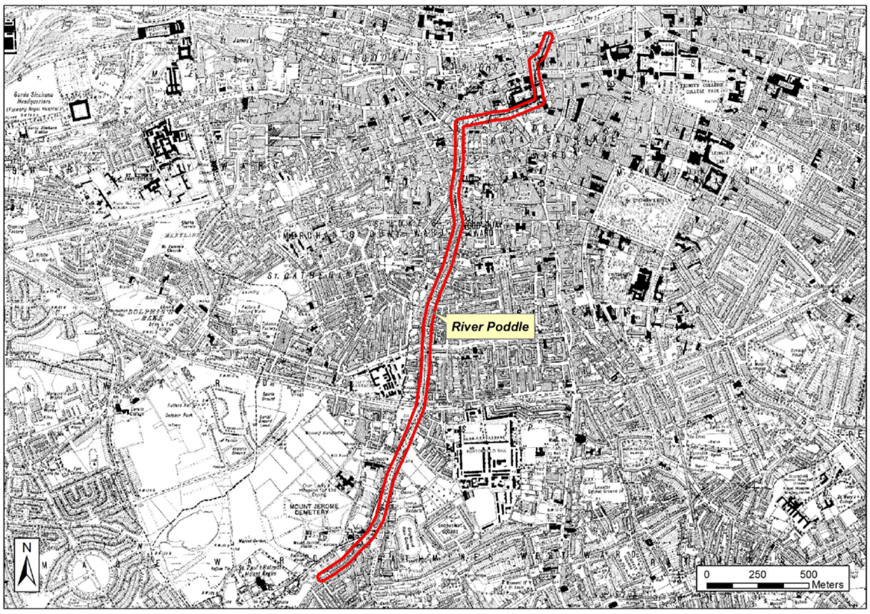
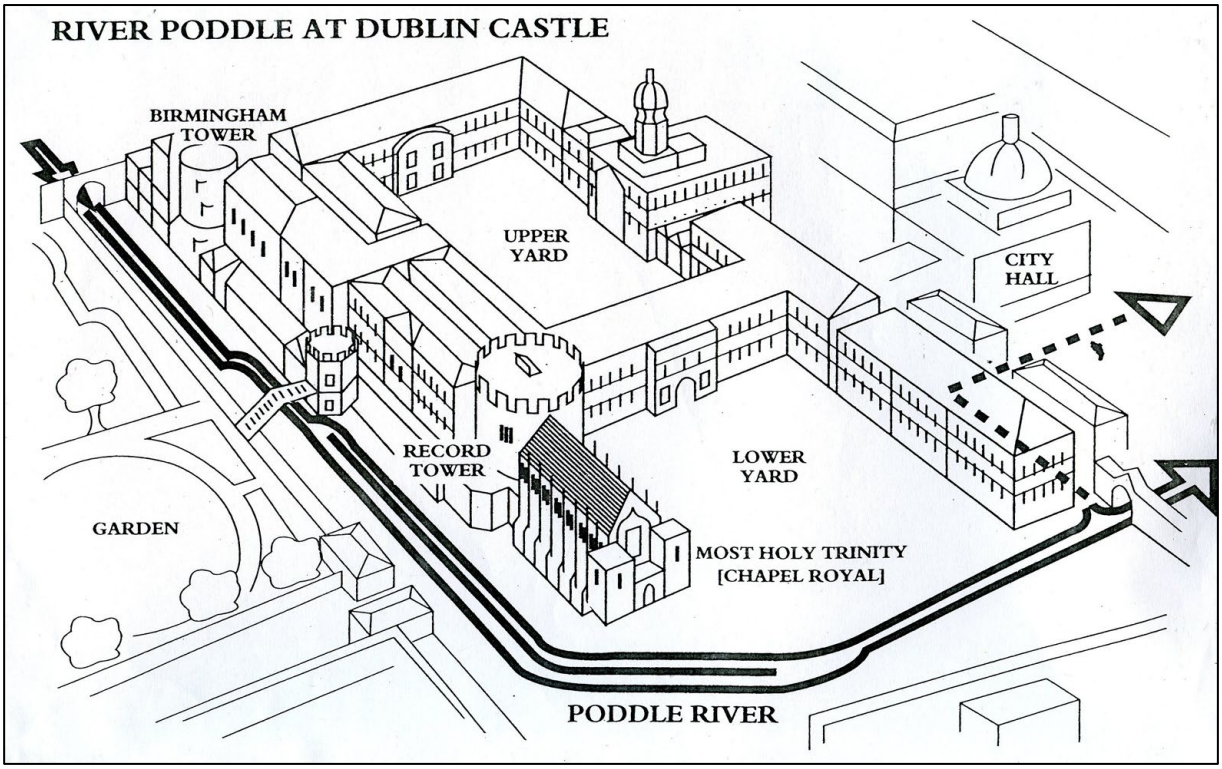

River Poddle
MOUNT JEROME CEMETERY
N
0 250 500
Meters



Schematic showing the Poddle at Dublin Castle (Source: Dublin City Council).

The grate where the Poddle flows into the Liffey, at low tide, at Wellington Quay.

DUBLIN CITY - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glasnevin Cemetery**
Other names used for site	Prospect Cemetery
IGH THEME	**IGH 15 Economic Geology**
TOWNLAND(S)	
NEAREST TOWN/VILLAGE	**In Dublin City**
SIX INCH MAP NUMBER	**18**
ITM CO-ORDINATES	**714666E 737215N**
1:50,000 O.S. SHEET NUMBER	**50 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
Very large public cemetery of 120 acres.

Geological System/Age and Primary Rock Type
The cemetery was first used in 1832, and has been in constant use since. The rocks used in gravestones and memorials are of many different types and ages.

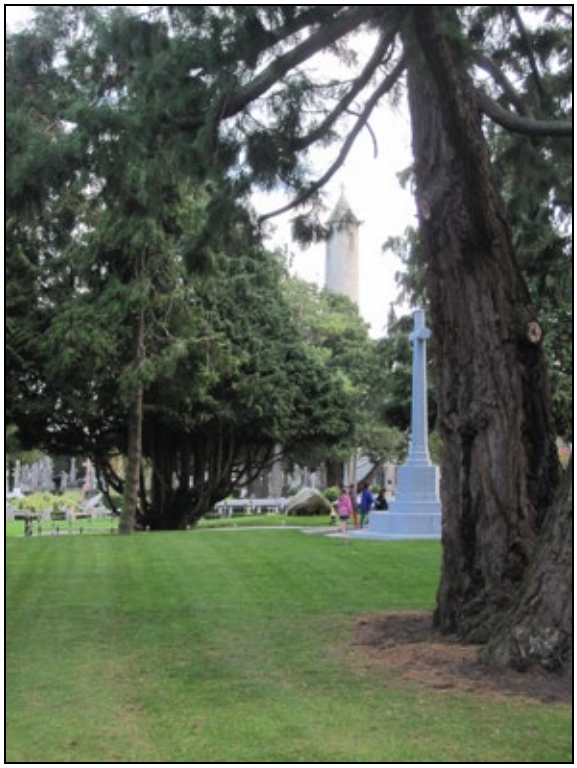
Main Geological or Geomorphological Interest
Described as Ireland's Necropolis the Glasnevin Cemetery is a very large area between Glasnevin and Finglas, and adjoining the National Botanic Gardens. The list of people buried here includes a massive roll call of Ireland's political leaders, artists, musicians and civil figures. The older parts of the cemetery have gravestones mostly made of unpolished limestone or granite, but with superb craftsman's skills evident in the stone masonry. These are most likely to be from standard contemporary supplies that were brought to Dublin by horse cart from Wicklow (granite) or perhaps by canal or railway (limestones). The newer sections of the cemetery have a different feel, with gravestones made with rock types from all over the world, with a predominance of polished types. Overall, the variety of rock types on display, and the enormous variety of ways in which it has been worked and treated are an educational and historical resource.

Site Importance - County Geological Site
The cemetery provides an unparalleled range of worked rock types accessible to view. It also provides great scope for research into the provenance of the rock types used, and this may be something already considered within the grave restoration project ongoing in the cemetery.

Management/promotion issues
Visiting the cemetery is easy, and the development of the Glasnevin Cemetery Museum, along with guided tours around the graves of key historical figures means that it is very accessible. The preparations for 1916 celebrations have included extensive restoration of older gravestones. The Museum sells a range of maps and books on the history of the cemetery, but the geology has not been described to date. A publication is in preparation by the author of this report.

Michael Collins grave beside the Museum.

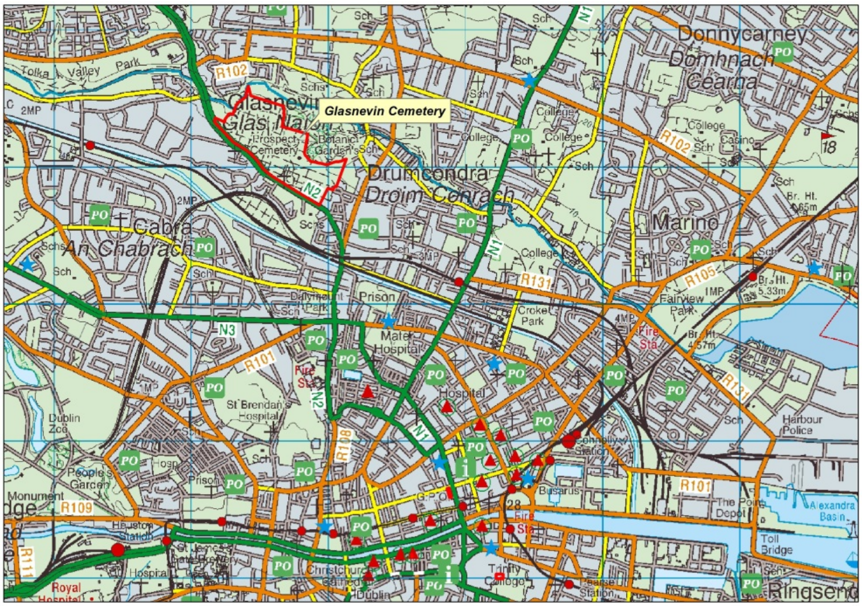
View of the older part of the cemetery.



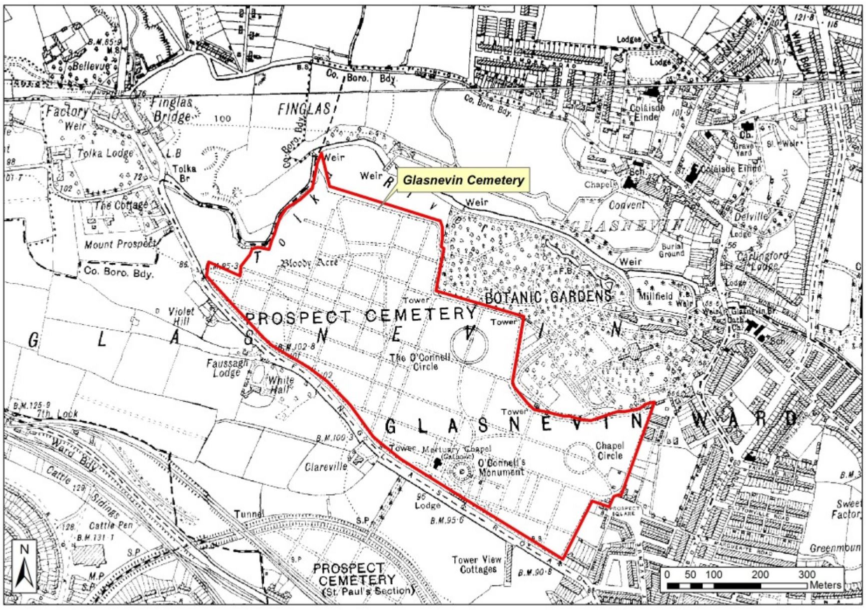
Left: Parnell's grave under the boulder in the cholera pit grave.
Right: One of the more exotic polished stones in the newer part of the cemetery.

