THE GSI GROUNDWATER NEWSLETTER

NUACHTÁN SCREAMHUISCE SGÉ

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IN THIS ISSUE

"It is inevitable that environmental legislation will increasingly be framed around the concept of risk" states a recent publication "Groundwater in the UK - A Strategic Study". The word 'risk' now appears in EU Directives (eg in relation to the Precautionary Principle and Landfills). Quantitative risk assessment and risk analysis software are a growth area in environmental science. Where does the methodology of risk assessment fit into the groundwater scene in Ireland? On page 3, the philosophy and language of **risk** is used to provide a framework for the location of potentially polluting activities and, in particular, for the **groundwater protection scheme** being proposed for Ireland by the GSI. Use of this framework enables a systematic approach to be taken in decision-making and, provided the GSI guidelines for aquifer definition and vulnerability categories are used (or alternative national guidelines), decision-making can be applied evenly across the country.

One of the hazards posing a significant threat to groundwater is **septic tank effluent**. Maeve Scott and Nick Gray give a series of interesting and important recommendations on the location and management of septic tank and on-site sewage systems, based on their studies (pages 5-6). Kevin Cullen comments on the **groundwater protection scheme** being proposed for Ireland on page 7; and this is followed by an article on the approach being taken **to groundwater source protection in Iowa.**

Kevin Cullen relates a somewhat surprising but pleasing experience when drilling on the shoreline at Portmarnock (page 9). On page 10, David Ball considers the problem of **unused or defunct wells**, particularly in less developed countries, and advocates greater **community participation** as a solution.

Editor

IRISH SPELEOLOGY 15

This 80 page journal of the Speleological Union of Ireland is now available. In this, the 30th anniversary edition, nearly half the pages deal with reports and surveys of new caves and exploration reports. As you would expect several are of Burren caves, but there are 4 papers dealing with karst in Co. Kerry. Other areas covered include Blackburn Cave in the White Limestone of Co. Antrim and sites in Cork and Kilkenny.

The other half of the journal is more research based, and covers diverse topics including archaeological cave sites in Co. Limerick, vertebrate faunas excavated from Pollnagollum in Fermanagh, Aillwee Cave sediments, radon gas levels in some Burren caves and the glacial erosion of the shale edge of the north-western Burren, and its influence on karstic development. There is also a major review of speleothems as palaeoclimatic recorders.

Copies cost £5 (Irish or sterling) and can be obtained by post from Dr John Kelly, Gortnacally, Florencecourt, Co. Fermanagh or from Dr Matthew Parkes in the Geological Survey of Ireland.

Notice and first call for participation : 12TH INTERNATIONAL CONGRESS OF SPELEOLOGY and 6th CONFERENCE ON LIMESTONE HYDROLOGY AND FISSURED AQUIFERS. Le Chauz-de-Fonds, Neuchâtel. Switzerland - August 10 - 17, 1997

Further information about this major speleofest, with a significant scientific core, for anyone interested in karst hydrology, can be obtained from Matthew Parkes in the GSI. Alternatively, you could write to the organisers at SubLime, P O Box 4093, ch-2304 La Chaux-de-Fonds, Switzerland. Pre-registration is possible through the Internet to : http://www.unine.ch/UIS97/
E-mail; congress.uis97@chyn.unine.ch

GSI BEDROCK MAPS AND BOOKLETS

The Geological Survey of Ireland (GSI) is publishing a new series of bedrock maps each accompanied by an attractively produced booklet with colour photographs. The map scale is 1:100,000. Bedrock maps are important to all of us in providing an overview of the geology. The maps show the distribution of the various rock types and different ages of the rocks. The rocks are described in an accompanying booklets which have separate sections for the interested lay person and the geologist and other professional persons. Each booklet contains a summary of the groundwater and mineral resources and potential. An appendix lists key localities so that interested persons can see the rocks for themselves. The series should appeal to walkers, tourists, teachers and others as well as professional interests.

The following map sheets (with accompanying booklets) are now available - North Mayo (Sheet 6), Connemara (Sheet 10), Kildare-Wicklow (Sheet 16), Carlow-Wexford (Sheet 19), Dingle Bay (sheet 20), East Cork-Waterford (Sheet 22), South Wexford (Sheet 23) and South Cork (sheet 25).

Tipperary (Sheet 18), Sligo-Leitrim (Sheet 7), Cavan-Monaghan (Sheet 8 & 9), and Kerry-Cork (Sheet 21) are scheduled for publication during 1996 and the series of 21 maps is due for completion in 1998.

The map and booklet sells for £12.50. The cost of the map on its own is £10. Copies are available from GSI @ (01) 6041420. Laminated copies of each map can be ordered at an additional cost of £15. Postage and packing is £2.00 extra on each order. Major credit cards are accepted.

RISK AND RISK MANAGEMENT – A FRAMEWORK FOR GROUNDWATER PROTECTION SCHEMES

What is risk?

