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THE GSI GROUNDWATER NEWSLETTER

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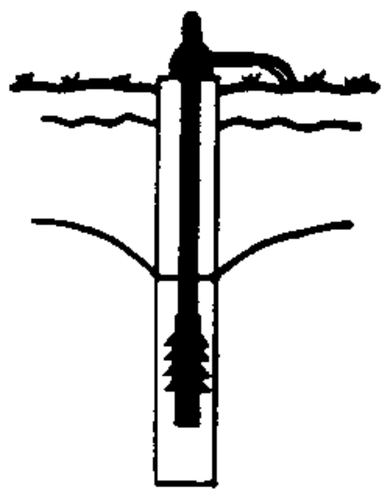

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No. 11. March, 1989

IN THIS ISSUE

Donal Daly, Geological Survey of Ireland.

GROUNDWATER POLLUTION

Bad Siting of Bungalows Can Lead to Health Hazards: An Example.

Granting planning permission for houses in areas with unsuitable geological and groundwater characteristics can lead to surface water and/or groundwater pollution and the consequent health hazards. This example illustrates a situation where several bungalows have been erected in recent years near a town but outside the area with piped water and sewage systems and where both groundwater and surface water are being polluted.

Topography: Relatively flat; lowlying area.

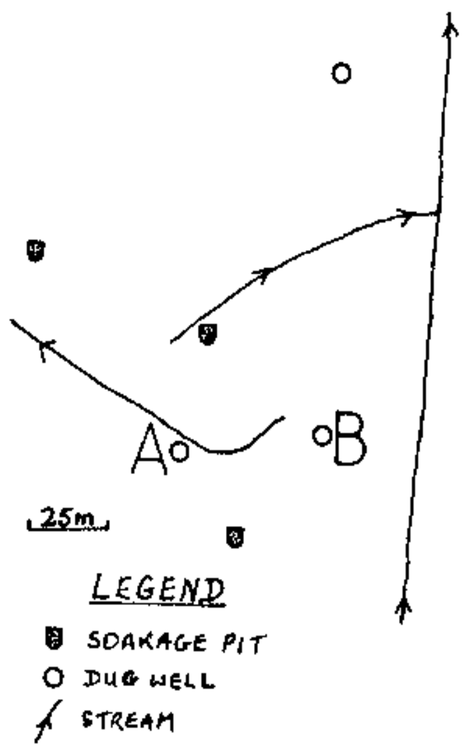
Geology: About 1m sticky, grey till (boulder clay) overlying gravel on limestone bedrock.

Hydrogeology: The till has a low permeability; the gravel is the main aquifer; and the limestone is a poor aquifer. The water table is 0.5-1.0m bgl.

Water Supplies: Individual dug wells in the gravel.

Sewage Treatment: Septic tanks with soakage pits.

Environmental Effects: As the soakage pits penetrate the gravel the effluent is polluting the groundwater.



At least two wells are polluted (A and B in the diagram) - none of the other wells in the area were tested. As the water table is high, the percolation rate is insufficient to take all the effluent, so it overflows or is piped into the nearby ditches and streams, consequently polluting surface water.

Economic Costs: One householder has been forced to drill an 80m borehole into the limestone. The total cost of the borehole, new pump and pumphouse is likely to be greater than £2,000.

Solutions: Soakage pits should never have been allowed in this area. However, there is no guarantee that pipe distribution systems would work as the percolation rate in the till is likely to be very low. A constructed percolation area above ground level or the installation of the recently developed peat system, that will be available in the near future from Bord na Mona/Wavin Ireland Ltd., are possible but expensive remedial measures.

Lessons: 1. In unsewered areas, if surface water and groundwater pollution and the consequent health hazards are to be avoided, any planning permission granted should be subject to specified remedial measures being taken.

2. In areas with unsuitable geological and hydrogeological conditions the planning emphasis should be on the provision and utilisation of serviced sites in towns and villages.

Donal Daly, Geological Survey of Ireland.