View of the newer part of the cemetery.

View of the older part of the cemetery.


Glasnevin Cemetery
Donnycarney
Domhnach Cearna
Drumcondra
Droim Conrach
Cabra
An Chabrach
Marino
Glasnevin
Glas Naíon
Prospect Cemetery
Botanic Gardens
Prison
Croke Park
Mater Hospital
Fairview Park
St Brendan's Hospital
Dublin Zoo
People's Garden
Heuston Station
Royal Hospital
Harbour Police
Alexandra Basin
Toll Bridge
Ringsend
Trinity College
Pearse Station
Christchurch
Dublin
R102
R131
R105
R101
R108
R109
R111
N1
N2
N3
PO


Glasnevin Cemetery
N
0 50 100 200 300
Meters


Glasnevin Cemetery
PROSPECT CEMETERY
BOTANIC GARDENS
GLASNEVIN
GLASNEVIN WARD
The O'Connell Circle
O'Connell's Monument
Mortuary Chapel
Chapel Circle
Bloody Acre
Tower
Tolka River
Finglas Bridge
FINGLAS
Tolka Lodge
The Cottage
Mount Prospect
Co. Boro. Bdy.
Violet Hill
Faussagh Lodge
White Hall
Clareville
Tunnel
Cattle Pen
Cattle Sidings
Tower View Cottages
PROSPECT CEMETERY (St. Paul's Section)
Convent
Chapels
Delville
Greenmount
Bellevue
Factory
Weir
N
0 50 100 200 300
Meters

DUBLIN CITY - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**GPO (General Post Office)**
Other names used for site	
IGH THEME	**IGH 15 Economic Geology**
TOWNLAND(S)	
NEAREST TOWN/VILLAGE	**In Dublin City**
SIX INCH MAP NUMBER	**18**
ITM CO-ORDINATES	**715806E 734642N**
1:50,000 O.S. SHEET NUMBER	**50 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
The General Post Office Building in the centre of O'Connell Street, in particular the doorways and marble panelled interior area for customers.

Geological System/Age and Primary Rock Type
This is a Georgian building of modern historical vintage, opened in the early1800s. The marble panelling of note here was fitted in 1928 during restoration of the building following the damage done during the 1916 Rising.

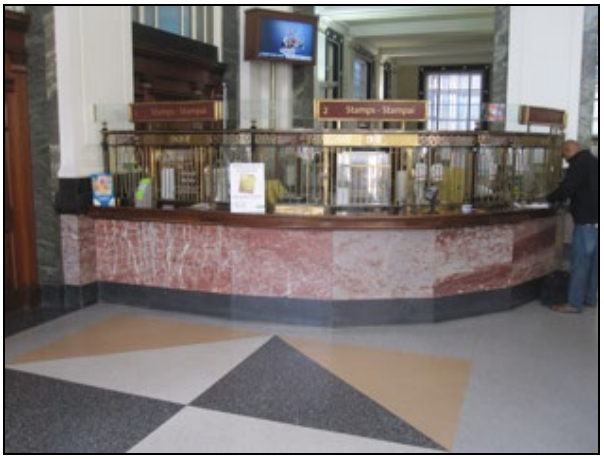
Main Geological or Geomorphological Interest
The interior hall for customers is heavily panelled with Irish marbles, primarily just three types: Connemara Green Marble, Cork Red Marble and a black marble which could be from Kilkenny or from Galway. Their intensity of use is notable within the main hall of counters for customer service, but is best displayed in the two halls inside the main doors. The selected black marble here is highly fossiliferous with corals dominating one hall and brachiopod shells the other.

The exterior of the building is also interesting with two key building stones used. The wings are built with granite from Golden Hill in Wicklow. The dominating front pillars are made of Portland Limestone, imported from Dorset in England. This is a classic freestone, widely used in important buildings. It is easily carved when freshly quarried, but hardens with exposure to air.

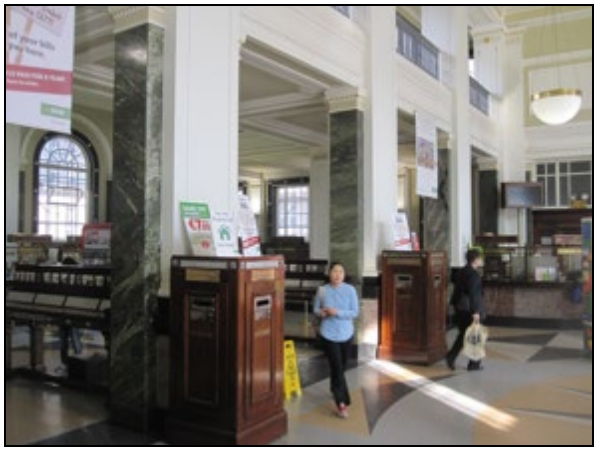
Site Importance - County Geological Site
The sole use of three classic Irish marble types was perhaps a deliberate nationalistic choice in the period it was refurbished. Irrespective of that, it provides a good example of building stone use.

Management/promotion issues
As an iconic national building there are few issues to consider regarding safety and access. There is room for better promotion of the building stone interest of the panels in the public area. There could be information panels close by or on the marbles. There could be a free leaflet for tourist visitors to pick up.

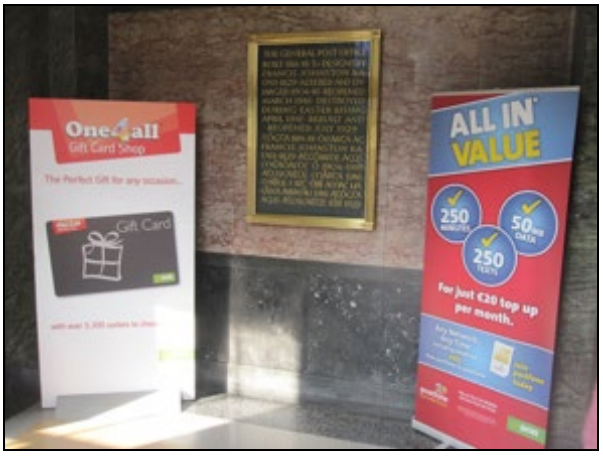
The GPO exterior.



Cork Red Marble beneath the counters.

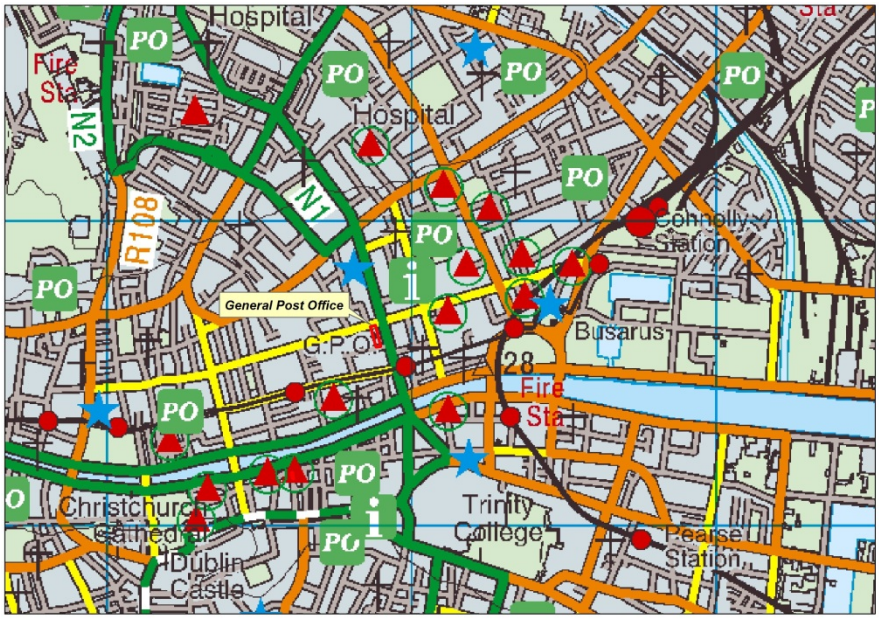


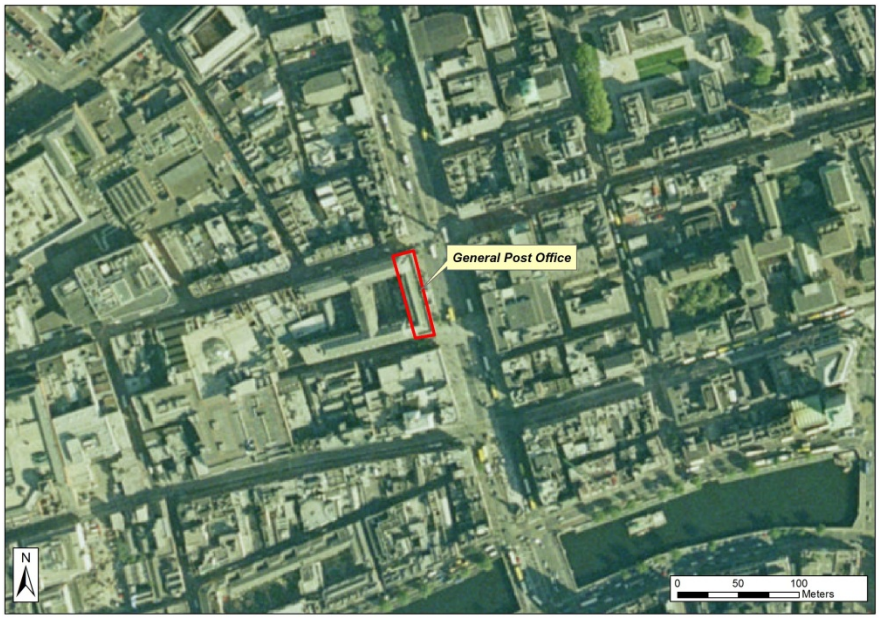
The pillars are clad in Connemara Marble.

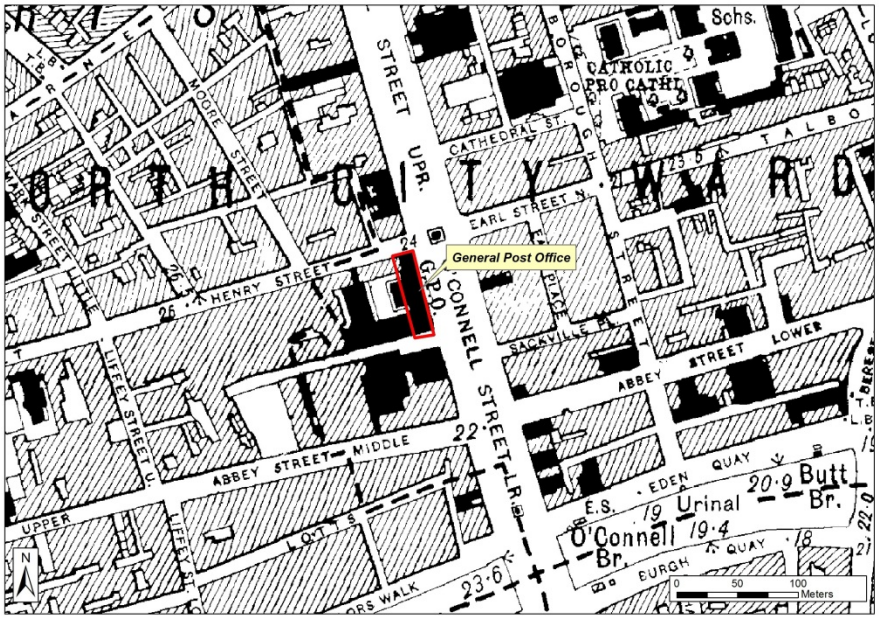


Cork Red Marble above fossiliferous black marble is obscured by advertising signs.

Left: Cork Red Marble over fossil corals in Black Marble.
Right: Doorway pillars in Connemara Green Marble.