Risk can be defined as the likelihood or expected frequency of a specified adverse consequence. Applied to groundwater, it expresses the likelihood of contamination arising from potentially polluting sources or activities (called the **hazard**). A Royal Society (London) Study Group (1992) formally defined an **environmental hazard** as "an event, or continuing process, which if realised, will lead to circumstances having the potential to degrade, directly or indirectly, the quality of the environment". Consequently, a hazard presents a risk when it is likely to affect something of value (the **target**, which in this case is groundwater). It is the combination of the probability of the hazard occurring and its consequences that is the basis of **risk assessment**.

RISK = PROBABILITY OF AN EVENT × CONSEQUENTIAL DAMAGE

There are three key stages in risk analysis: risk **estimation**, risk **evaluation** and risk **management.** These are highlighted by the following questions.

♦ What can go wrong? *Hazard identification and identification of outcomes* ♦ How likely is it to go wrong? *Estimation of probability of these outcomes or estimation of vulnerability* ♦ What would happen if it did go wrong? *Consequence analysis*	**risk estimation**
♦ Is the risk acceptable and can it be reduced?	**risk evaluation**
♦ What decisions arise from risk estimation and risk evaluation? ♦ What control measures are needed to minimise the risk?	**risk management**

What is the relationship between protection and risk?

Protection, like risk, is a relative concept in the sense that there is an implied degree of protection (absolute protection is not possible). An increasing level of protection is equivalent to reducing the risk of damage to the protected quantity, e.g. groundwater. Moreover, choosing the appropriate level of protection, necessarily involves placing a relative value on the protected quantity.

How can the risk concept be applied to groundwater and groundwater protection in Ireland?

Groundwater protection schemes are usually based on the concepts of groundwater contamination risk and risk management. In the past, these concepts were in the background, often implicit, sometimes intuitive factors. However, with the language and thought-processes associated with risk and risk assessment becoming more common, relating a groundwater protection scheme to these concepts allows consistent application of a protection policy and encourages a rigorous and systematic approach. The conventional source-pathway-target model for environmental management can be applied to groundwater risk management:

Potential source of contamination —*pathway*→ **Target**

or

Hazard —*vulnerability*→ **Aquifer or gw source**

The GSI uses the following terminology and definitions.

The **risk** of contamination of groundwater depends on three elements:

i) the **hazard** provided by a potentially polluting activity;

ii) the **vulnerability** of groundwater to contamination;

iii) the potential **consequences** of a contamination event.

Risk management is based on analysis of these elements followed by a **response** to the risk. This response includes the assessment and selection of solutions and the **implementation of measures** to prevent or minimise the consequences and probability of a contamination event.

The **hazard** depends on the potential **contaminant loading**. The natural **vulnerability** of the groundwater dictates the **likelihood of contamination** if a contamination event occurs. The **consequences** to the target depends on the **value** of the groundwater, which is normally indicated by the aquifer category (regionally important, locally important or poor) and the proximity to an important groundwater abstraction source (a public supply well, for instance). **Preventative measures** may include, for instance: control of land-use practices and in particular directing developments towards lower risk areas; suitable building codes that take account of the vulnerability and value of the groundwater; lining of landfill sites; installation of monitoring networks; specific operational practices. Consequently, assessing the risk of contamination to groundwater is complex. It encompasses geological and hydrogeological factors and factors that relate to the potentially polluting activity. The geological and hydrogeological factors are (a) the vulnerability to contamination and (b) the relative importance or value of the groundwater resource. The factors that relate to the potentially polluting activity are (a) the contaminant loading and (b) the preventative measures. A conceptual model of the relationship between these factors is given in the figure on the following page, where septic tank effluent is taken as the hazard.

A groundwater protection scheme should integrate these factors and in the process serve to focus attention on the higher risk areas and activities, and provide a logical structure within which contaminant control measures can be selected.

RISK TO GROUNDWATER

↙	↘
HYDROGEOLOGICAL FACTORS	**OTHER FACTORS**
⇩	⇩
(a) VULNERABILITY	**(a) CONTAMINANT LOADING**
(b) GROUNDWATER VALUE	**(b) PREVENTATIVE MEASURES**

