

REGIONAL GROUNDWATER RESOURCE DEVELOPMENT CASE STUDY, CO. KILDARE.

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ABSTRACT

Strategic management of water resources is required to sustain rapidly increasing urban and industrial development in County Kildare. Kildare County Council commissioned Nicholas O' Dwyer Ltd., Patrick J. Tobin and Co. Ltd. and White Young Green (formerly Kevin T. Cullen & Co. Ltd.) to undertake a regional study of the available water resources and a programme for sustainable resource development to meet the potable water requirements of the County. Groundwater presently plays an increasingly important role in the provision of potable water in County Kildare. This paper outlines the investigation and development programme for the groundwater aspect of this integrated regional study.

After an initial evaluation three aquifers were prioritised for immediate development based on estimated aquifer potential and strategic location. These were the Allenwood Limestone (Monasterevin, Rathangan and north of Robertstown), the Calp Limestone (Johnstown Bridge) and Gravel Deposits (Robertstown). Drilling investigations proved well field yields of 2.5 – 4.5 Megalitres/day (MLD) in the Allenwood Aquifer, 3.75 MLD in the Calp Aquifer, and 5 MLD in the Gravel Aquifer. Water quality was found to meet the potable drinking water standards with basic treatment for iron, manganese and bacteria. Long-term pumping tests were undertaken to determine the sustainable yield and impact on the surrounding environment, with environmental assessments completed for each development. To maintain long-term water quality for future generations source protection plans were prepared which provide a scientific basis for the planning of future developments that may pose a risk to these groundwater resources.

INTRODUCTION

Kildare is heavily dependent on the River Liffey to meet its potable water needs. This is not sustainable due to increased demands on the Liffey waters from outside the county and the overall management of the balance between water abstractions, environmental protection and amenity requirements within the river catchment. Prior to this study approximately 20% of Kildare's water supplies were met by groundwater. This contrasts strikingly with other European Countries where up to 70% of potable needs are met by groundwaters.

An initial desk study highlighted the potential aquifer resources in County Kildare, for the most part these aquifers are located within the county boundary and therefore allow some practical management of the resource by the Local Authority.

Using a strategy study some or all of the existing and potential groundwater sources within a county may be considered useful for the county. However, it is far more likely that only a number of the aquifers will be considered valuable in the context of network rationalisation, treatment costs and long term safe yields and impacts. The prioritised or most valuable resources will emerge from an aquifer ranking exercise that compares the development potential of each aquifer with respect to its location, safe yield, quality and vulnerability.

A methodology was set up for County Kildare where proving of the sustainable yields and quality from the aquifers would be undertaken within two phases. To protect the county's groundwater resources, for future generations, environmental assessments and source protection plans were undertaken in Phase III.

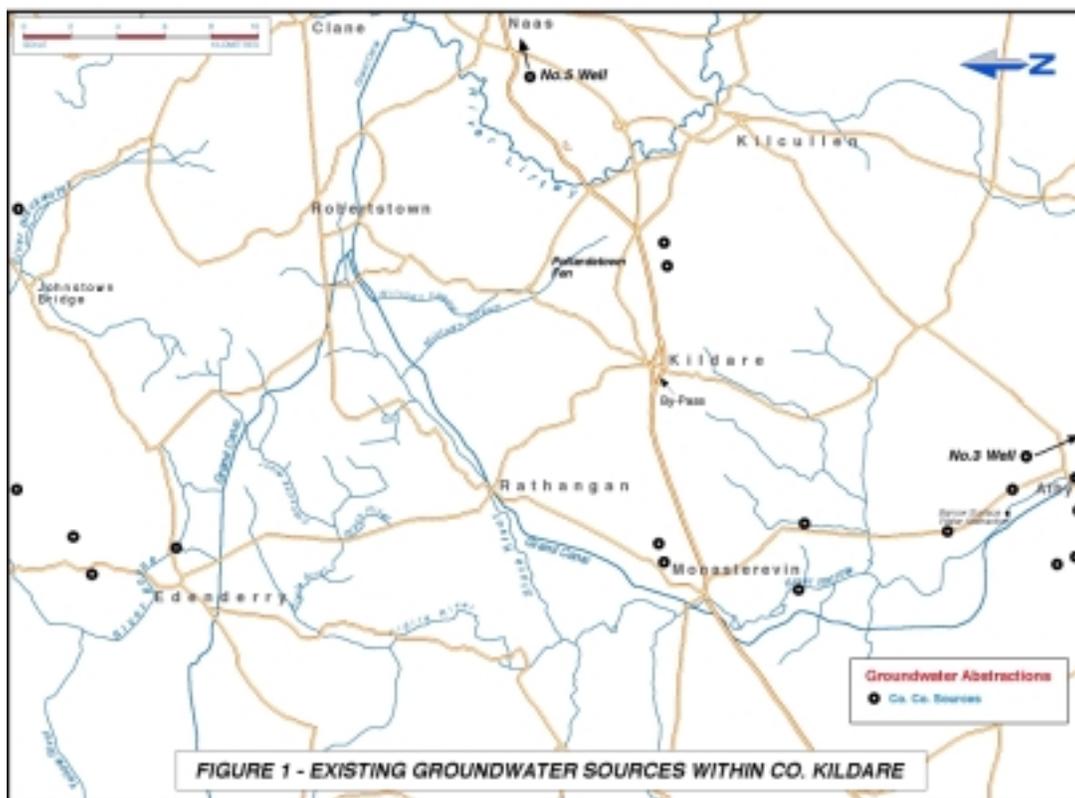
Regular meetings with the client and project team were held to ensure that the development of aquifer resources integrated with the development of the surface water resources, regional water demands and distribution system.