Hospital
Fire Sta.
N2
PO
Hospital
N1
R108
PO
PO
PO
PO
Connolly Station
General Post Office
G.P.O.
Busarus
28
Fire Sta.
PO
PO
Christchurch Cathedral
Dublin Castle
Trinity College
Pearse Station
PO


General Post Office
N
0 50 100 Meters


Schs.
CATHOLIC
PRO CATH.
CATHEDRAL ST.
EARL STREET N.
STREET UPR.
MOORE STREET
HENRY STREET
G.P.O.
General Post Office
O'CONNELL STREET LR.
SACKVILLE PL.
ABBEY STREET LOWER
ABBEY STREET MIDDLE
LIFFEY STREET
UPPER
LOWER
EDEN QUAY
Butt Br.
Urinal
O'Connell Br.
QUAY
N
0 50 100 Meters

DUBLIN CITY - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Museum Building, TCD**
Other names used for site	
IGH THEME	**IGH 15 Economic Geology**
TOWNLAND(S)	
NEAREST TOWN/VILLAGE	**In Dublin City**
SIX INCH MAP NUMBER	**18**
ITM CO-ORDINATES	**716178E 734033N**
1:50,000 O.S. SHEET NUMBER	**50 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
The Museum building of Trinity College Dublin, in particular the original interior.

Geological System/Age and Primary Rock Type
The building was completed in 1857.

Main Geological or Geomorphological Interest
Conceived and built as a Museum for the University of Dublin, this building is an architectural gem in its own right, but is notable for the variety and use of different marbles and other building stones in its imposing interior hall. It was built by the firm of Dean and Woodward who shortly after built the famous Oxford University Museum of Natural History. The exterior and the capitals of columns inside have many excellent carvings in Portland Limestone by the O'Shea Brothers. Internal columns and staircase are made from a wide range of polished limestones and metamorphic marbles, including green Connemara Marble, black Kilkenny Marble, mottled Cork Red Marble and many others.

The original construction was internally subdivided in 1953, but the entrance hall remains largely as it was. The positioning of additional cases with geological exhibits in the entrance lobby and hall, plus a male and female Giant Irish Deer Skeleton, make for additional geological interest.

Site Importance - County Geological Site
It is a very fine demonstration of rock types in building construction and ornamentation.

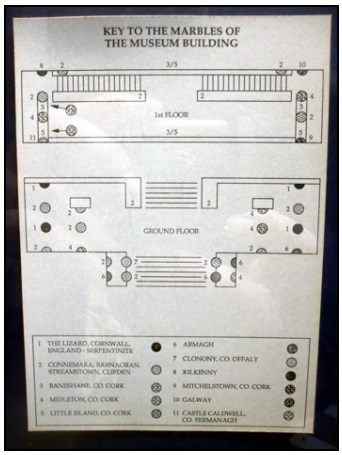
Management/promotion issues
The building is an integral part of the College facilities and houses geology, geography and engineering staff and as such is a working building today. To date, there has been no particular promotion of it within the University, in the same fashion as the Book of Kells and the Long Room Library, but it is believed that there may be some discussion of the idea of resurrecting it as a museum or public focused building within the campus. Despite the lack of any present signage, it is a regular place for tourists with guidebooks to seek out and visit.

The Museum Building central hall.

Columns of varied marble types.

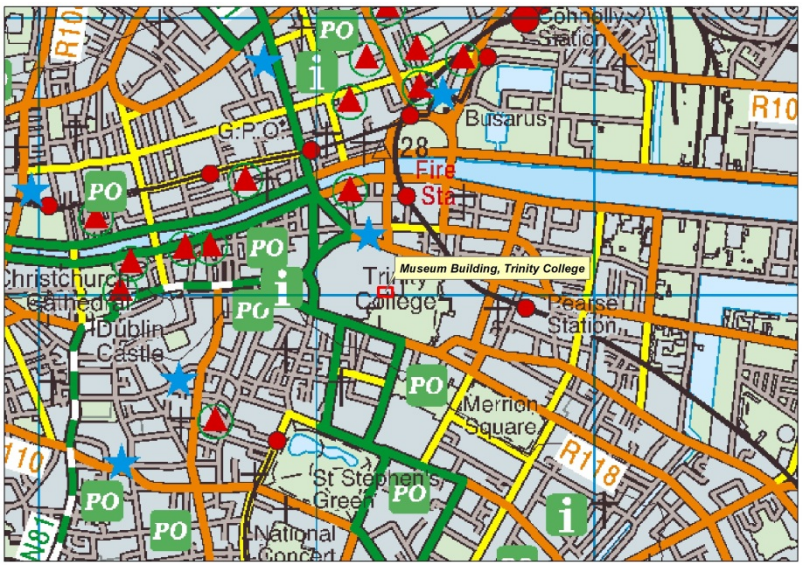
The front view of the building.

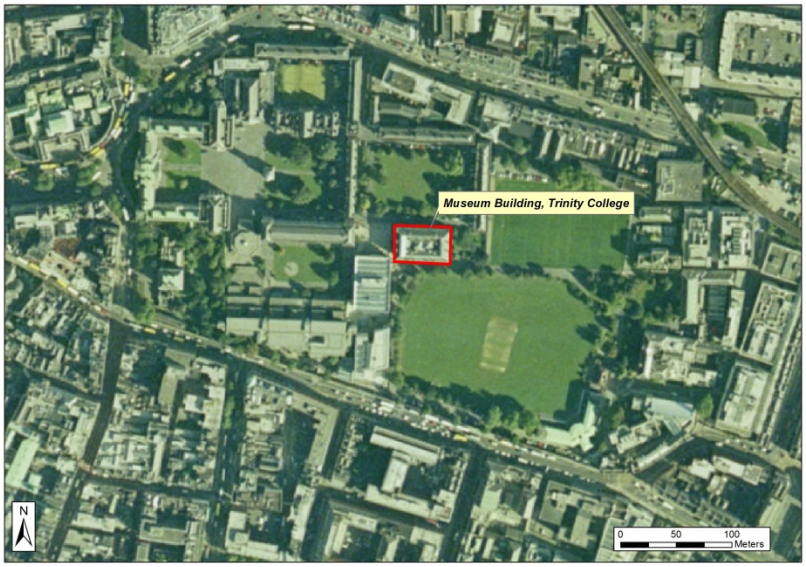
Entrance hall with Giant Irish Deer skeletons.

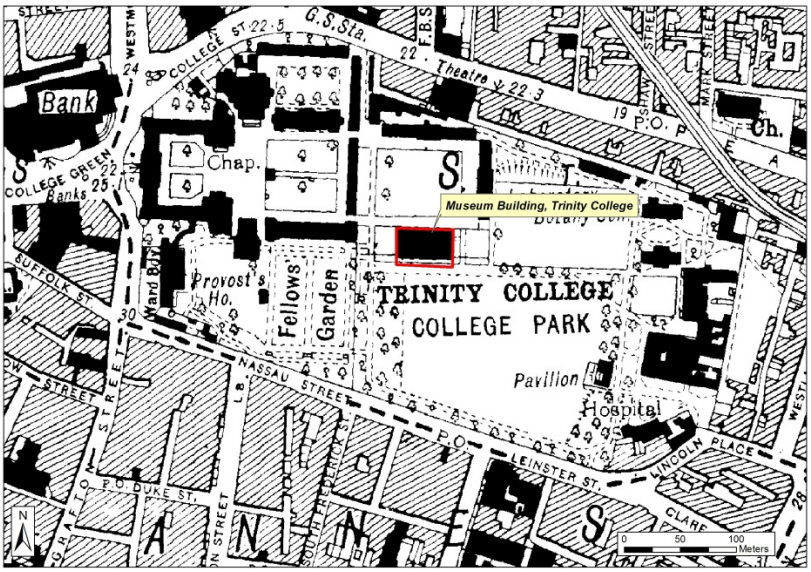


Plan and display of building stone used.

Female Giant Irish Deer skeleton.


Museum Building, Trinity College
Connolly Station
Busarus
R10
G.P.O.
Fire Sta.
Christchurch Cathedral
Dublin Castle
Trinity College
Pearse Station
Merrion Square
R118
St Stephen's Green
National Concert


Museum Building, Trinity College
N
0 50 100 Meters


Museum Building, Trinity College
Bank
Chap.
COLLEGE GREEN
TRINITY COLLEGE
COLLEGE PARK
Provost's Ho.
Fellows Garden
Pavilion
Hospital
NASSAU STREET
DUKE STREET
LEINSTER ST.
LINCOLN PLACE
COLLEGE ST.
Theatre
P.O.
Ch.
N
0 50 100 Meters

DUBLIN CITY - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Oscar Wilde Statue**
Other names used for site	
IGH THEME	**IGH 15 Economic Geology**
TOWNLAND(S)	**St. Andrews**
NEAREST TOWN/VILLAGE	**In Dublin City**
SIX INCH MAP NUMBER	**18**
ITM CO-ORDINATES	**716500E 733726N**
1:50,000 O.S. SHEET NUMBER	**50 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
A life size statue of Oscar Wilde, on Merrion Square, made of sculpted rocks, placed on top of a very large boulder of quartz.

Geological System/Age and Primary Rock Type
The statue is modern. The constituent rocks are of a wide variety of ages.

Main Geological or Geomorphological Interest
An extremely striking statue of Oscar Wilde is an artwork in its own right. It is of particular geological interest because the life size statue is almost entirely made of different ornamental rock types, fashioned to create a realistic representation.

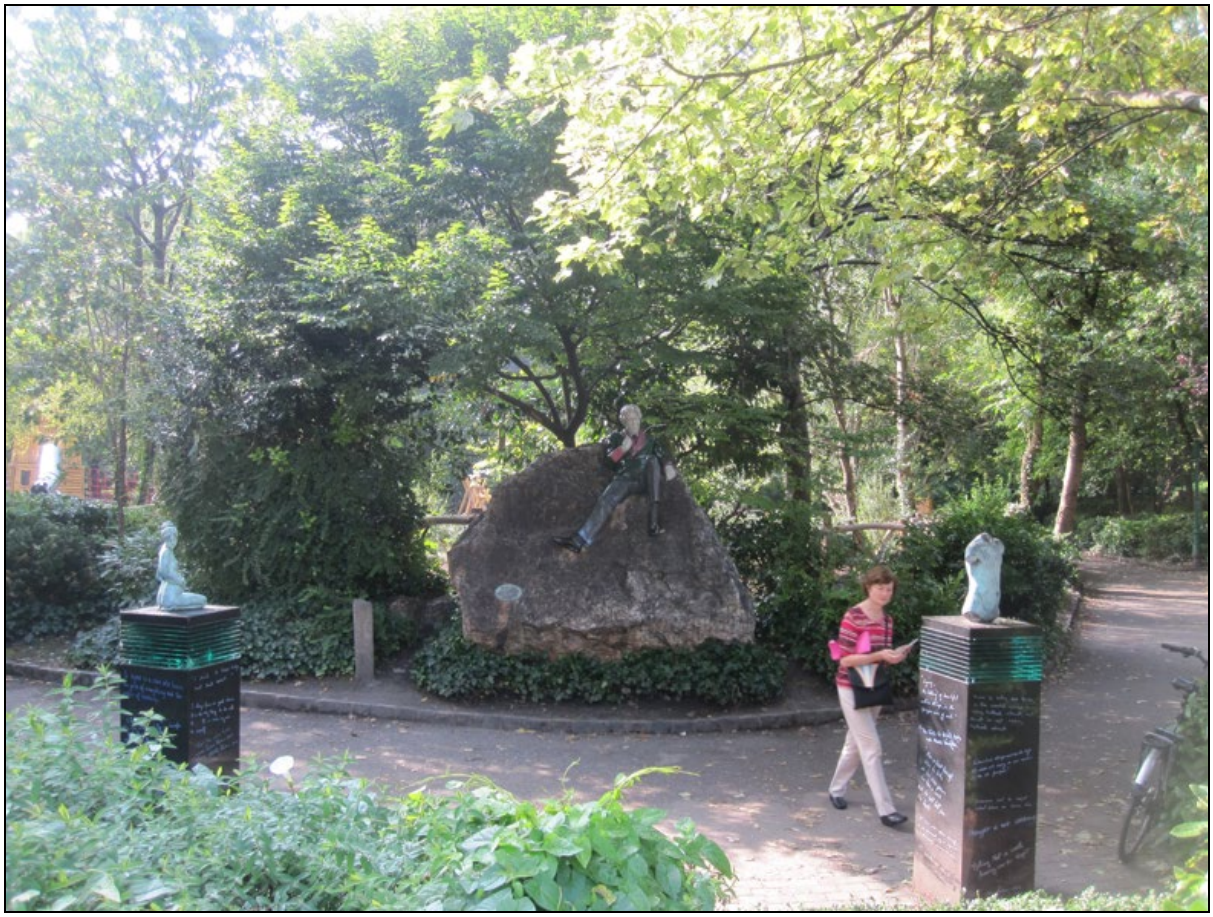
The sculpture is made from exotic materials, such as Canadian green nephrite jade for the jacket, Guatemalan white jade for the head and hands and a rare pink stone from Norway called thulite for the collar and cuffs. The trousers are made of an irridescent larvikite from the Oslo Fjiord In Norway (known as blue pearl granite in the stonemason's trade) and the shoes and socks are black Indian granite, polished and unpolished respectively. Shoelaces, buttons and the green carnation are made of bronze, and he wears a Trinity Old Boys tie, made in coloured glazed porcelain.