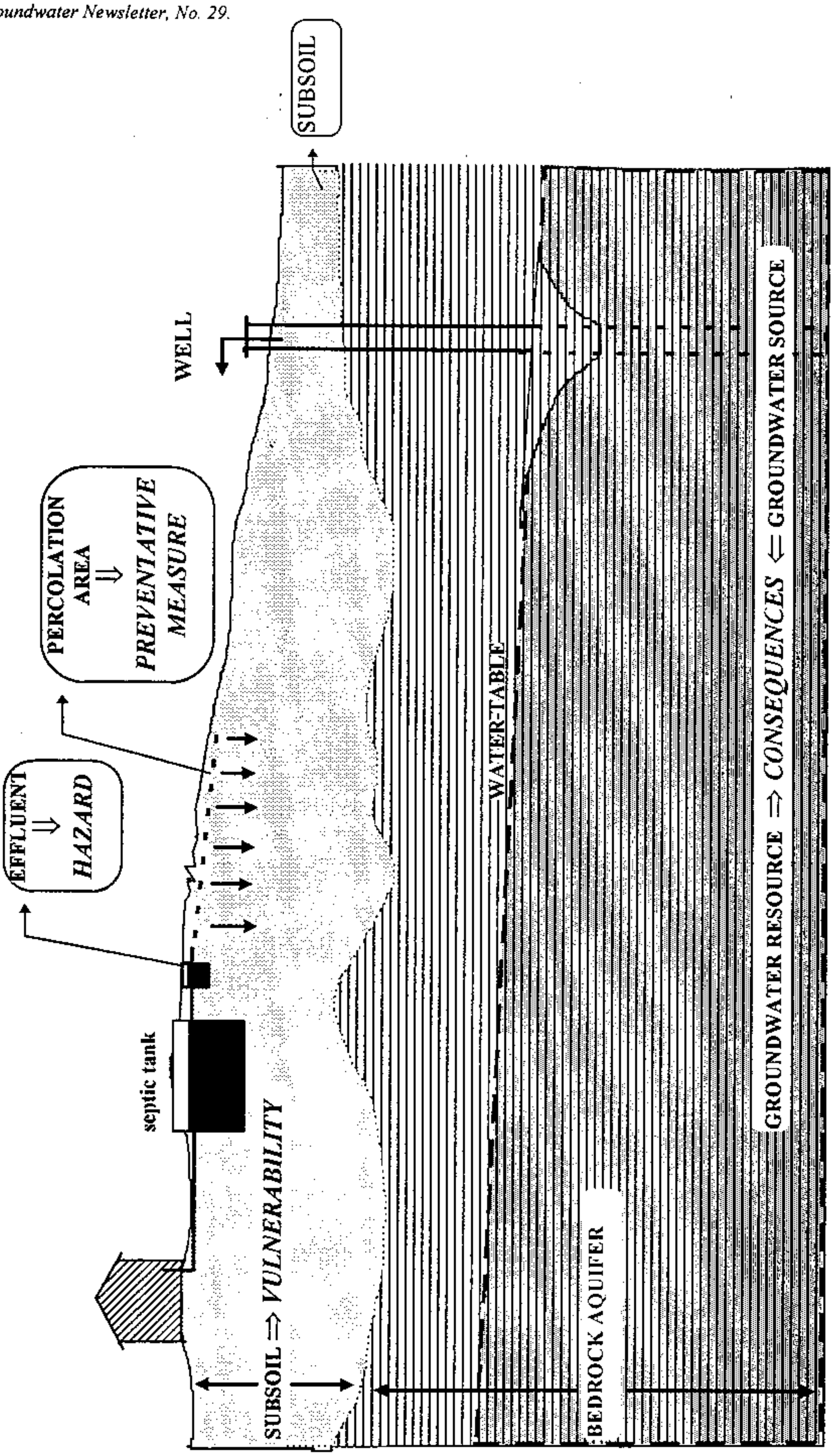
Exposure of groundwater to hazard can sometimes be reduced by engineering measures (such as geomembrane liners beneath landfills). However, in most cases, a significant element of the total exposure to hazard will depend on the natural geological and hydrogeological conditions, which define the vulnerability or the sensitivity of the groundwater to contamination. Engineering measures may be required in some situations to reduce the risk further.

Is this approach being applied in Ireland?

- The framework provided by the risk concept is being used by the GSI in drawing up groundwater protection schemes.
- The EPA requires developers to provide information on the two hydrogeological factors – aquifer category and vulnerability (both as defined by GSI guidelines) – when applying for Integrated Pollution Control (IPC) Licences.
- The EPA is likely to recommend that the same information should be required in the selection process for landfill sites.

Donal Daly* and Paul Johnston**

*** Geological Survey of Ireland** **** Department of Civil, Structural and Environmental Engineering, TCD.**



A CONCEPTUAL MODEL OF THE ELEMENTS OF RISK AND RISK MANAGEMENT

WASTEWATER TREATMENT IN UNSEWERED AREAS OF IRELAND : A REVIEW

A recent review of wastewater treatment in unsewered areas of Ireland showed widespread low level groundwater contamination caused by badly located and poorly maintained septic tank systems[1]. All aspects of on-site wastewater treatment options serving communities with less than 1000 population equivalent were reviewed.

Conventional septic tank - percolation areas were frequently found to be an inadequate form of wastewater treatment. They were not designed for twentieth century living conditions and are unsuited for dwellings that use appliances which consume large quantities of water such as automatic washing machines and dishwashers, and for developments serving larger populations such as hotels, pubs and restaurants. It was concluded that conventional septic tank systems need to be restricted to areas with very good soil and hydrogeological conditions and a low septic tank density. In other locations, some form of secondary treatment such as package plants, sand filters or artificial wetlands are recommended.

Some of the conclusions and recommendations on how to minimise the risk to groundwater from septic tank systems are outlined briefly below.

