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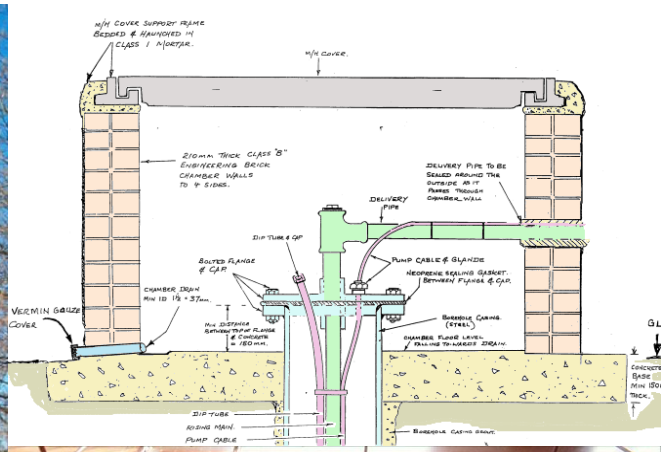
Environment Agency

BOREHOLE CONSTRUCTION

MODULE HANDBOOK



Course Number T504

BOREHOLE CONSTRUCTION

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Overall aim

This module aims to provide the student with the ability to design, install and evaluate abstraction and monitoring boreholes and monitoring networks for both groundwater quality and quantity.

Assessable learning outcomes

By the end of the module it is expected that students will be able to:

- understand the principles of groundwater monitoring, including the link between conceptual modelling and the design of monitoring facilities;
- select the appropriate techniques for drilling boreholes in a range of geological formations;
- produce outline designs for boreholes, including specifying screen type and slot size and designing filter packs.
- recognise the special considerations of constructing boreholes in wetlands and contaminated land, and understand the principles of borehole maintenance, rehabilitation and decommissioning.

In addition, students will enhance their mathematical, analytical and group-working skills.

Whom is this module for?

This module is aimed at people whose role requires them to interpret the results of groundwater quality and quantity monitoring, or to design and install new groundwater monitoring and abstraction boreholes. This may be in connection with a wide variety of activities, including the following:

- Processing of applications for groundwater investigation consents and groundwater abstraction licences.
- Undertaking or reviewing 'appropriate assessments' under the Habitats Directive.
- Designing and drawing up specifications for groundwater monitoring networks within and around wetland Sites of Special Scientific Interest.
- Design and construction of augmentation boreholes.
- Processing of applications and evaluation of technical reports on landfill, waste disposal and contaminated land issues.

Context of the module

This module forms part of a developing programme for training staff of the Environment Agency to Masters level. This flexible programme provides Environment Agency staff with opportunities for training that is tailored to their career development. The overall objectives of the programme are to develop:

- fundamental geoscience knowledge and skills required by technical staff in the Environment Agency;
- the confidence that comes from having applied that knowledge to solve problems that are typically encountered by Environment Agency geoscientists in their work;
- the self-assurance gained from being taught by and having talked with people who are acknowledged experts in their fields;
- a knowledge of sources of information, combined with an appreciation of when additional information is likely to be needed.

Method of delivery and Module Tutor

This module is delivered via one contact session of two days, comprising lectures, discussion sessions and classroom practicals. Participants are encouraged to bring along for discussion real problems in borehole construction that they have encountered in their work.

The module is supplemented by directed reading and individual work.

The lectures will be given by Angelo Papaioannou and Rod Mitchell.

The Environment Agency technical contact for this module is Phil Stewart
Email: phil.stewart@environment-agency.gov.uk

How to apply

If you are interested in this course then you will need to discuss this with your Team Leader, and identify this training need within your individual development section of the Learning Zone.

Time commitment

This module requires a total input of around 35 study hours. The breakdown is roughly as follows:

- Lectures and practical work, 17 hours (two days of residential course).
- Directed learning, 18 hours (pre-course reading and independent learning).

This time commitment needs to be discussed with your Team Leader but it should be noted that you cannot expect all of the directed learning time to come from official Environment Agency allocations.