The figure itself is reclined on a very large boulder, not of Wicklow granite as stated on many websites etc, but of quartz from Wicklow, derived from a major fault zone. Other elements include related figures on plinths with quotations from Oscar Wilde.

Site Importance - County Geological Site
The statue is a remarkable example of different rock types used to extraordinary artistic effect, and is fully publicly accessible.

Management/promotion issues
The quartz boulder on which the statue reclines is becoming darker coloured each year with weathering and growth of algae. The proposal to undertake a cleaning exercise has been discussed, and may be undertaken by a team of geological volunteers after some trial cleaning techniques have been tested.

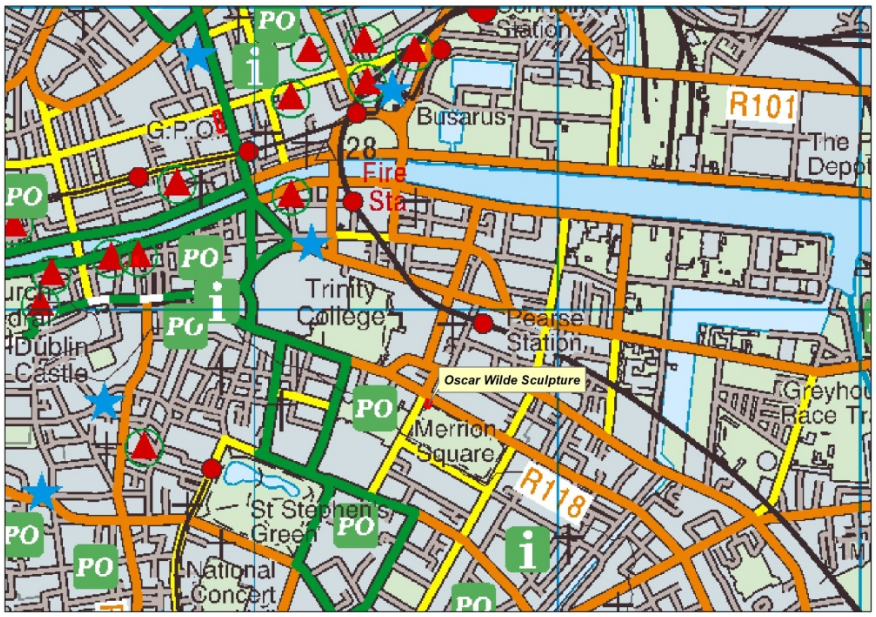
Further promotion would be desirable, along with correction of factual errors about the geological materials used, as erroneously given on many websites.

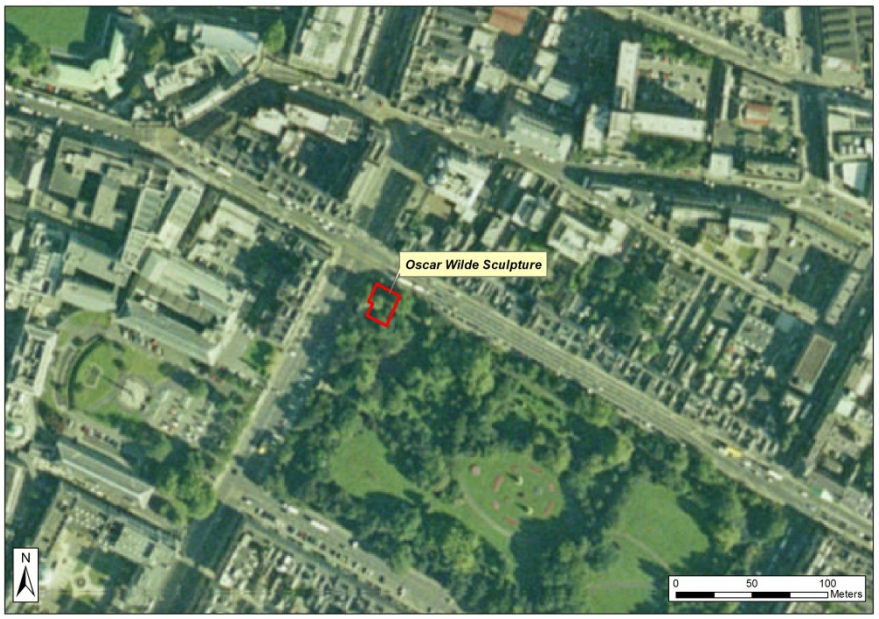


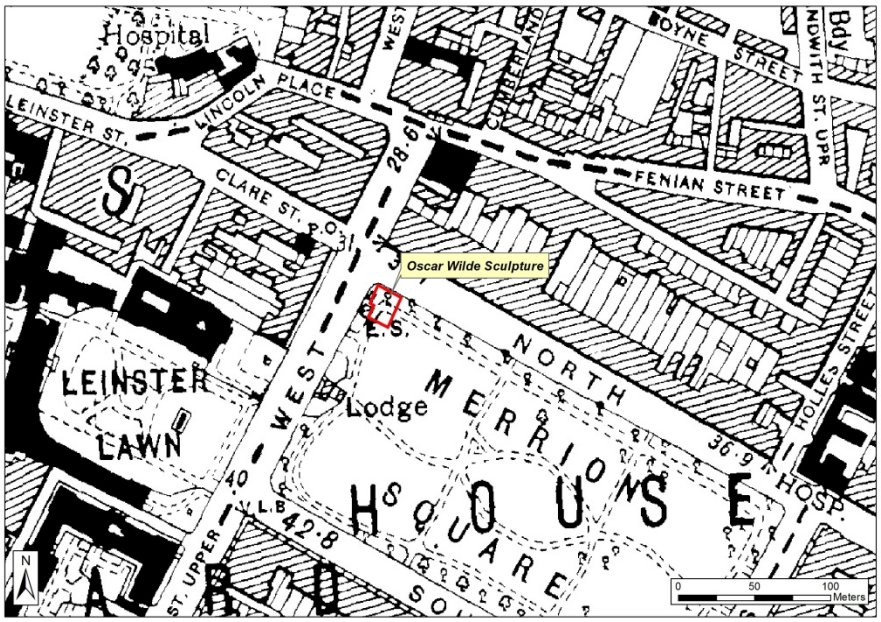
An overview of the statue on the boulder of quartz and ancillary sculptures.

The statue on the boulder of quartz.

Close up of the stained quartz boulder and labradorite trousers, polished Indian granite shoes and unpolished socks.


PO
i
G.P.O.
Busarus
R101
28
Fire
Sta
Trinity
College
Pearse
Station
Dublin
Castle
Oscar Wilde Sculpture
Merrion
Square
R118
St Stephen's
Green
National
Concert


Oscar Wilde Sculpture
N
0
50
100
Meters


Hospital
LINCOLN PLACE
LEINSTER ST.
CLARE ST.
P.O.
BOYNE STREET
FENIAN STREET
Oscar Wilde Sculpture
LEINSTER
LAWN
WEST
Lodge
NORTH
MERRION
SQUARE
HOLLES STREET
HOSP.
ST. UPPER
N
0
50
100
Meters

DUBLIN CITY - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**51 St. Stephen's Green**
Other names used for site	Museum of Irish Industry
IGH THEME	**IGH 15 Economic Geology**
TOWNLAND(S)	
NEAREST TOWN/VILLAGE	**In Dublin City**
SIX INCH MAP NUMBER	**18**
ITM CO-ORDINATES	**716144E 733302N**
1:50,000 O.S. SHEET NUMBER	**50 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
The entrance lobby of the building is original from mid 1800s, and displays a demonstration set of Irish marbles.

Geological System/Age and Primary Rock Type
The lobby of the present day offices at 51 St. Stephen's Green is the original entrance for what was the Museum of Irish Industry, sited here although the building has been remodelled behind the facade. The lobby contains large polished panels of numerous Irish marbles and polished building stones, which are of many different geological ages.

Main Geological or Geomorphological Interest
In 1848 this building from c. 1760 was purchased by the Government and converted into the Museum of Irish Industry, in which geology was a key feature, both due to Sir Robert Kane's efforts and to the collections of the Geological Survey of Ireland which were also displayed here. The entrance hall was fitted out as a vivid demonstration of the native resources available as polished marbles. Some 40 different rock types are displayed as large wall mounted rectangular panels and used in a few pillars.

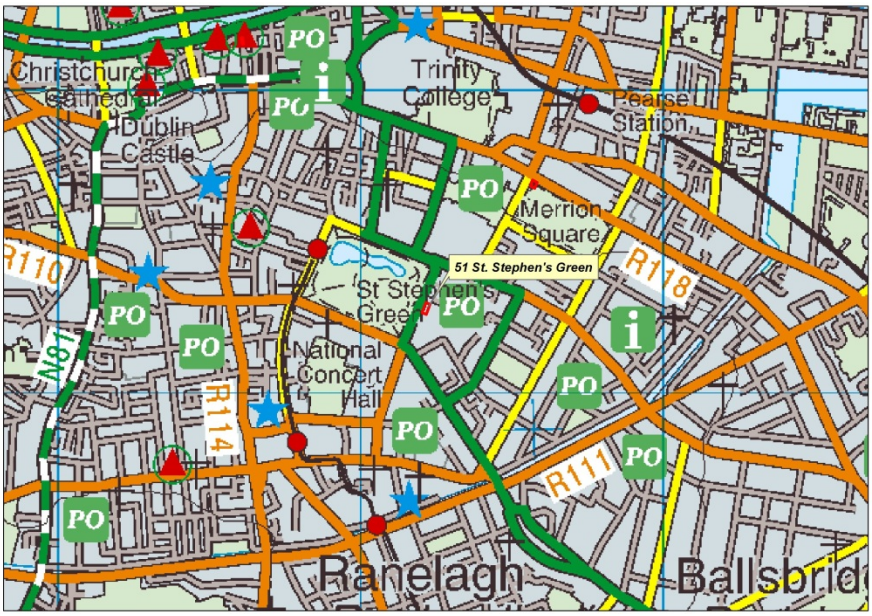
Site Importance - County Geological Site
It is an excellent educational and accessible resource on Irish building stones as well as being an interesting historical museum display.