- Percolation areas were originally designed for the hydraulic disposal rather than the treatment of wastewater. More investigation into the treatment processes and the efficiency of percolation areas is required to identify the acceptable wastewater load for individual sites.
- Without major expense, some design modifications of percolation areas at the construction stage may achieve better effluent treatment. Trenches rather than beds should be used and several shallow, narrow trenches are preferable to one or two wide trenches.
- Potential treatment is increased by designing distribution pipes close to the ground surface and using vegetation with deeper roots.
- Two percolation areas should be used and alternated.
- Uniform periodic application of wastewater is preferable to continuous gravity flow application.
- If appropriate, alternative effluent application methods such as surface irrigation can offer better treatment.
- The hydraulic load and the possibility of surface ponding are reduced by controlling the volume of effluent discharged, thereby improving the treatment performance of the percolation area. This can be achieved by a reduction in water usage, ensuring no stormwater reaches the septic tank system, and using water saving appliances. If it is feasible to adapt the plumbing arrangements, water from washing activities can be reused for activities such as toilet flushing, crop and landscape irrigation and carwashing.
- Wastewater strength influences the performance of a percolation area. However, according to SR6[2] the size of the percolation area is solely based on the soil permeability regardless of the number of people using the system and the type of premises. A modification of SR6 guidelines to recommend an increase in percolation area size with increasing population equivalent would be more appropriate.
- The minimum size for septic tanks may need to be increased to ensure enough residual capacity for any increase in population equivalent to be served by the system.
- Site evaluation procedures as outlined in SR6[2] are too reliant on the percolation test which is subject to much variability. The site evaluation procedures need to be performed by skilled authorised personnel and detailed soil analysis incorporated into the assessment. Inspection of the site by the local authority engineers before and after construction at the appropriate times of the year, preferably in Spring or late Winter, appears to be necessary.
- Management of septic tank systems is crucial if contamination problems from septic tanks are to be avoided. The responsibility of the homeowner for the system has not proved successful so the design, installation, construction and servicing of septic tank systems needs to be overseen by a regulatory body. The resources required to enforce regulations and for the inspection of sites could be partly offset by fees for licences and possible fines.
- SR6[2] needs to be made a legal standard with supporting codes of practice and mandatory regular inspection/servicing.

- Contamination from septic tank systems could be reduced if the planning, public health and water pollution legislation was enforced.
- Information on alternative on-site sewage treatment systems including package plants, sand filters and artificial wetlands that offer secondary treatment need to be made available to the public and local government. This is particularly important for premises with a population equivalent of 10 or more.
- A code of practice governing proprietary on-site sewage treatment systems needs to be drawn up and introduced as they are currently outside current SR6[2] recommendations.
- Aquifer protection plans need to be considered more in the planning process.

As environmental restrictions become tighter and population density and industrialisation increases, the widespread use of septic tank systems (33% of the population at present) may become unacceptable and secondary treatment will become necessary. However, in the foreseeable future the widespread use of septic tank systems will continue but the adverse effects can be reduced by changing or modifying current practices and guidelines. In the long-term, both the public and local government need to accept that on-site sewage treatment facilities that offer secondary treatment are essential to reduce groundwater contamination and preserve high quality resources, and attitudes to alternative on-site treatment systems such as reed beds need to change.

References

1. Scott, M., 1995. *A review of wastewater treatment in unsewered areas of Ireland.* M.Sc. thesis, Environmental Sciences Unit, Trinity College, University of Dublin.

2. SR6, 1991. Septic tank systems - *recommendations for domestic effluent treatment and disposal from a single dwelling house.* NSAI, Ireland.

Maeve Scott and Nick Gray, Environmental Science Unit, Trinity College, Dublin 2.

BOOK REVIEW

INTRODUCING GROUNDWATER (second edition)

by **Michael Price**. Published in paperback by Chapman and Hall.

"In the time that it takes you to read this sentence, three people will die because they do not have ready access to a safe and reliable supply of drinking water". Thus began the first edition of Mike Price's *Introducing Groundwater* published in 1985. With chapter headings such as 'Caverns and capillaries' and 'Springs and rivers, deserts and droughts', the aim of the book was to provide the non-specialist with a readable introduction to the subject of hydrogeology. The style was accessible, mathematical formulae were kept to a minimum and the book was indeed a very good read.

The second edition has just been published and I am pleased to say that the updated text retains all the virtues of clarity and good style of the first edition. Some of the existing chapters have been expanded - e.g. the chapter on droughts now includes a description of the 1988-1992 drought which has had such a major impact on water supplies in eastern England - and a new chapter has been added on groundwater pollution. Although it is still aimed at the non-specialist (and therefore is an ideal introductory text for undergraduate geologists and engineers) the book is also a useful and enjoyable read for the specialist hydrogeologist who perhaps needs to refresh his or her memory on some of the basic concepts of the science.

Bruce Misstear, Department of Civil, Structural and Environmental Engineering, TCD.