Pre-course preparation

In order to gain maximum benefit from this module, it is essential that you prepare yourself before attending the course by reading and becoming familiar with the following:

- Driscoll F G (1986). *Groundwater and Wells*. 2nd edition, St Paul, MN, Johnson Filtration Systems Inc. Found on the bookshelves of most hydrogeologists, this book gives practical descriptions of all aspects of designing, drilling, developing, test pumping and equipping boreholes and wells. Read Chapters 10 to 15.
- Howsam P, Misstear B and Jones C (1995). *Monitoring, maintenance and rehabilitation of water supply boreholes.* Report 137, Construction Industry Research and Information Association. This practical guide is particularly useful for diagnosis of borehole problems and choice of rehabilitation method. Read in particular Chapters 2, 3, 6 and 7.
- Misstear B, Banks D and Clark L (2006). *Water Wells and Boreholes*. Chichester, John Wiley & Sons. Recently published book, expanding and updating the well-known *Field Guide to Water Wells and Boreholes*, published by Lewis Clark in 1988. Expensive to buy, but worth the effort of tracking down a copy.

The pre-course reading will be discussed during the introductory session of the course.

Syllabus for residential course

As already mentioned, the Borehole Construction module is designed to be delivered over two days, in a single block. The main topics covered by the module are:

Day 1 Principles of groundwater monitoring. Basic drilling techniques and borehole design. Regulatory aspects of borehole construction and drilling contracts.

Day 2 Detailed borehole design. Borehole development and completion. Working in contaminated land and wetlands. Borehole maintenance, rehabilitation and decommissioning.

Students are expected to arrive at the training venue by 9.30 am at the start of the course, so that there can be a prompt start on Day 1. Both days are full teaching days, and students should not expect to be able to leave before 17:00 on Day 2

The topics will now be described in more detail. In practice, there may be some variation in the order in which topics are covered.

Attendance Block (2 days)

DAY 1

Main topics for the day: Principles of groundwater monitoring. Basic drilling techniques and borehole design. Regulatory aspects of borehole construction and drilling contracts.	
Session	*Topic*
1	Principles of groundwater monitoring. Why are you doing it? For how long? What are you expecting to see?
	Types of borehole: abstraction versus monitoring; open boreholes versus piezometers; nested versus single piezometers; multi-level sampling.
2	Basic drilling techniques (including coring), with pros and cons and suitability for different purposes.
	Borehole design (depth, diameter, completion, headworks).
3	Selection of drilling sites (access, buried services, overhead hazards, etc).
	Groundwater investigation consents, notifying the British Geological Survey.
4	Drilling contracts, bills of quantities, economics of borehole design, drilling supervision, driller's logs.

Notes: Day 1 is entirely based in the classroom, and consists of lecturing, discussion and some group exercises.

DAY 2

Main topics for the day: Detailed borehole design. Borehole development and completion. Working in contaminated land and wetlands. Borehole maintenance, rehabilitation and decommissioning.	
Session	*Topic*
1	Specifications for casing, screen, slot sizes, gravel packs, etc.
	Borehole development, including airlifting and acidisation.
2	Borehole completion, above and below ground, highlighting good and bad practice.
	Pumps and sampling equipment.
3	Special considerations of working in wetlands.
	Working in contaminated land, disposal of arisings, puncturing layers, etc. Borehole materials and sensitive water quality determinands.
4	Borehole maintenance and rehabilitation.
	Borehole decommissioning, good practice.

Notes: Day 2 is entirely based in the classroom, and consists of lecturing, discussion and some group exercises.

Independent Learning

After the residential course, students should revisit the references given in the pre-course reading list, for more background on the topics covered during the teaching sessions.

Field demonstration

It is intended that students should have a 1-day field demonstration of the drilling or installation of a suitable borehole. This would happen after completing the two-day residential course, probably on a separate occasion when a suitable local drilling project has been identified. Alternatively, students could be involved in properly-run borehole construction during the course of their normal work, with appropriate supervision from their Team Leader or local Technical Specialist.

Completing the module

In summary, successful completion of the Borehole Construction module consists of the following elements:

1) Attendance on both days of the residential course (a register will be kept to record attendance).
2) Attending a 1-day field demonstration of borehole construction, or taking part in properly-run borehole construction for 1 day, to the satisfaction of your Team Leader (not formally assessed).

Module dates

Once approval has been received from National Learning & Development to run the course, the relevant dates will be made available on the Learning Zone.