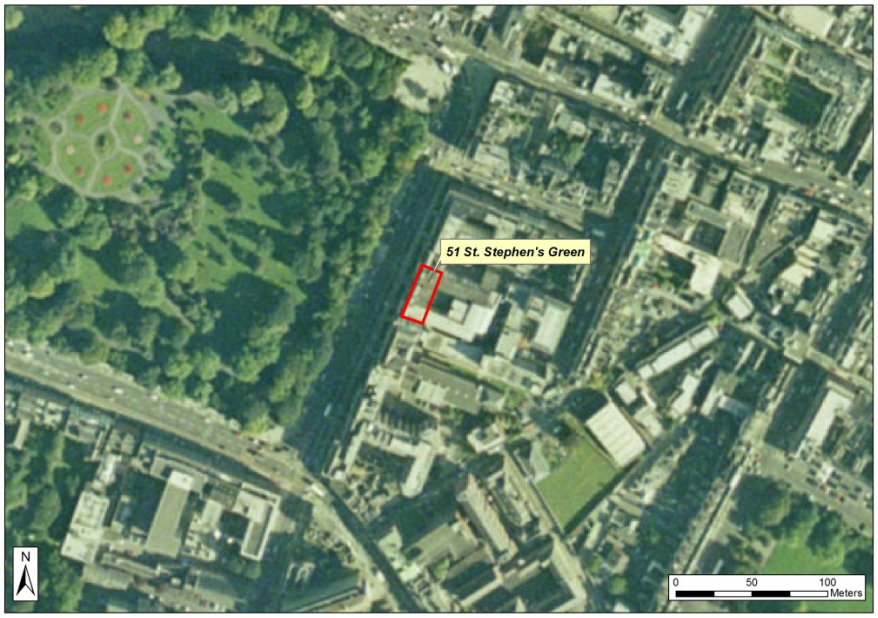
Management/promotion issues
The building is in the care of the Office of Public Works, and houses various offices. Whilst it is not actively promoted for public access, it is possible to visit the entrance hall to examine the panels. A list of the forty panels tells where each is from. The reception staff at the desk just beyond the hallway, do have a photocopied leaflet that they will provide to anyone enquiring about the history of the building. The leaflet mentions the marbles without giving any great details. It could be expanded easily to give more geological information.

The interior of the entrance hall to 51 St. Stephen’s Green.

The interior of the entrance hall to 51 St. Stephen’s Green.

The interior of the entrance hall (left) and exterior (right) to 51 St. Stephen’s Green.


Christchurch Cathedral
Dublin Castle
Trinity College
Pearse Station
Merrion Square
51 St. Stephen's Green
St Stephen's Green
National Concert Hall
R110
R114
R118
R111
N81
PO
Ranelagh
Ballsbridge


51 St. Stephen's Green
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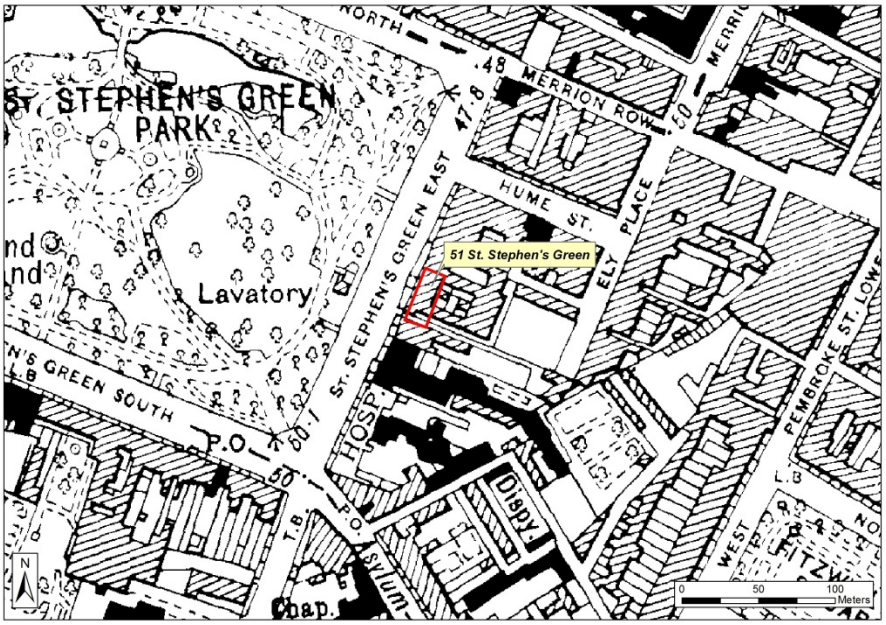
Meters


ST. STEPHEN'S GREEN PARK
Lavatory
NORTH
MERRION ROW
HUME ST.
ELY PLACE
ST. STEPHEN'S GREEN EAST
STEPHEN'S GREEN SOUTH
PEMBROKE ST. LOWER
51 St. Stephen's Green
HOSP.
Dispy.
Chap.
N
0
50
100
Meters

DUBLIN CITY - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE:	**Dublin City Walls**
OTHER NAME(S):	
IGH THEME:	**IGH 15 Economic Geology**
TOWNLAND(S):	
NEAREST TOWN/VILLAGE:	**In Dublin City**
SIX INCH MAP NUMBER:	**18**
ITM CO-ORDINATES:	**714917E 734026N (Cook Street)**
	715002E 733800N (Powers Square)
	715248E 733854N (Ship Street)
1:50,000 O.S. SHEET NUMBER:	**50 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
Three remaining sections of the Medieval city walls of Dublin City.

Geological System/Age and Primary Rock Type
The walls are composed of local Calp limestone of Carboniferous age, but built between 1100 and 1125, also incorporating some later historic re-facings and additions including the 20th Century addition of a crenelated parapet at Cook Street.

Main Geological and Geomorphological Interest
The sections of the wall are representative of the early use of local stone in defensive construction. Whilst most of the City walls are no longer extant, there are several short sections surviving. The three sections comprising this site are perhaps the longest and most intact. The best section, and most dramatic because of its height, is seen along Cook Street, below St. Audoen's Church. A long section of wall including Stanhurst's Tower is seen in Ship Street adjacent to the entrance into Dublin Castle. The Bermingham Tower and Record Tower and below ground the remains of the Powder tower are the principal remains of the city defences within Dublin Castle. A further surviving long section of wall can be seen in Power's Square, close to the Iveagh Markets. Sections of note, but which are not included in this site definition, also occur in the basement of Civic Offices at Wood Quay; a short section of wall in Lamb Alley and Isolde's Tower, preserved but barely visible in an underground chamber at the base of a new building on Exchange Street Lower.

Site Importance: County Geological Site
This site constitutes an important reference point for the early use of local building stone within the urban environment of Dublin City, and historical development of a capital city.

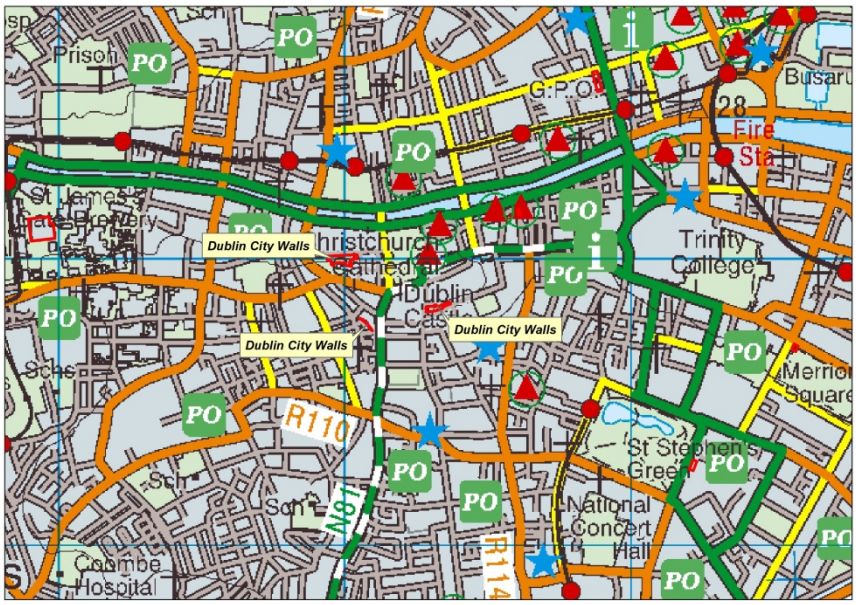
Management/promotion issues
Dublin City Council have made important efforts to protect and promote the remaining segments of the city walls and through a diversity of devices and signs in the streets and at Newmarket through the clever public realm design, the position of the walls can be followed where no upstanding remains are seen. An excellent booklet outlining the story of the walls with the detailed map (used here) is freely available. A very detailed Dublin City Walls and Defences Conservation Plan (2004) for the City Walls can be downloaded from the Council website:
http://www.dublincity.ie/main-menu-services-planning-heritage-and-conservation/heritage

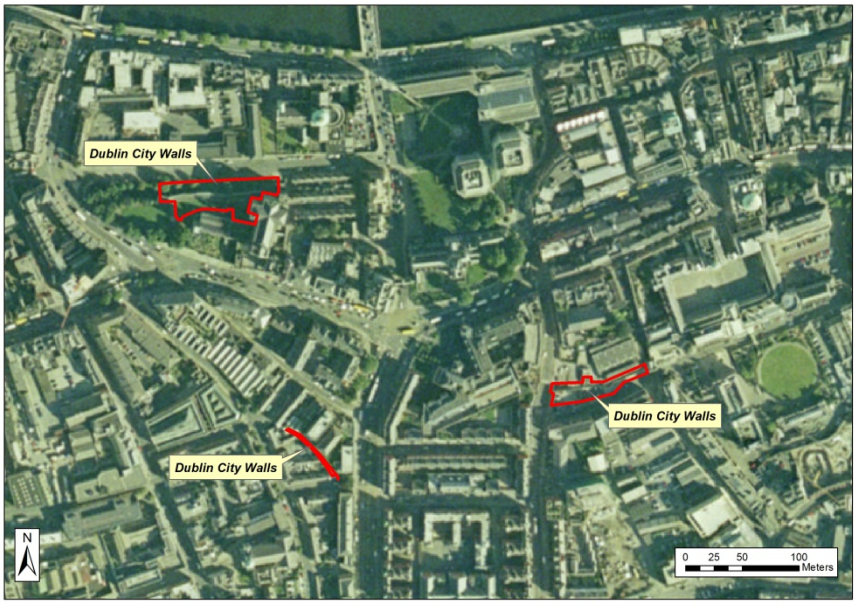
An iPhone App tour (https://itunes.apple.com/ie/app/dublin-city-walls/id388288868?mt=8) of the city walls is also available. The Dublin City Council City Walls iPhone app offers a unique guide to the medieval history of Dublin City. Using the historic city wall as its framework, it blends graphics, videos, photos and breathtaking 3D animations of the medieval world.

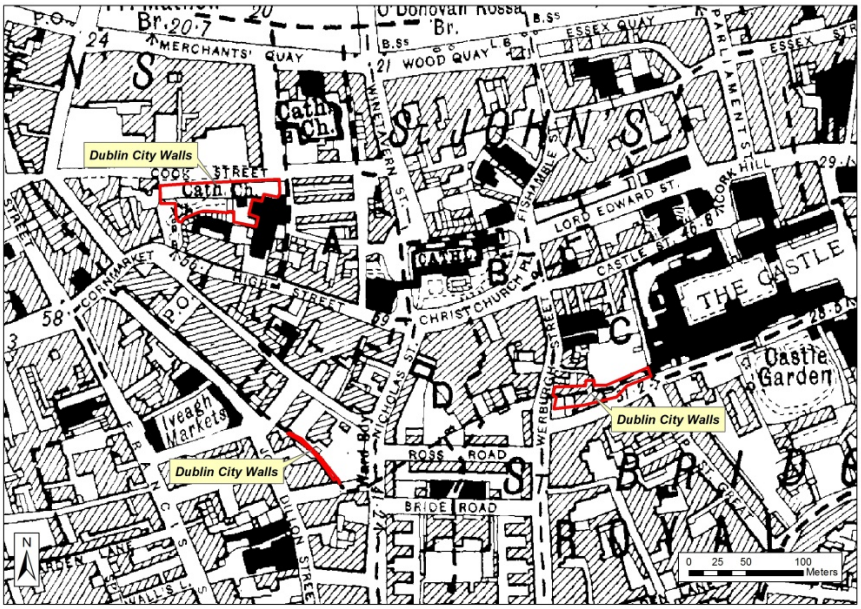
The section of wall in Ship Street, looking east with Stanhurst's Tower in the middle.