GROUNDWATER PROTECTION SCHEME

It is often said that Ireland benefited from being slow to join the communications race as we arrived just as digital phone systems became available. By introducing a digital phone network we "leapfrogged" many of the industrialised countries who had continued to up grade their systems while we kept "turning the handle". Equally, it would appear that we will benefit from our tardiness in developing a national aquifer protection policy in that the guidelines now proposed by the Geological Survey of Ireland builds on the experience of the more advanced economies of Western Europe and the United States.

The groundwater protection scheme advocated by the Survey takes the best experience from these countries and provides us with a scheme that is both scientifically and practically based. The introduction of concepts such as risk, vulnerability and aquifer status underpin the scientific aspects of the scheme while the provision of protection zones is useful for day to day planning decisions. Of particular note is the concept of a "development matrix" which allows each potentially polluting development to be readily assessed both in terms of its risk to the environment and its physical setting.

Most countries have recognised the importance of preventing groundwater pollution. While it is difficult to undo past mistakes it is possible to prevent similar situations in the future. The proposed groundwater protection scheme as advocated by the Geological Survey provides us with the tool to maintain existing groundwater quality and possibly with time to reverse some of our past mistakes. As with the digital phone system, if we adopt the GSI guidelines we can keep a leap ahead of other countries and secure the position for future generations.

Kevin Cullen, K T Cullen & Co

PROTECTING IOWA'S DRINKING WATER THROUGH WELLHEAD PROTECTION

Often, the term 'wellhead protection' is used interchangeably with terms such as source water protection, or groundwater protection. Actually, wellhead protection (WHP) is a form of groundwater protection that is specifically aimed at preventing contamination of public drinking water supplies. Though initiated at the federal level, WHP is state run in order to increase its effectiveness at the local level. The federal government requires every state to establish its own WHP programme, but implementation methods are left to each state's discretion.

WHP got its start in the 1986 Amendments to the Safe Drinking Water Act (SDWA), which were passed to enhance drinking water protection efforts. It is a unique programme in that it emphasises the prevention of drinking water contamination as a principal goal, rather than relying on correction of contamination once it occurs. According to the SDWA, each state must prepare a WHP programme and submit it to the Environmental Protection Agency (EPA). The Department of Natural Resources (DNR) is the state agency responsible for developing Iowa's WHP programme. Certain elements must be included in the programme, but the law provides flexibility for states so that they can establish programmes that suit local needs and goals in order to protect a public water supply's source. The federal government (EPA) approves the state developed WHP programmes, and is required to provide technical assistance to the states, while local public water suppliers are responsible for implementation.

Currently, Iowa is in the process of developing its WHP programme. For this reason, participation in WHP is voluntary, and it is expected to remain so following completion and acceptance of Iowa's programme. Historically, the DNR has, and continues to, employ the use of separation distances and sanitary surveys in order to address drinking water protection needs. Separation distances dictate the minimum allowable distance between a potential source of contamination and a public water supply well. Sanitary surveys involve on-site reviews of the source, facilities, equipment, operation and maintenance of a public water supply system, and are conducted by the DNR's six state-wide field offices.

Though Iowa has not yet completed its version of WHP, this has not prevented communities from initiating their own programmes. In fact, nearly fifty communities (with a combined population of over 100,000 people) have already done so. Many of these have received guidance from Iowa Rural Water Association's groundwater technician. The groundwater technician visits small community and rural water systems that rely on groundwater and promotes the benefits of a WHP programme. The services of the technician are provided at no cost to the communities through a grant funded by the EPA. This grant is administered by the National Rural Water Association and is implemented at the state level by individual state water associations. At present, twenty-nine groundwater technicians working in thirty-one states facilitate the development of WHP programmes. Iowa is one of fifteen states that initiated the WHP programme in March 1991.

The process of implementing a community WHP programme is relatively straightforward :

1) Select the Planning Team
Select a representative group of community members to direct WHP activities.

2) Delineate the area to be protected
Identify the areas surrounding the well site(s) that could affect the quality of the groundwater. Gather information to map the WHP area. There are several mapping methods, ranging from simply drawing a circle to identify a protection area on a map, to obtaining computer generated groundwater models.

3) Identify potential contamination sources
Identify and locate potential threats to the water supply. Sources of contamination could include industrial, commercial, agricultural, and residential sources. The greatest hazard typically comes from those sources that are older, unregulated, and inactive.

4) Manage the WHP area
It is up to the planning team to assess the risks present in the community, and to develop a plan to manage the protection area. The complexity of this step will vary depending on the economic, industrial and political conditions in the community. Management techniques can range from public education to simple permitting restrictions to intricate regulatory ordinances.

5) Develop a contingency plan
It is important to develop a contingency plan with procedures for responding to a crisis and ideas for alternative water supplies. For the management plan to remain effective, the entire plan should be reviewed annually.

There are a multitude of reasons for developing a WHP programme. At the federal level, WHP promotes compliance with the SDWA and decreases the financial burden on federal agencies resulting from contamination incidents. Locally, it protects public health, reduces the potential liability of the public water supplier, and avoids costs associated with remediation, locating alternative water sources, or installing treatment facilities. WHP also has the potential to reduce operating expenses through monitoring waivers. Several states offer such testing waivers for communities that participate in the programme. Though not currently available in Iowa, there is support for the inclusion of monitoring waivers within Iowa's official WHP plan.