Infiltration Galleries (Part II)

This contribution is a continuation of an article begun in the December issue of the **Newsletter.** It is intended here to provide some information on the assessment of vulnerability for those who have responsibility for the management of an existing gallery or who would like to consider one as a source of supply.

The hydrogeological factors required to assess the vulnerability of a particular gallery and the additional sources of data which may be available are:-

(1) Aquifer Geometry. The results of site investigation work for nearby bridges, pipelines etc. may be relevant. Otherwise data may be obtained from trial pits or geophysical surveys.

(2) Permeability and storage of the strata between gallery and river. For existing galleries the pumping levels and discharge rates can be used. At new locations tests in trial pits and sieve analyses should give reasonable estimates.

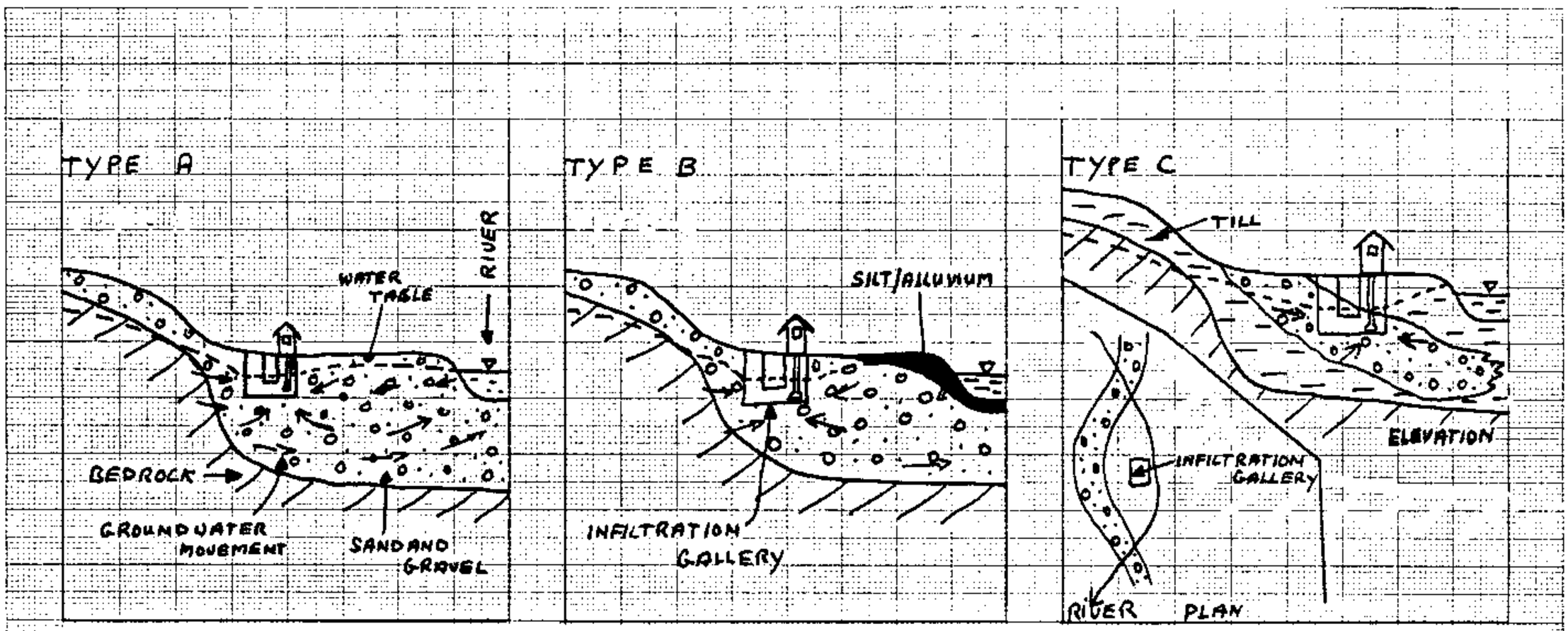
(3) The degree of continuity (or isolation) with the river. Collection of pumping and river level data. Temperature and chemical monitoring of gallery and river water and/or water tracing experiments through trial pits should be carried out.