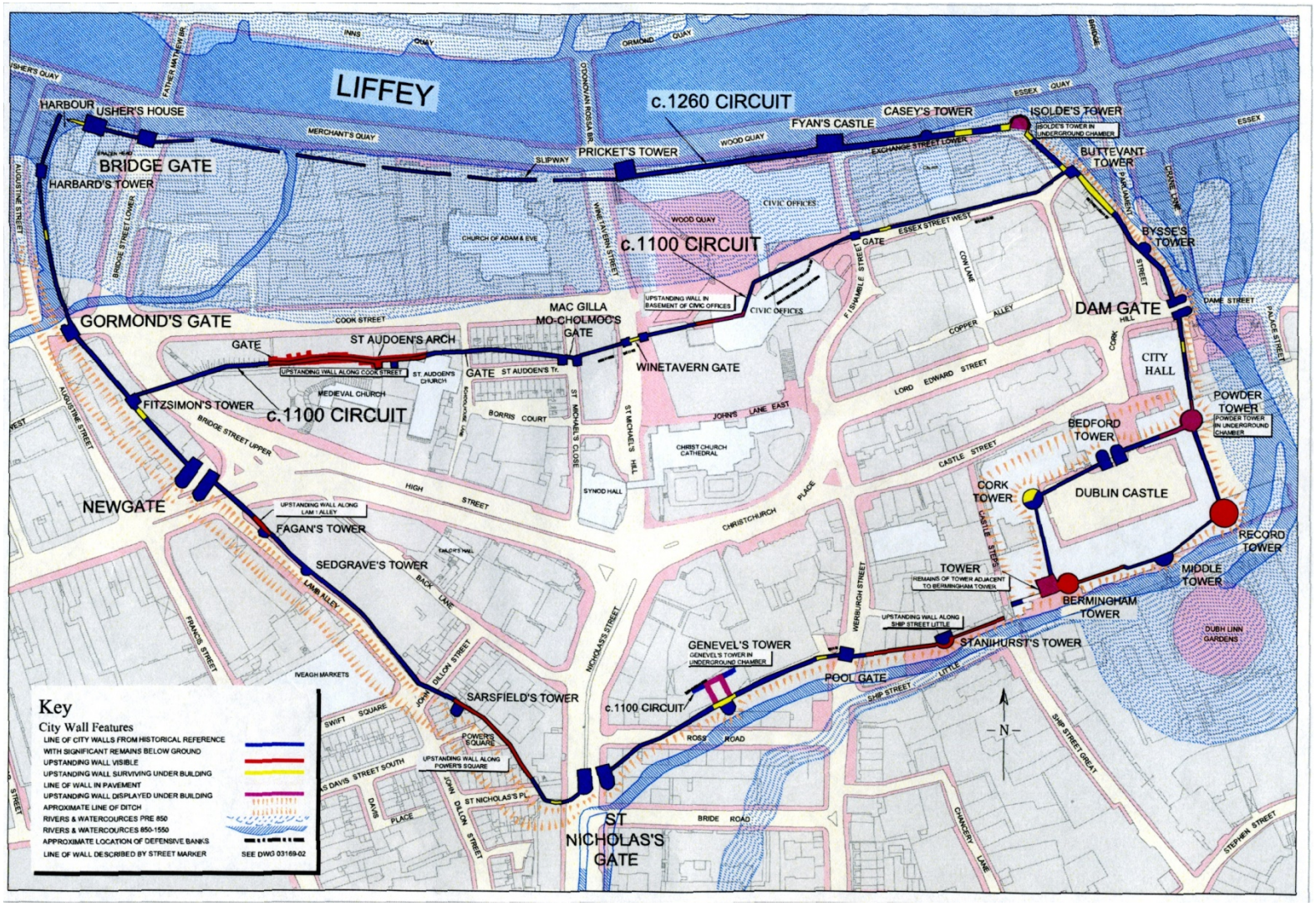
The section of wall visible in Power's Square.

The section of wall in Cook Street below St. Audoen's Church.


Dublin City Walls
Dublin City Walls
Dublin City Walls
R110
R114
N81
Prison
G.P.O.
Trinity College
St Stephen's Green
National Concert Hall
Fire Sta
Christchurch Cathedral
Dublin Cas
Coombe Hospital
PO


Dublin City Walls
Dublin City Walls
Dublin City Walls
N
0 25 50 100
Meters


Dublin City Walls
Dublin City Walls
Dublin City Walls
MERCHANTS' QUAY
WOOD QUAY
ESSEX QUAY
ST. JOHN'S
COOK STREET
Cath. Ch.
CORNMARKET
HIGH STREET
CHRIST CHURCH PL.
LORD EDWARD ST.
CASTLE ST.
THE CASTLE
Castle Garden
Iveagh Markets
ROSS ROAD
BRIDE ROAD
N
0 25 50 100
Meters


LIFFEY
c.1260 CIRCUIT
c.1100 CIRCUIT
c.1100 CIRCUIT
c.1100 CIRCUIT
HARBOUR
USHER'S HOUSE
BRIDGE GATE
HARBARD'S TOWER
PRICKET'S TOWER
FYAN'S CASTLE
CASEY'S TOWER
ISOLDE'S TOWER
ISOLDE'S TOWER IN UNDERGROUND CHAMBER
BUTTEVANT TOWER
BYSSE'S TOWER
DAM GATE
CITY HALL
POWDER TOWER
POWDER TOWER IN UNDERGROUND CHAMBER
BEDFORD TOWER
DUBLIN CASTLE
CORK TOWER
RECORD TOWER
MIDDLE TOWER
BERMINGHAM TOWER
TOWER
REMAINS OF TOWER ADJACENT TO BERMINGHAM TOWER
STANIHURST'S TOWER
GENEVEL'S TOWER
GENEVEL'S TOWER IN UNDERGROUND CHAMBER
POOL GATE
SARSFIELD'S TOWER
ST NICHOLAS'S GATE
FAGAN'S TOWER
SEDGRAVE'S TOWER
NEWGATE
FITZSIMON'S TOWER
GORMOND'S GATE
MAC GILLA MO-CHOLMOC'S GATE
WINETAVERN GATE
ST AUDOEN'S ARCH
GATE
UPSTANDING WALL ALONG COOK STREET
UPSTANDING WALL IN BASEMENT OF CIVIC OFFICES
UPSTANDING WALL ALONG LANE / ALLEY
UPSTANDING WALL ALONG SHIP STREET LITTLE
UPSTANDING WALL ALONG POWER'S SQUARE
MEDIEVAL CHURCH
ST AUDOEN'S CHURCH
CHRIST CHURCH CATHEDRAL
SYNOD HALL
CIVIC OFFICES
CHURCH OF ADAM & EVE
IVEAGH MARKETS
DUBH LINN GARDENS
Key
City Wall Features
LINE OF CITY WALLS FROM HISTORICAL REFERENCE
WITH SIGNIFICANT REMAINS BELOW GROUND
UPSTANDING WALL VISIBLE
UPSTANDING WALL SURVIVING UNDER BUILDING
LINE OF WALL IN PAVEMENT
UPSTANDING WALL DISPLAYED UNDER BUILDING
APROXIMATE LINE OF DITCH
RIVERS & WATERCOURCES PRE 850
RIVERS & WATERCOURCES 850-1550
APPROXIMATE LOCATION OF DEFENSIVE BANKS
LINE OF WALL DESCRIBED BY STREET MARKER
SEE DWG 03169-02
N

DUBLIN CITY - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Temple Bar Street Well**
Other names used for site	St. Winifred's Well
IGH THEME	**IGH 16 Hydrogeology**
TOWNLAND(S)	**St. Andrew's**
NEAREST TOWN/VILLAGE	**In Dublin City**
SIX INCH MAP NUMBER	**18**
ITM CO-ORDINATES	**715537E 734190N**
1:50,000 O.S. SHEET NUMBER	**50 GSI BEDROCK 1:100,000 SHEET NO: 16**

Outline Site Description
An historic street well in the middle of Temple Bar.

Geological System/Age and Primary Rock Type
The well is a hydrogeological feature of historic and perhaps modern water flow.

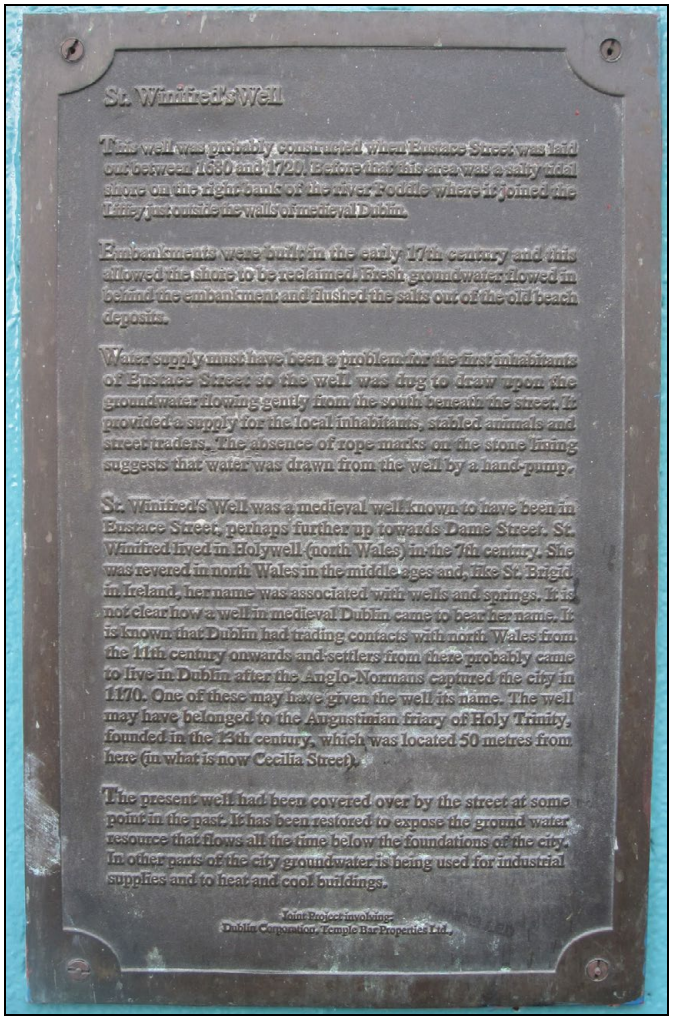
Main Geological or Geomorphological Interest
The Temple Bar Street Well is thought to date from between 1680 and 1720, and was dug to supply freshwater for the local inhabitants of the city, which had become protected by embankments. The water was groundwater that flowed into this area of previously saline groundwater.

St. Winifred's Well was an earlier Medieval well thought to have been situated very close to this one, perhaps only 50m away.

Site Importance - County Geological Site
The site presents an interesting aspect of hydrogeology in a very accessible location.