Overall, WHP is an effective way to protect groundwater used as a public water supply. It is a proactive programme that seeks to manage potential contamination sources on the land that contributes recharge to a well. WHP was designed with community implementation in mind. It is controlled at the local level because it can only be achieved when the whole community embraces its worth. The five step implementation process offers communities with little or no experience in groundwater protection or land use planning a simple, structured approach to establishing a WHP programme. Finally, the potential rewards of WHP are substantial, and are well worth the time and effort needed to develop a successful programme.

Acknowledgement: This article was first published in the Iowa Groundwater Quarterly, Vol.6, No., 1995 and is republished here with permission.

Greg Caron, Iowa Rural Water Association

A LUCKY STRIKE OR PURE SCIENCE

It is often asked whether it is possible to get fresh water if a well is drilled off the coast. As with anything to do with hydrogeology the answer depends on many variables, most of which are only understandable by hydrogeologists and those from other earth science disciplines. However, a recent well drilled at Portmarnock established that where the geological conditions are favourable then fresh water can be found at depth even where the drilling site is effectively surrounded by salt water. Here, the dune sands that form the peninsula overlie a thick, impermeable boulder clay which in turn rests on top of limestone bedrock. The deep well penetrated down into the limestone aquifer and pumped groundwater with a conductivity of 1,100 μS/cm compared to the potable MAC of 1,500 μS/cm. With a yield of some 30,000gpd this deep well provides a very useful supply of fresh water. The boulder clay layer at Portmarnock rests on the limestone bedrock and continues towards the mainland where the bedrock outcrops and receives recharge from rainfall. Groundwater moving from the mainland passes beneath the peninsula before discharging into the Irish Sea. The sealing clay layer keeps out the full influence of the salt water and allows the fresh groundwater to be exploited at Portmarnock, some distance from the mainland. This contrasts with many other failed attempts to get fresh groundwater at coastal locations immediately to the north and south of Portmarnock.

So, if asked about the possibility of finding fresh water off the coast, say "yes but it depends"!

Kevin Cullen, KT Cullen & Co Ltd

NEWS FROM ABROAD

US: Factors in Successful Groundwater Protection Programmes

A study by the Urban Institute has found that in areas where there are unusually successful local groundwater protection programmes, the following features were present:

- programmes should co-ordinate the resources of several layers of government;
- strong protection measures cannot be adopted without informed, concerned citizens;
- an emergency response capacity should be in place to minimise possible damage to groundwater resources;
- localities with geographic information systems are better able to make decisions;
- detailed studies help localities understand the groundwater resource, recharge areas, and potential contamination sources;
- a sound local programme must include at least some police/regulatory powers, such as zoning ordinances or source controls.

Source: Geraghty and Miller's Groundwater Newsletter, Vol. 23, No. 17.

Midwest US: Herbicides and Nitrates

Out of 303 shallow wells (wells most at risk) tested by the US Geological Survey, 24% contained herbicides and 59% contained nitrates. However, no samples exceeded the EPA's maximum contaminant levels or health advisory levels for herbicides but 6% exceeded the nitrate standard.

Source: Geraghty and Miller's Groundwater Newsletter, Vol. 23, No. 17.

Compiled by the Editor

GAINING SUSTAINABLE WATER SOURCES BY LISTENING AND LETTING GO

Water is for people. In developing groundwater supplies, we tend to forget that our work relates to the needs of people. Although in our training and practice, we embrace the politically correct concept of community participation, real contact with local people is often lost during a project as we heed the demands and agendas of funding agencies and our own needs.

For more than 20 years, I have worked in groundwater development in Europe, Africa, the Middle East and the Far East. During my work in villages and rural areas, I was repeatedly struck by the number of unused or defunct boreholes and wells. These boreholes often represented a series of development projects spanning decades. In the past, I looked for and usually found a technical reason for the failures. As a young hydrogeologist, I felt consoled when my technical skills could spot the flaws in the work done before me. Such consolation wore thin over time as I realised that the previous hydrogeologists had probably found flaws in the work of their predecessors - each of us making technical improvements, yet ultimately failing to provide a sustainable water source.

Why? Because no matter how much we improve groundwater technology, we will undermine our technical excellence if we ignore the human and political factors peculiar to each site. Some hydrogeologists caution that we should not become socio-anthropologists. I agree. But we should apply our people skills : We can communicate, we can think, and we can understand complex issues and personal concerns.