Each of the phases of the groundwater development project is summarised below.

DESK STUDY

A desk study was undertaken to prioritise aquifers for development. Although groundwater data was found to be extremely sparse, professional experience played an important role in the assessments.

The initial part of the desk study involved an assessment of the vulnerability of the 29 existing County Council groundwater supply sources to contamination (Figure 1). This was completed in September 1998.



The parameters proposed for use in the vulnerability assessment consisted of well-head information, well construction details, geological information, proximity to potential contamination sources and water quality. However, the desk study showed information on well design and geology to be poor. The resulting vulnerability rating was therefore based primarily on available geological information, water quality data and proximity to contaminant sources such as roads, septic tanks, sewage plants, farmyards and drains. The sources are rated in terms of extreme, high, medium and low vulnerability.

The assessment of the existing groundwater sources for County Kildare found that 3 sources have been decommissioned and 1 was inaccessible. The remaining sources were investigated and the following was concluded:

- 4 were found to have an extreme vulnerability,
- 5 were found to have a high vulnerability,
- 3 were found to have a high to moderate vulnerability,
- 9 were found to have a moderate vulnerability,
- 2 were found to have a moderate to low vulnerability,
- 2 were found to have a low vulnerability.

The desk study also assessed the potential sources within the county by compiling all the available geological and hydrogeological information within the county and 5-10km beyond the county boundary.

This data included:

- overburden type and thickness,
- bedrock type and aquifer classification,
- groundwater quality,
- location and type of natural heritage areas and
- groundwater yields.

Databases within the Geological Survey of Ireland (GSI), the Office of Public Works (OPW), Kevin T. Cullen & Co. Ltd. (KTC), the County Council and private companies/contractors were used to compile the available data for the county and immediate surrounds. A further eight trial wells were drilled, tested and sampled, to enhance interpretation in areas where data was sparse.

The desk study defined the distribution of regionally and locally important aquifers and provided an estimate of the likely volumes of groundwater available from each aquifer system. Also, the groundwater quality characteristics for each aquifer system were defined on the basis of the available data sets.

Based on the expected aquifer potential and the strategic requirement for additional water resources, three prioritised aquifers were put forward for further investigation (Figure 2):

- Allenwood Limestone in West Kildare (Monasterevin and Rathangan) and Mid-Kildare (Robertstown)
- Calp Limestone in North Kildare (Enfield/Johnstown Bridge)
- Gravels around Robertstown.

A fourth aquifer, the Curragh Gravel, was highlighted during the desk study. The Curragh Aquifer is a great expanse of gravelly glacial deposits which underlie the Curragh area and extends beyond to Nurney and Suncroft in the south, the Hill of Allen in the north and near Kilcullen in the east. Details on yields from the Curragh (“North Kildare Gravel Aquifer”) gravels are well documented. The Curragh aquifer occupies a trough in the bedrock surface. The central core of the bedrock trough is underlain by limestone bedrock with more resistant sandstones and volcanics forming the edges of the trough like structure. The limits of the aquifer are clearly defined by outcrop in the east and northwest. Elsewhere the edge of the aquifer is less clear as the outwash deposits pass laterally into a more till dominated glacial sequence. Drilling undertaken as part of the Kildare By-pass project has shown these gravels extend to greater than 60 metres in the centre of the bedrock depression.