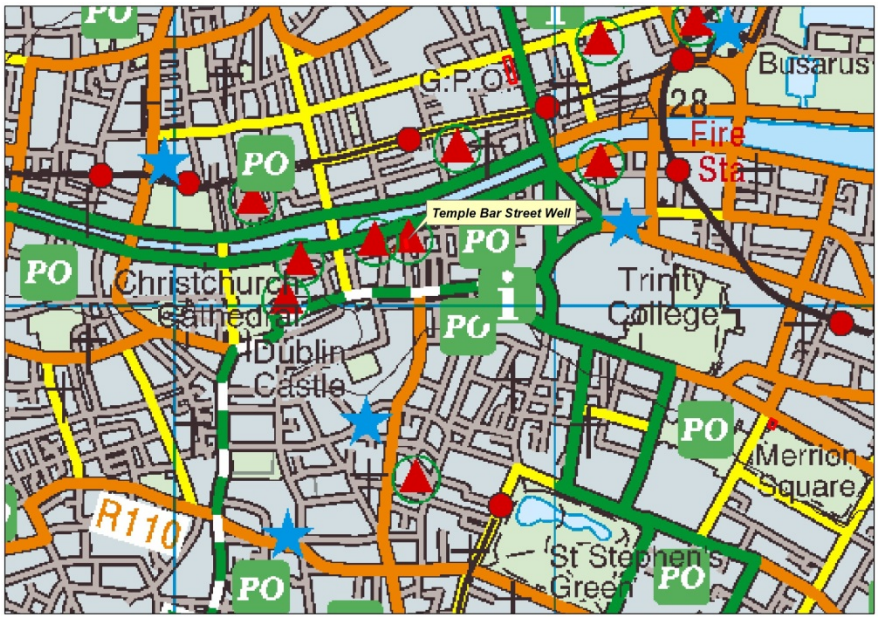
Management/promotion issues
The location of the 300 year old well means that it is very accessible to local people and to visitors to Temple Bar. There is a wall plaque adjacent to it, that explains the importance and history of this well and the even older St. Winifred's Well in the same general location. However, the location next to pubs in a busy nightlife area means that the well is poorly served by many people who are unaware of its importance. The plaque is not directly attached to the well and is easily overlooked, so an opportunity may be lost for many passers-by.

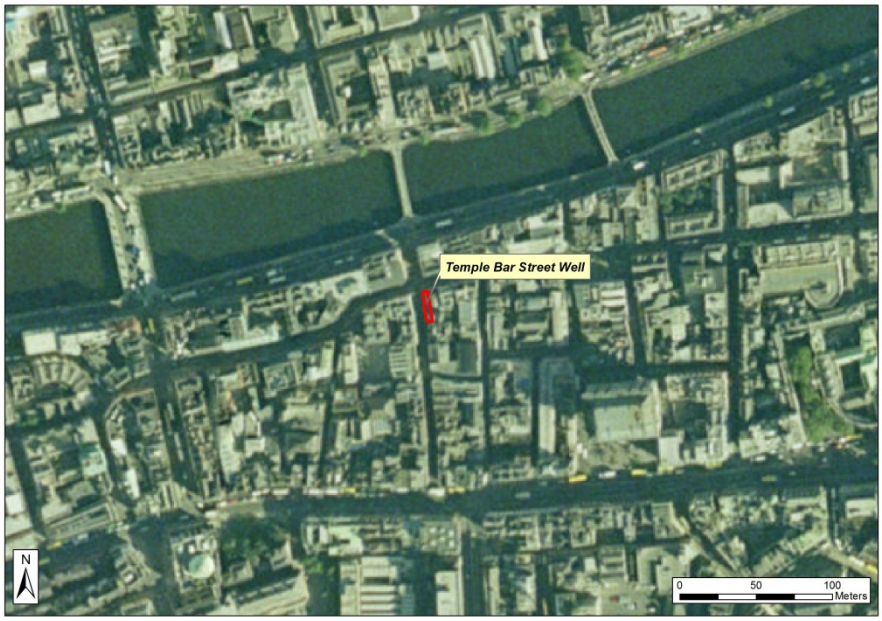
It is very difficult to propose solutions in a densely occupied and heavily used street, but perhaps an extremely concise panel stating that it is a '300 year old freshwater well tapping a groundwater source' could be attached to the top of the well.

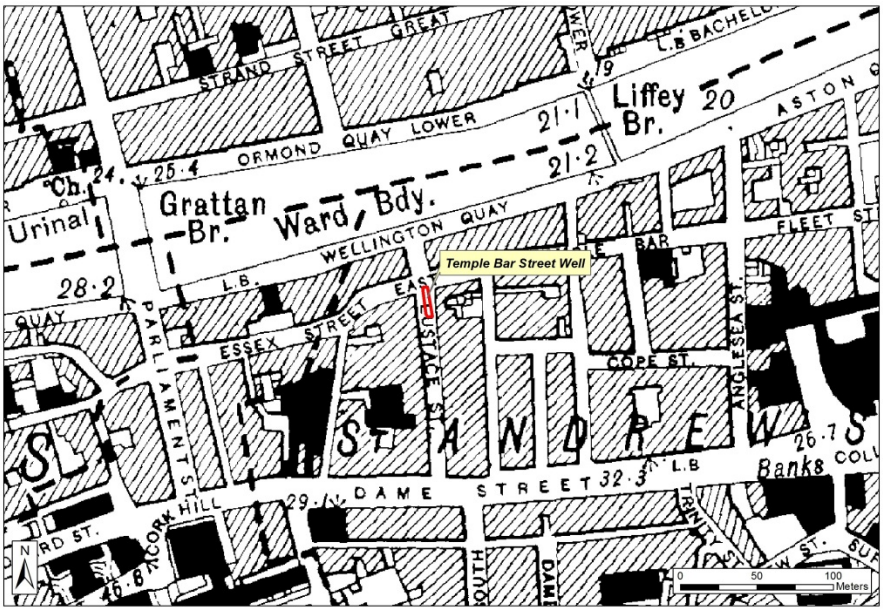


The street sign explaining the well and groundwater flows beneath the area, with the well pictured (right) and the sign on the wall behind.

The streetscape of the well, adjacent to pubs and other premises means it is somewhat 'lost' in the mix, and subject to regular abuse of various types.


Temple Bar Street Well
G.P.O.
Busarus
Fire Sta
Christchurch Cathedral
Dublin Castle
Trinity College
Merrion Square
St Stephen's Green
R110
PO


Temple Bar Street Well
N
0
50
100
Meters


Temple Bar Street Well
STRAND STREET GREAT
ORMOND QUAY LOWER
Liffey Br.
Grattan Br.
Ward Bdy.
WELLINGTON QUAY
ESSEX STREET EAST
PARLIAMENT ST.
TEMPLE BAR
FLEET ST.
COPE ST.
ANGLESEA ST.
ST ANDREW
DAME STREET
Banks
N
0
50
100
Meters

DUBLIN CITY - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE: **Guinness Wells**
OTHER NAME(S):
IGH THEME: **IGH 16 Hydrogeology**
TOWNLAND(S):
NEAREST TOWN/VILLAGE: **In Dublin City**
SIX INCH MAP NUMBER: **18**
ITM CO-ORDINATES: **713870E 734130N**
1:50,000 O.S. SHEET NUMBER: **50** **GSI BEDROCK 1:100,000 SHEET NO:** **16**

Outline Site Description
The Guinness Brewery has always depended upon the availability of water. It requires water for the product and the processes in making beer. Water was also required for transport of raw materials to the brewery, and distribution of product within Ireland and for export overseas. There were several historic sources of water near the site; the River Liffey, the River Camac and the City Basins fed by water from the Grand Canal. However, Guinness' realised that river and canal water quality was variable. They made significant efforts to obtain a high quality water supply from the groundwater system below their site. They started in the 19th Century digging wells and drilling boreholes. There were at least eight historic wells and boreholes on the site. One borehole was a major feat of Victorian technology. Over several years they excavated a borehole down to 1,531.5 feet below Ordnance Datum (Poolbeg) about 85 metres north of Market Street. This is probably still the deepest water supply borehole constructed in the country. Even with this great depth, the yield of water from the Calp Limestone was relatively small. It is reported that they obtained a yield of 1000 gallons per hour. Guinness' dug and bored several wells into the coarse permeable gravels associated with the modern and palaeo channels of the River Liffey. One of these composite wells in the northern part of the site has recently been brought back into use. It is called the Cooperage Well. It currently provides a yield of 22,000 gallons per hour or 100 cubic metres per hour.

Geological System/Age and Primary Rock Type
Both boreholes are historical, dug into and through deposits of the former River Liffey Channel and into underlying Lower Carboniferous 'Calp' Limestone bedrock.

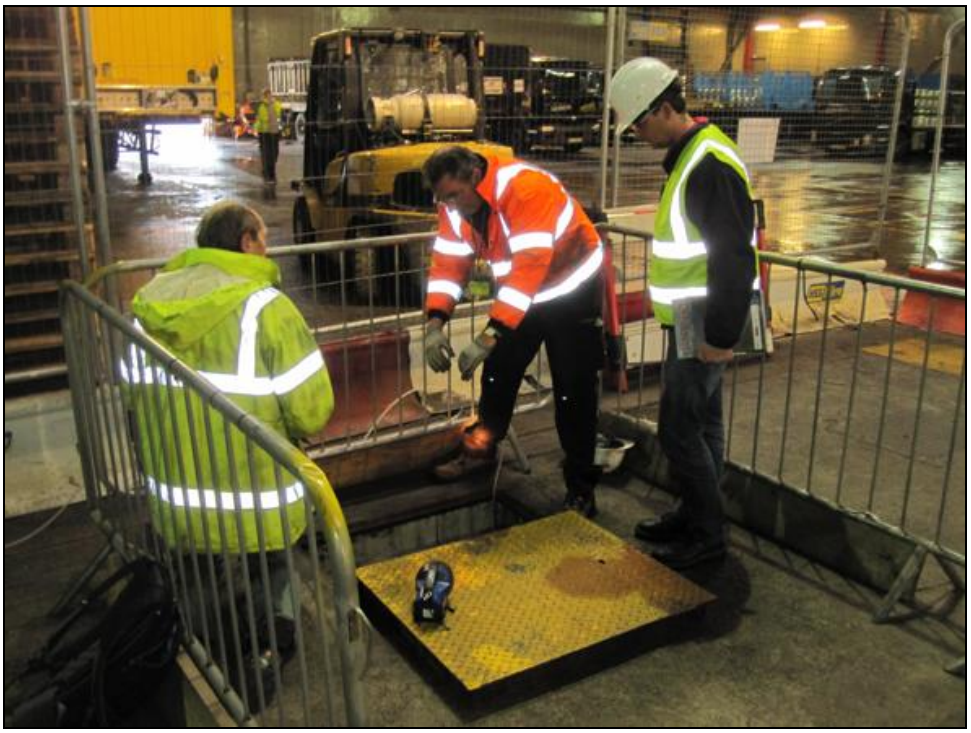
Main Geological or Geomorphological Interest
The Cooperage well is of an historic construction and has been reused to supply high volumes of water for processing needs, rather than for brewing needs. The large sustainable volume of water that can be pumped from the structure show that it is taking water from the gravels in the channel of the former River Liffey, rather than from bedrock.

The deep bedrock borehole has not yet been located, other than knowing that it was in the southern part of the site, north of Market Street, and north of the current Guinness Storehouse visitor centre. An ornate inscribed and hand-painted borehole construction log was seen in 1988. The drawing showed that this borehole was a significant technical achievement, involving geologists, engineers and drillers. Cross-section sketches from 1971 provided by Guinness show the well depth as 1,531.5 feet below Ordnance Datum. It is estimated that the groundlevel at the site was about 70 feet above Ordnance Datum, and therefore the borehole was over 1,600 feet deep. It went down through about 125 feet of the overburden deposits of gravels and boulder clays from glacial and postglacial times, into the Calp limestone bedrock. It is impoprtant because it was one of the earliest boreholes drilled in Ireland. It is also a reminder even in modern times that the yield from a borehole is not a function of depth. Water does not flow through the rock itself but flows through the open cracks or fractures in the impermeable rock. The deep Guinness borehole had a low yield

because it did not encounter many open breaks in the rock. The Cooperage well has a high yield of water because it draws water from the numerous open pore spaces in the loose coarse gravels deposits in the Liffey valley.

Site Importance: County Geological Site; recommended for Geological NHA
For both historical, technical and cultural importance the site is worthy of recognition as a County Geological Site, and may be recommended as a geological NHA in the future.