We cannot assume that when we have provided a new water supply, a government agency will take over its operation to provide support for local villagers and tribes to manage and use it. We live in an increasingly fractious and fragmented world where very few countries have sufficient affluence and stability to maintain reliable infrastructures. In developed countries, there are moratoriums on recruitment, cutbacks in field allowances, and dwindling central-government support for executive agencies. In developing countries, the fragility of the infrastructure is even more apparent. Many a rural borehole stops functioning because its operator has not received a salary for six months or longer. During the Cold War, Eastern and Western powers vied to support the infrastructure in newly independent countries and their particular models of central government agencies that took the responsibility for water supplies. Now, this does not happen. Therefore, I suggest we abandon the notion of government responsibility and recognise that the only people who can sustain a rural water source are those who will use it.

We have come some way toward recognising this, but not far enough. Our efforts to work with local people are blocked by our faulty perception of community as a convenient communal unity. In reality, a community is an assemblage of individuals who happen to live in a place for a particular time. Many villages in the Sahel, for example, include two or three different tribes, each following its own lifestyle and each frequently relying on different livestock. Imagine the stress that can arise between goat herders and camel owners when a new water supply is developed outside the scope of established water-sharing practices. Behind the image of a community are old allegiances, rivalries, and traditional patterns of behaviour. Control of water is power.

We must also recognise that - with the exception of disasters - people already have an adequate water-supply system. Without one, they would die in three days. Their existing supply may not meet our standards. The people may feel it needs improvement, but the community has to decide whether they want and can handle the change that a new water supply will bring.

However inadequate an existing water source may seem to us, the capacity to cope with change is a key issue. For example, Touareg in Mali and Majerteen in Somalia migrate to areas with shallow, salty groundwater at the end of a dry season because the water and plants replenish minerals absent from the human and animal diet. Here, the clans gather, intertribal bonds are strengthened, and marriages are arranged. Their pattern of water use involves complex social traditions, and World Health Organisation water-quality standards may not be uppermost in the minds of these people when they consider change.

To successfully develop a new water source, we must engage the people : listen to them, understand their concerns, and allow them to decide if they can sustain a new water supply amidst the changes it will bring. We can describe the feasibility of different technical options, but we cannot choose options for them.

For hydrogeologists and our counterparts in the old government agencies, the biggest challenge is letting go. In the past, we had control and a belief that government could take responsibility to sustain a source. Now in our own interest, we need to face the local decision-making process and recognise that the inhabitants are in control. As a hydrogeologist in Somalia in 1992, I could superficially see a need for new groundwater supplies. From the local people's perspective, however, with everything around them in disarray and with no central government, they could not cope with the responsibility of sustaining a new water supply. Therefore, my recommendation was to do nothing. We need to face the "zero zone" - that is, it may be better to do nothing. It may be better if we listen, wait, understand, and if necessary, walk away - rather than intervene. This challenge extends to funding organisations. Bureaucrats and economists measure project success by indicators such as rate of return. They prefer projects involving tangibles that can be accounted for - pumps, prime movers, and drilling rigs which, ideally, were also manufactured in donor countries. Conversely, they feel insecure funding projects with time frames dictated by the beneficiaries. Nor are they happy when asked tocompute the rate of return on a listening hydrogeologist!

If we hydrogeologists lack confidence to work directly with local people, we must strengthen our people skills. If we resist the concept of letting go, we must examine our personal agendas. If we lack the time or freedom to await the people's decision, we must challenge the donors (our clients) to pay for listening as an integral part of a development project.

These suggestions may seem like a negative message. They are not. This is a call for us to come to terms with the reality of groundwater development in areas as diverse as northern Alberta, central Mali, or the new South Africa. I believe we need to change the structure, agenda, and aspirations of groundwater development projects and to break out of the confines of projects defined principally by technical achievement.

These changes are not easy, nor will they happen quickly. Many vested interests will resist. But I would prefer to construct one necessary borehole and find it still in use after 10 years' time, than return to find 50 technically excellent boreholes with stripped diesels lying abandoned in the sun.

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David Ball, Consulting Hydrogeologist

MORE NEWS FROM ABROAD

California: Householders Hazardous Waste

Santa Monica has a permanent household hazardous waste facility (HHW). In the past year, it accepted 174 000 pounds of HHW from 2 200 people (5.5% of residents), averaging 79 lbs each. More than 40% is reused through a product exchange programme - 60% of latex paint, 50% of cleaners and 20% of pesticides are exchanged in original containers. From 1995 a new ordinance requires retailers to display specific information on hazardous materials - 'point of decision' displays.
Source: Geraghty and Miller's Groundwater Newsletter, Vol. 23, No.21.