In the valley fill deposits in Ireland a wide range of hydrogeological settings are possible. The three most common types (Figure I) will be discussed here.

Type A. The aquifer is generally unconfined and in direct hydraulic contact with the river. In this case the gallery is very vulnerable to pollution particularly at river lowflow or when the river floods at peak flow. In this environment, ideally galleries should be placed 70-250m from the river depending on the permeability of the sands and gravels. These distances are necessary in order to ensure that the travel time from river to gallery would exceed 50 days, i.e. the length of time for 99.9% elimination of E. coli in groundwater.

Where a gallery is less than 50 days travel time from a river of variable quality, regular monitoring of the river should be carried out and a warning system accompanied by a plan for dealing with a pollution incident should be in place.

Type B. A layer of silt (at least a metre thick) partially isolates the aquifer from the river. The vulnerability is much reduced in this case as it will take many days for river water to pass through the silt. The comparable ideal distances in this instance would be 45-150m.



(FIGURE 1: SCHEMATIC REPRESENTATION OF THE HYDROGEOLOGICAL ENVIRONMENTS SUITABLE FOR THE CONSTRUCTION OF INFILTRATION GALLERIES IN IRELAND).

Type C. A sand and gravel lens which is isolated from a river for 70-250m (depending on the permeability) upstream and downstream of the gallery. In this case the only risk of pollution would be in the event of flooding. Monitoring here would be on the same basis as that for other groundwater abstraction systems.

Table I contains suggestions on the type and frequency of monitoring of infiltration galleries in the three environments described above. It should be possible to reduce the frequency of sampling after a few years when the natural variations in water quality have been established.

	Water Level	Discharge Rate	Temperature	Conductivity	Microbiological Parameters 4	Partial Chemical Analysis 5	Full Chemical Analysis 6
TYPE A	Weekly[1]	Weekly[1]	Weekly[1]	Weekly[1]	6-12 times per year depending on the overall assessment of vulnerability		Twice a year 3
TYPE B	Weekly[1]	Weekly[1]	Weekly[1]	Weekly[1]	4 times per year 2	4 times/year 2	Twice a year 3
TYPE C	Weekly[1]	Weekly[1]	Monthly[1]	Monthly[1]	Twice a year 3	3 times/year 7	Twice a year 3
Nearby River	Weekly[1]	Weekly[1]	At the same time as the particular infiltration gallery		Co-ordinate with other agencies sampling in the locality		

1. Should be taken at the same time each week/month.
2. March - May (end) - Aug. (late) - Nov.
3. Early in the recharge period (Nov.) and late in the groundwater recession (Aug.-Sept.).
4. Coliform and E. Coli content.
5. T.H., D.O., NO_3, NH_4, Cl, K and T.O.C.
6. Data required to do a full ionic balance, Fe, Mn, T.D.S., T.A., pH etc.
7. As with 3 above and May (end).

Table I Recommended monitoring programme for infiltration galleries in different hydrogeological settings

Eugene Daly, Geological Survey of Ireland

Galway Farm Survey Background (Part 1)

Contamination of private wells and group water scheme sources has increased substantially over the past few years in east Galway. This appears to be related to an expansion in intensive farming and an increase in the number of septic tank systems. There is also a growing risk that one of the biggest freshwater lakes in Ireland (Lough Corrib) could become euthrophic due to a build-up of nutrients from the above sources.

This has triggered the Environmental Section of Galway County Council to undertake steps to alleviate the problem. The first is to identify and to assess the agricultural enterprises which have significant potential to cause degradation of water supplies. The second is to notify potential pollutors of their position regarding unsatisfactory farmyard practices, and to list remedial pollution control works that require attention before a specified date. The third is to take appropriate legal action, if necessary, against those who have not satisfactorily carried out the remedial works specified.