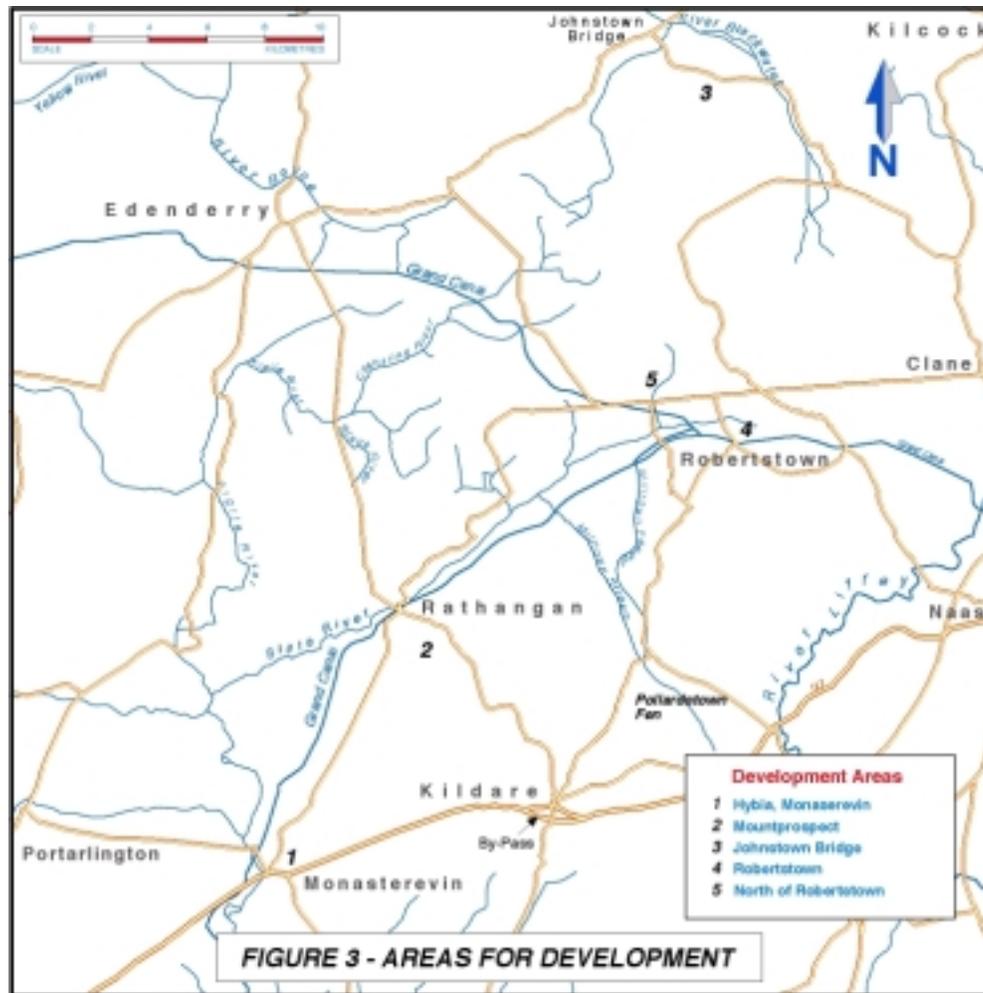
The Curragh Gravel Aquifer was not further investigated but remains as a potential for future development. Impact assessment of the dewatering of this aquifer during the construction of the Kildare By-pass will provide useful information on the feasibility of developing a sustainable resource from this aquifer.



PHASE I – AQUIFER PROVING WORKS

Following the desk study a trial well drilling, pumping test and sampling programme was carried out in five areas within the three prioritised aquifer systems (Figure 3):

- Monasterevin,
- Rathangan,
- Johnstown Bridge,
- Robertstown Village and
- North of Robertstown Village.



Phase I involved practical issues concerning the management of water resources and the determination of yields from the prioritised aquifers. Practical issues included; location of designated areas (especially wetlands), access for personnel and machinery, discharge locations for pumped waters, major environmental hazards, height for reservoirs and land ownership. Natural Heritage Areas (NHAs) and proposed Special Areas of Conservation (pSACs) on both a regional and local scale were identified and where possible lands adjacent to these were avoided. Coillte forest, County Council owned property and private lands outside the NHAs were selected and resistivity surveys carried out to identify locations for wells.

Trial wells were drilled and 72-hour pumping tests carried out to determine the yield from individual wells. Raw water samples were collected and analyses carried out to identify the groundwater quality at each of the well sites. Generally, the raw water met the drinking water standards except for iron, manganese and bacteria.

The Phase I investigations in the Robertstown Gravel Aquifer and Allenwood Limestone Aquifer have successfully proved the potential of developing yields of 4-6 MLD in both the Robertstown Village area and in the Hybla Wood, Monasterevin area. These areas are strategically ranked higher, based on location and potential yields and so Phase II works were carried out on these two sites initially due to higher priority.

The Phase I investigations in the Calp and Allenwood Limestone Aquifers has successfully proved the potential of developing a minimum yield of 3.75 and 5.4 MLD in both the Johnstown Bridge and the Rathangan areas.

The area to the north of Robertstown was not further investigated but remains as a potential for future development.

Therefore, four of the five areas were further developed under Phase II, where further drilling, extended pumping tests and sampling proved how feasible these areas were in developing groundwater for County Kildare.