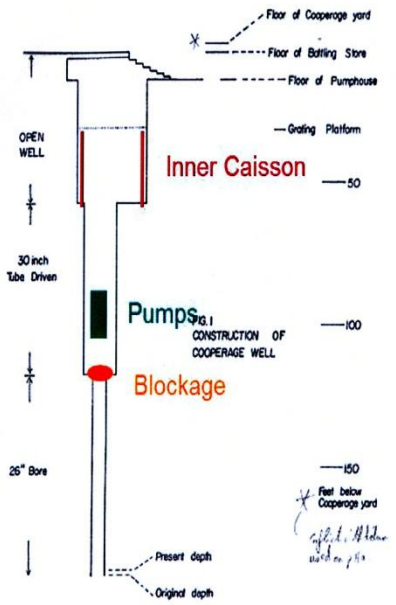
Management/promotion issues
Access is not possible without the exceptional assistance of Guinness staff responsible for the site. Promotion, other than information within literature and web resources, is not viable.



The access to the Cooperage Well in the Guinness Brewery.

The top of the Cooperage Well in the Guinness Brewery. There were four pumps taking water from the borehole. The right angle cast iron bends on the rising mains for two electric submersible pumps are seen on the right, and the two dark holes were the position of the two removed pump rising mains.

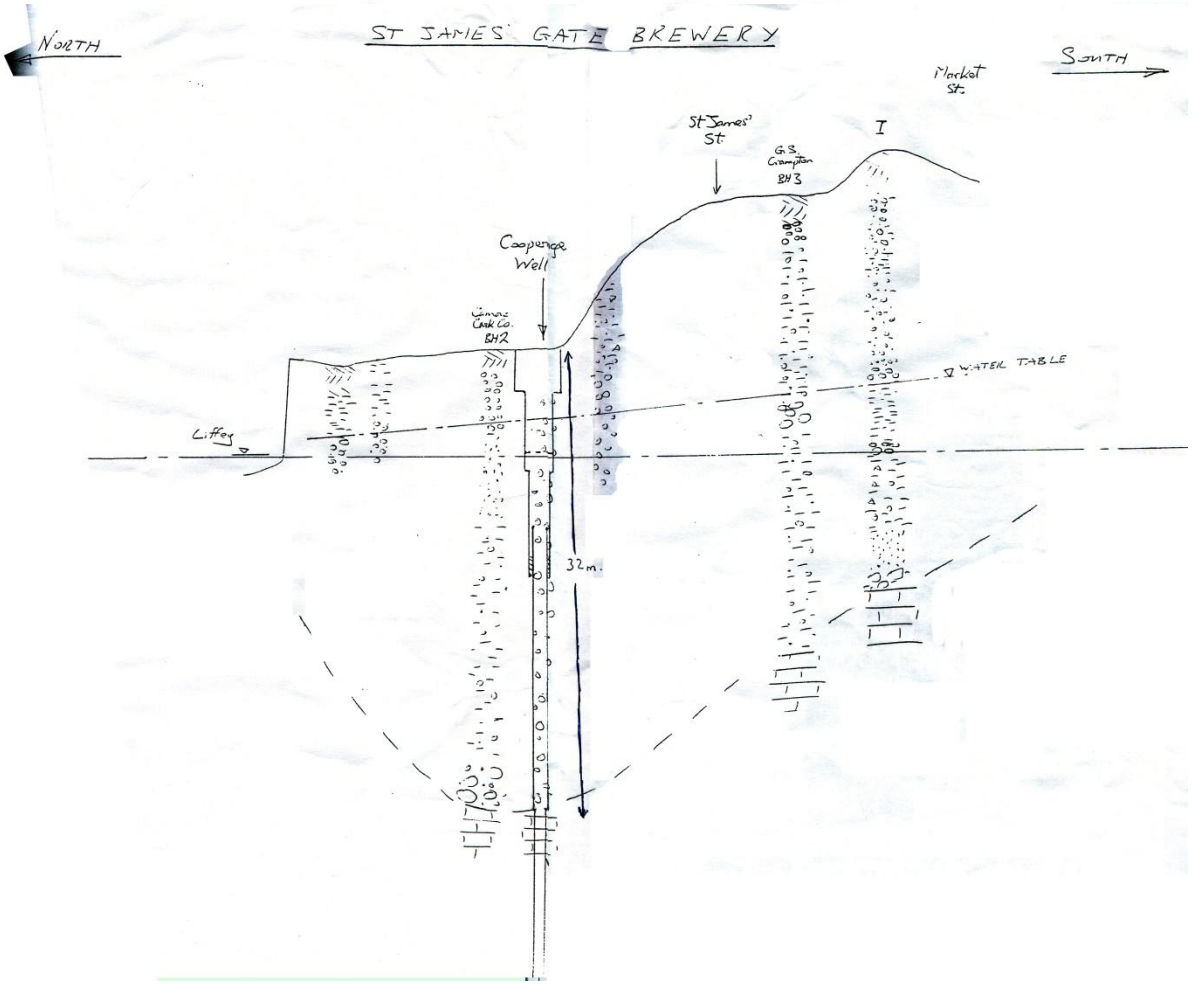
History of Construction Of Cooperage Well

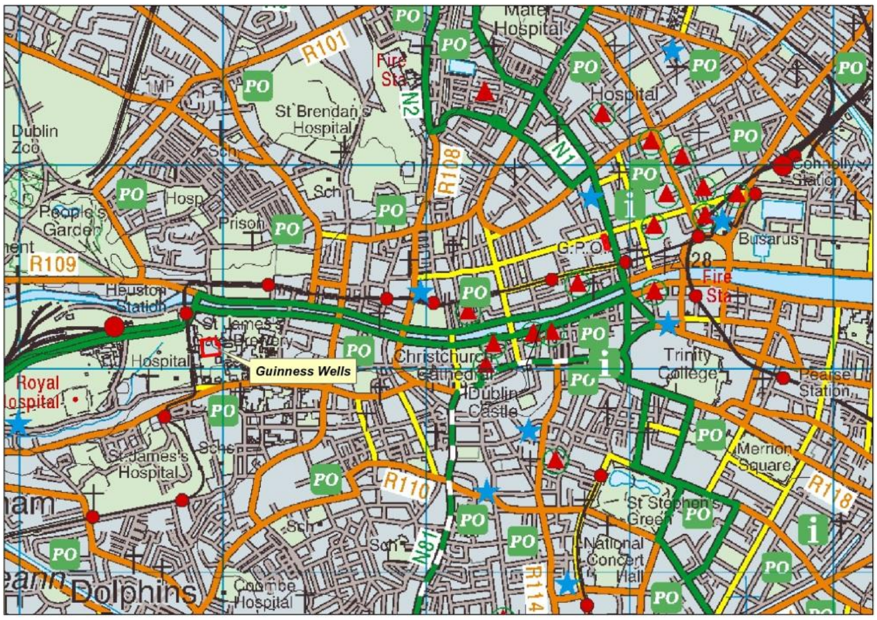


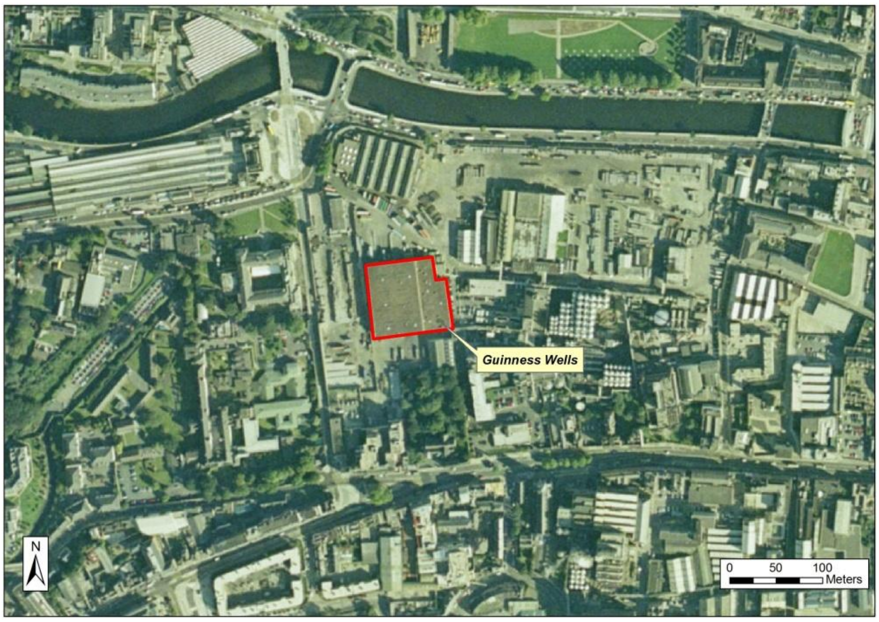
The Cooperage Well was most probably constructed in three stages, as follows:

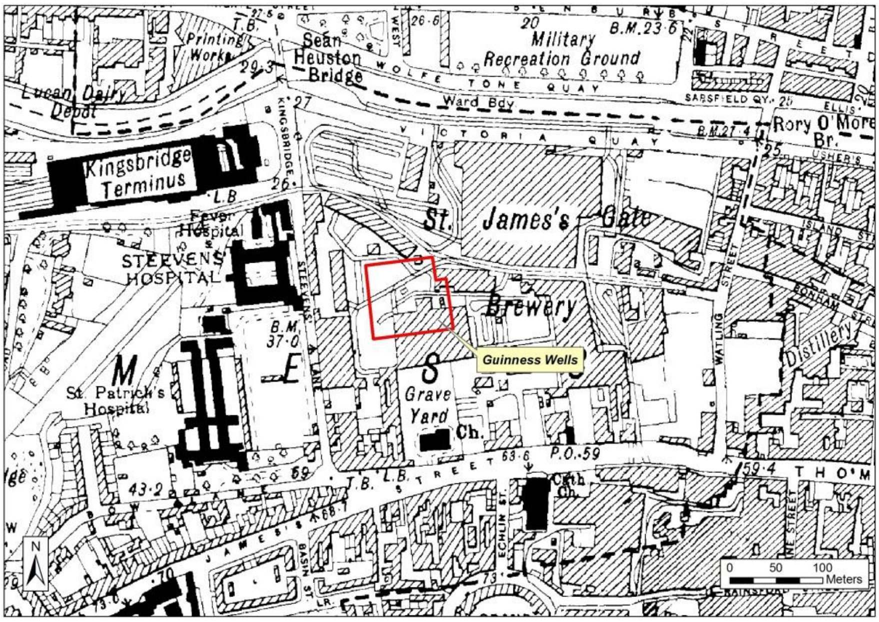
- 1880 - 3.1 m diameter well to 17.1 metres, inner and outer cast-iron caissons - narrower inner caisson below grating at approximately 3 metres (shown in red in drawing opposite).
- 1902 – 292 mm diameter tube was driven down below the dug well and proved increased supply available from the deeper strata (not shown); and
- 1903 - 762 mm diameter tube to 35.36 m and 660mm diameter bored well below to 56.99 metres below the former Cooperage yard floor level (this level is unknown and is not equivalent to the current Export Warehouse floor level).

Well data	
Total depth	approximately 57m
Bedrock depth	approximately 24m
Gravels Depth	approximately 10m




Guinness Wells
R101
R109
R108
R110
R114
R118
N1
N2
N81
Dublin Zoo
People's Garden
Heuston Station
Royal Hospital
St James's Hospital
St Brendan's Hospital
Prison
Fire Sta
Christchurch Cathedral
Dublin Castle
Trinity College
Busarus
Connolly Station
Pearse Station
Merrion Square
St Stephen's Green
National Concert Hall
Coombe Hospital
Dolphins
PO


Guinness Wells
N
0 50 100
Meters


Guinness Wells
Sean Heuston Bridge
Military Recreation Ground
Wolfe Tone Quay
Victoria Quay
Kingsbridge Terminus
Lucan Dairy Depot
Printing Works
Fever Hospital
Steevens Hospital
St Patrick's Hospital
St. James's Gate
Brewery
Grave Yard
Ch.
Distillery
Rory O'More Br.
Sarsfield Qy.
Ward Bdy
N
0 50 100
Meters