Two sub-catchments were chosen in which an intensive farm survey was carried out, namely the Abbert (2500 ha.) and the Grange (1500 ha.), both major tributaries of the Clare river, which itself is a major tributary of Lough Corrib. These two catchments have a history of bacteriological contamination of wells, springs and surface waters. Intensive monitoring of drinking water sources has been carried out throughout both catchments, with high levels of E.coli, ammonia, iron and nitrate being recorded.

Both catchments are underlain by Carboniferous limestone which is karstic in nature and thus renders surface and groundwater extremely vulnerable to contamination from point and non-point sources. Its high vulnerability is due to the ease with which run-off can percolate into the aquifer system via swallow holes, fissures, fractures and leakage through the beds of surface streams. Once in the aquifer system, rapid transmission occurs rendering wells and drinking sources susceptible to contamination from sources some twenty kilometres away.

The objective of the farm survey was to cover all aspects which may contribute to the total production of farm wastes. A three page questionnaire was issued, having over twenty parameters applicable to calculating waste effluent volumes. Seven surveyors were employed to gather the information from each farm. The survey covered over 1500 farms, from March to June 1988. Given the difficulty of the survey, it is felt that the accuracy achieved is quite reasonable.

In the next issue of the Newsletter, the farm survey results will be analysed, and particular attention paid to their significance as catchment pollution contributors. Also a comparison will be made between agricultural and septic tank pollution contributions for the same catchments.

Tony Cawley, Dept. of Engineering Hydrology, U.C.G.

White Clover Versus Applied Nitrogen: Pollution Implications.

According to Michael Ryan, Johnstown Castle, in a report on an agricultural conference at Stonleigh in England, the threat of increasing fertilizer nitrogen prices and concern for the environment are creating renewed interest in the use of white clover rather than inorganic fertilizer. According to one researcher at the conference, nitrogen losses to the environment are lower in clover-based systems than in conventional systems. Leaching from grass-clover swards is similar to that from grass receiving 150 kgN/ha and is low.

(Source: Irish Farmers Journal, 14 January 1989, Page 22).

Donal Daly, Geological Survey of Ireland.

LOCAL NEWS

A New Consultancy Service Formed

Peter Bennett, formerly a hydrogeologist with the Geological Survey of Northern Ireland and past President of the Irish Branch of the I.A.H., has set up a new consultancy service. Peter can be contacted at:

Hydrogeological and Environmental Services Ltd.,
387 Lisburn Road,
Belfast BT9 7EX.

Editor.

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4. Resistivity - Wenner Profiling near Kinvara

Clare Morgan used resistivity sounding and mapping techniques in an area of karst limestone southwest of Kinvara, Co. Galway. The purpose of the geophysical survey was to map and delineate subsurface geological controls in this region of poor rock exposure and variable overburden thickness.

A series of 8 parallel Wenner profiles were carried out on a grid in order to produce a contour map showing lateral variation of apparent resistivity. This mapping technique enabled a fairly rapid reconnaissance of the area to be carried out and it defined a number of resistivity anomalies.

Wenner array profiling uses 4 in-line electrodes which have a constant separation 'a'. This separation distance largely controls the depth of investigation which is approximately 17% of the total array length. An 'a' value of 50m was chosen in the survey giving an array length of 150m and an approximate depth of investigation of 25m. The survey was carried out by advancing the entire array in 50m steps along each traverse line. Calculated apparent resistivities were then plotted on the map at the mid-point of each array location and then contoured at an interval of 1000 ohm-metres. (See Fig. 1).

Three main zones are recognisable and are interpreted with available geological data as follows:-

(1) High resistivities, in general greater than 5000 ohm-metres, lie at the southwest end of lines 6, 7 and 8. These are attributed to compact Waulsortian reef limestone.
(2) Resistivity values in the range 2000-4000 ohm-metres which cover a large area of the map are taken to represent oolitic limestone.
(3) A resistivity low with values between 1000 and 2000 ohm-metres is thought to represent porous, weathered and highly fractured oolite.

Zone 3 thus represented a likely site for drilling a well and was further investigated by a series of pseudosections and vertical electric soundings.