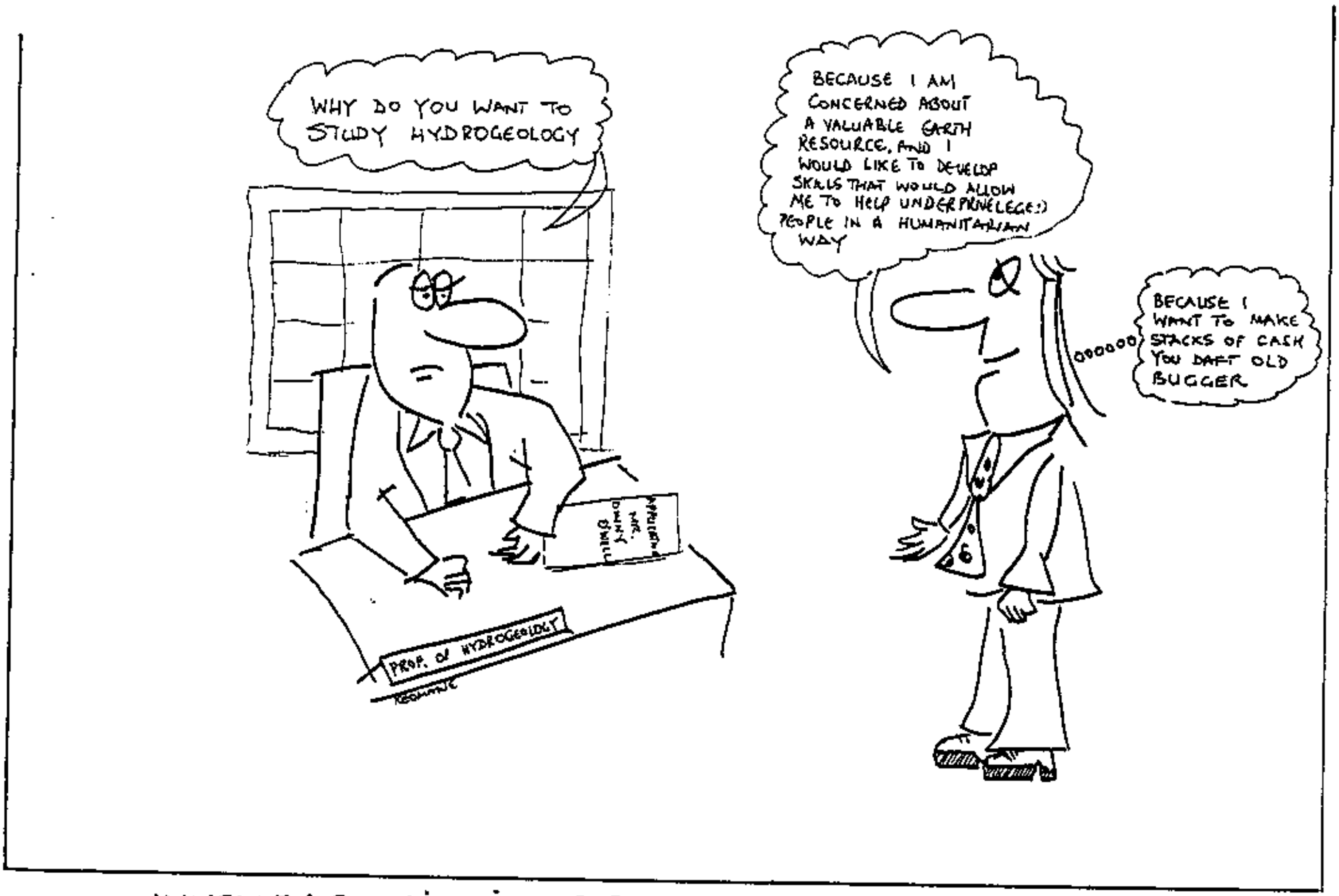
US: Significant Levels of Microbial Contamination

Current data indicate about 20%-25% of groundwater sources in the US are contaminated by pathogenic viruses or bacteria. About 40 000 of the 210 000 groundwater systems have had microbial violations indicating contamination of their groundwater, wells, or distribution systems during the last five years.
Source: Geraghty and Miller's Groundwater Newsletter, Vol. 24, No. 24.

Britain: Tritium - a Tracer for Landfill Leachate?

Research by Aspinwall & Co. has shown that leachate from landfills taking in only household and commercial waste contains high levels of tritium, a radioactive isotope of hydrogen; in fact levels were higher than those detected in leachate from landfills taking radioactive waste. The present natural background level of tritium in rainwater is 3-10 tritium units (TU) (levels were much higher in the late 50's and early 60's due to nuclear weapons testing). The mean tritium value for 30 leachate samples was 7 714 TU. The source of these surprisingly high levels is not known. One possibility is gaseous tritium light devices (GLTDs) such as "exit" signs. These tritium levels do not pose a significant risk to the environment. According to Howard Robinson of Aspinwalls, the research has unearthed a valuable tool for monitoring the environmental impact of landfills. The contrast in tritium levels between leachate and uncontaminated surface and groundwater in the vicinity of landfills could be used to detect leachate releases.
Source: The ENDS Report, No.252, January 1996.

Compiled by the Editor



UNIVERSITY, SOMETIME IN THE SEVENTIES

CONTRIBUTIONS FOR THE NEXT ISSUE OF THE NEWSLETTER

The GSI Groundwater Newsletter aims to improve communication among scientists and engineers involved in groundwater. It includes news, developments, reviews and opinions on all aspects of groundwater - exploration, development, management, water quality, pollution and energy. It is published three times each year.

Your contribution to the dialogue would be welcome. **Contributions should arrive before 30th September 1996** to:

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