PHASE II – FURTHER INVESTIGATIVE WORKS

The programme for Phase II involved further investigative works within three of the aquifers (Gravel, Allenwood Limestone and Calp) and the works were carried out as follows :

- Wide diameter wells were drilled at the most suitable locations taking into account the geological structure of the aquifers and the potential location of a central treatment plant.
- Consultation with Duchas regarding heritage designated areas.
- A multiple-well extended pumping test was carried out at each production site. The extended test, lasting for 4 weeks, provided aquifer characteristics, boundary conditions and environmental impact information.
- The initial source protection zones were developed based on data obtained during the extended pumping tests.
- The long-term quality of the pumped groundwater was established and samples collected periodically to assess any variation.

PHASE III – ENVIRONMENTAL IMPACTS AND SOURCE PROTECTION

As part of the planning process, Environmental Impact Statements (EIS) and Environmental Reports (ER) for the proposed abstractions, depending on the abstraction rates, were undertaken. An EIS is required for abstractions greater than 2 million m³/yr, or if there are significant environmental impacts resulting from the development. These studies determined the baseline conditions of the existing environment and identified any impacts that the developments may cause. Mitigation measures can be implemented into the design of the development to ensure minimal effects on the local environment.

The proposed abstraction rate at Robertstown is above the threshold limit for an Environmental Impact Statement and therefore the assessment was carried out and submitted to An Bord Pleanala for approval. Although the others are below the threshold, environmental reports (similar to an EISs) were carried out. These reports showed that there was no significant impact on the environment resulting from these developments. The EIS/ERs describe the receiving or existing environment into which the proposed development will be placed. Potential impacts resulting from the development are outlined in the EIS/ERs together with proposed mitigation measures, which will prevent or reduce the identified potential impacts. Potential impacts would be mitigated by the provision of deeper wells, low flow augmentation and other measures compatible with the concept of sustainable development.

Source protection plans were developed for each area. These plans provide planning tools for the sound management of groundwater supplies. Each offers a means of managing the protection of groundwater supplies from contamination by using a risk-based approach, with guidelines for the planning and licensing authorities in carrying out their functions, and a framework to assist in decision-making on the location, nature and control of developments and activities in order to protect groundwater. Use of the plan will help to ensure that within the planning and licensing processes due regard is taken of the need to maintain the beneficial use of groundwater.

The plan does not set out to limit development but merely to control potentially polluting activities where they could lead to groundwater contamination. The level of control within the inner and outer protection zones is determined by the classification of the aquifer (regionally/locally important or poor) and the availability of a protective overburden layer covering the aquifer. Where the overburden layer is clay rich and thick then the aquifer has a low vulnerability to pollution and so the level of controls applied will be also low. Where the overburden cover is thin or absent then the aquifer has a high or extreme vulnerability and in these circumstances a high degree of control is required.

The overburden type and thickness at each well head were used to determine the vulnerability of the aquifer based on the GSI Vulnerability Mapping Guidelines (1999 Groundwater Protection Schemes: GSI, EPA, DOELG) given in Table 1 below.

| Vulnerability Rating | Hydrogeological Conditions | | | | |
|----------------------|---|---|---|-------------------------------------|----------------|
| | Subsoil Permeability (Type) and Thickness | | | Unsaturated Zone | Karst Features |
| | High Permeability (e.g.sand/gravel) | Moderate Permeability (e.g.sandy subsoil) | Low Permeability (e.g.clayey subsoil, clay, peat) | (Sand/gravel aquifers <u>only</u>) | (<30 m radius) |
| Extreme | 0-3.0m | 0-3.0 m | 0-3.0m | 0-3.0m | - |
| High | >3.0 | 3.0-10.0m | 3.0-5.0m | >3.0m | N/A |
| Moderate | N/A | >10m | 5.0-10.0m | N/A | N/A |
| Low | N/A | N/A | >10.0m | N/A | N/A |

Notes: i) N/A =not applicable
ii) Precise permeability values cannot be given at present
iii) Release point of contaminants is assumed to be 1-2 m below ground surface

Public consultation took place for each wellfield, where details of each scheme were presented together with the EIS/ER and the source protection plans.

Following receipt of planning permission, it is expected that the project will involve a build and design contract whereby the treatment facility and pipe network is designed and built to facilitate supplying the public water demand until 2020.

CONCLUSIONS

Groundwater is an integral part of the hydrogeological cycle and the development of large volumes of groundwater will impact on other elements of the hydrogeological regime. However, as elsewhere, groundwater can be developed in useable quantities in Kildare in a manner that maximises the natural quality of this renewable resource while at the same time minimising the effect on the environment generally. Groundwater can be readily developed in County Kildare to meet the population needs in a manner that complies fully with the principals of sustainable development.

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