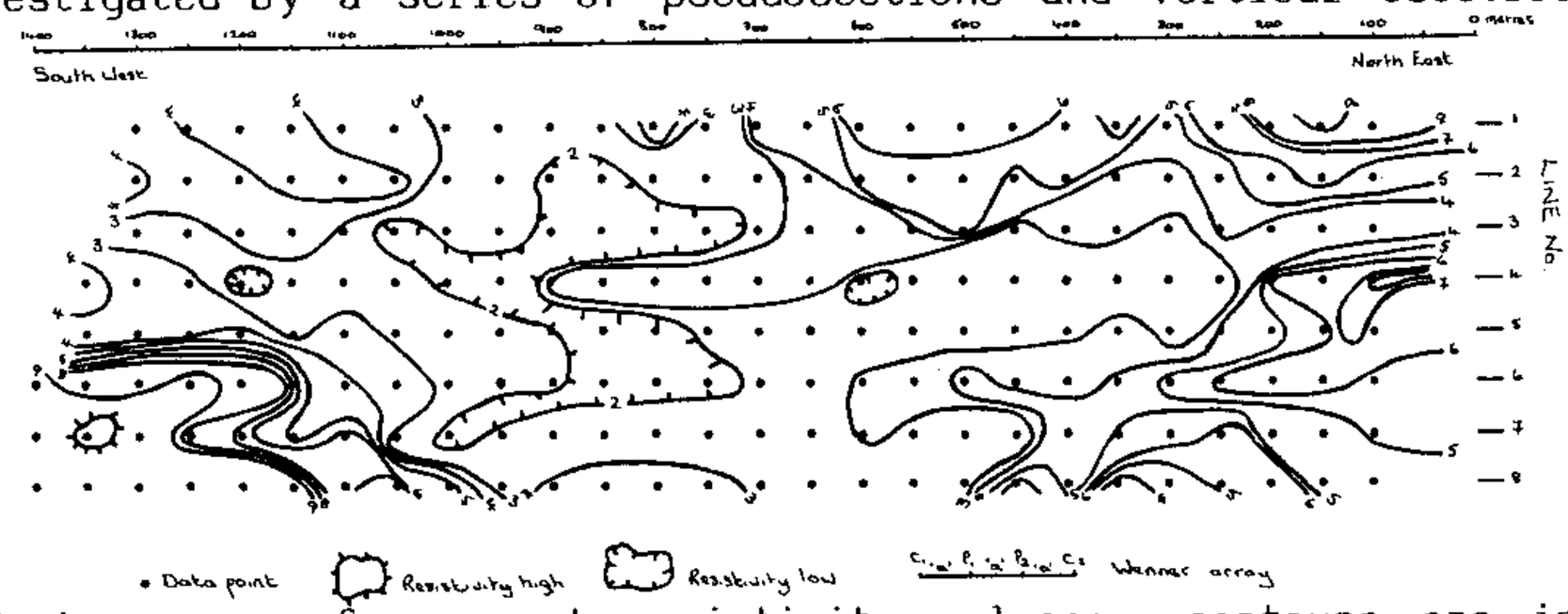

Fig. 1: Contour map of apparent resistivity values; contours are in thousands of ohm-metres.

Kevin Barton, Applied Geophysics Unit, U.C.G.

I.A.H. NEWS

Committee Changes

At the I.A.H. annual general meeting in November, the committee stood down after many years hard work and a new committee was elected. The new members are:

President: Bob Aldwell, Geological Survey of Ireland. Tel: (01) 609511

Secretary: Catherine Coxon, Trinity College Dublin. Tel: (01) 772941

Treasurer: Eugene Daly, Geological Survey of Ireland. Tel: (01) 609511

Portlaoise Meeting Secretary: Richard Thorn, Sligo R.T.C. Tel: (071) 43261

Portlaoise Meeting

The 9th Annual Groundwater Seminar will be held on Tuesday 25th and Wednesday 26th April at the usual venue, the Killeshin Hotel, Portlaoise. This year the theme is **"Groundwater chemistry and groundwater for the bottled water and aquaculture industries".**

Maureen and Timothy Green from England, authors of "The Good Water Guide" are our guest speakers. The seminar will include presentations by a wide range of people involved in research, legislation and production in the bottled water and aquaculture industries, and there will be contributions by hydrogeologists from the Geological Survey, private consultancies and academic institutions.

The session on the first morning will include an introduction to natural groundwater chemistry, temporal variations in water quality, groundwater monitoring programmes and groundwater vulnerability and protection. Bottled waters provide the Tuesday afternoon theme, and the talks will span legislation and marketing as well as geological aspects. The final theme, on the Wednesday morning, is groundwater and aquaculture: this session will deal with water requirements for fish farming, the suitability of groundwater sources and an overview of fish farming in Ireland and future prospects.

While the meeting is obviously of particular relevance to anyone with an interest in bottled waters or fish farming, much of the material, particularly in the first session, is of relevance to other groundwater uses, such as for public drinking water supplies. So we hope to have a wide range of participants, to generate plenty of interesting discussions!

If you have not already received an application form, please contact one of the I.A.H. committee members (whose phone numbers are given above).

Catherine Coxon, Secretary, I.A.H., (Irish Group).

NEWS FROM ABROAD

Worrying Evidence for "Dilute and Disperse" Advocates!

A study in Wisconsin of twenty municipal and six industrial waste sites found VOC (volatile organic carbon) contamination of groundwater at natural attenuation tip sites, with very little at clay lined sites. In general, compared to the municipal sites (which accepted only residential, commercial, institutional and some demolition waste), few of the industrial sites contained VOC's in groundwater. Benzene and vinyl chloride, the two compounds exceeding state groundwater standards most often, were among the four most frequently occurring compounds at all municipal sites. It is being found that VOC's are better indicators than inorganics of groundwater contamination from leachate.

(Source: The Groundwater Newsletter of the Water Information Centre Inc., Vol. 17, No. 22).

Comment: This evidence must be a matter of concern for scientists and engineers in Ireland and Britain who advocate the use of "dilute and disperse" type sites.

Donal Daly, Geological Survey of Ireland.

Pesticide Usage by Householders.

More pesticides are used per acre in the United States by the homeowner than by the farmer, according to the National Academy of Sciences. The U.S. EPA found that pesticides are used in 91% of U.S. households.

(Source: The Groundwater Newsletter of the Water Information Centre, Inc., Vol. 17, No. 24).

Comment: Reports such as this illustrate how readily quantities of pesticides can end up being disposed of in domestic waste tip sites.

Donal Daly, Geological Survey of Ireland.

Groundwater Pollution Course at Birmingham

A one week residential course, offering an introduction to sources and effects of pollution, investigation techniques, transport and chemical processes, modelling, prevention and remedies, will take place at the University of Birmingham on 17-21 April. For more information contact David Lerner, Department of Geological Sciences, University of Birmingham, P.O. Box 363, Birmingham B15 2TT. Tel. 032 414 6156.

Editor.

Low Winter Rainfall in England and Wales

According to researchers at the Institute of Hydrology and the British Geological Survey in Wallingford, Oxfordshire, England and Wales is heading for a summer drought unless there is an exceptionally wet spring. Total rainfall over England and Wales between November 1988 and January 1989 was 49% of the average and the lowest since 1879.
(Source: New Scientist, 18 March 1989.)

Editor

CONTRIBUTIONS FOR THE NEXT ISSUE OF THE NEWSLETTER

The **GSI Groundwater Newsletter** aims to improve communication among the many scientists and engineers involved with groundwater. It includes news, developments, reviews and opinions on all aspects of groundwater - exploration, development, management, water quality, pollution and energy. It is published at three-monthly intervals.

Your contribution to the dialogue would be welcome. These should reach the Geological Survey before **15th May, 1989** for inclusion in the next issue. All items should be as short (maximum 350 words), **interesting and newsworthy as possible.**