Guide To Good Practice

SEPA
Scottish Environment Protection Agency

Water Supply Borehole Location, Construction and Headworks

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This guidance has been prepared by the Scottish Environment Protection Agency (SEPA) to raise awareness of both good and bad practice in the siting, construction and completion of water supply boreholes. This document has been modified from an Environment Agency document of the same title. SEPA gratefully acknowledges the use of the Environment Agency document to produce this Scottish version.

Who is it aimed at?

It is intended to help owners of existing boreholes to protect their sources. It is also for anyone considering having a borehole drilled. It tells you what to look for, what to specify and what your responsibilities are, as well as helping drillers submit realistic prices for doing the job properly and to adopt the necessary high standards.

Why is it needed?

It is important that the right precautions are taken when planning and constructing water supply boreholes, to prevent contamination of the sources themselves and pollution to the groundwater in general. There are many examples of badly constructed, completed or maintained private water supply boreholes, which can pose a risk to source owners. Once drilled and completed a borehole is often out of sight and out of mind – until things go wrong, e.g. becomes polluted, fails environmental health checks[1], or the output falls.

These guidelines are not prescriptive; SEPA does not have a standard specification for drilling or completing water supply boreholes. Common objectives must be met, but precisely how they are achieved is a matter for the client and contractor. Both have legal and other responsibilities and legal liabilities. The client's interests must be protected, whilst the contractor is usually looked on as 'the expert' in these matters, and is expected to use designs, materials and workmanship appropriate to the setting and risks.

What does it cover?

The guidelines focus on those aspects of borehole siting, construction and headworks design relevant to source protection. Further details are provided in the text and in the tables and diagrams at the end of this document.

Other considerations

There are a number of other factors that need to be considered when planning or constructing a borehole, which are beyond the scope of this guidance. They include:

- regulatory control;
- health and safety;
- electrical safety and regulations;
- dangers from toxic or explosive gases;
- leaking sewers, effluent disposal from septic tanks;
- storage, handling and accidental spillages of fuels and chemicals.
- the presence of buried services (gas, electric etc);

A list of useful references can be found at the back of this document.

Legal liabilities

Although at present there is no requirement for owners of boreholes to inform SEPA of any intention to abstract water a new abstraction control regime will be implemented in 2005. This is likely to require water abstractors to apply to SEPA for authorisation. This will be via notification, General Binding Rules or a licence.

It is a criminal offence to cause or knowingly permit groundwater to become polluted, with heavy penalties in a sheriff court, or an unlimited fine and/or imprisonment on indictment. If source owners allow pollution of groundwater to occur, for example by surface contamination draining down their borehole, they not only jeopardise their own water supply, but they could also be prosecuted by SEPA, and be responsible for cleaning up the groundwater. Similarly, if the contractor does not design or construct the borehole properly, taking account of the risks, they too could be liable.

Once polluted groundwater is always expensive, and often impossible, to clean up. SEPA's philosophy is that prevention is better than cure.

Test pumping

To determine the yield of a borehole a period of test pumping is carried out. It is recommended that water quality samples should be taken at the end of the test, to determine whether the source is contaminated and whether the water is fit for the intended use. The latter issue falls within the remit of the local Environmental Health department. In addition to quality sampling, it is important that the pumping rates and water levels are measured accurately before, during and after the pumping period.

The information obtained can be used to select appropriate permanent pumping equipment. It also is a measure of the borehole performance at the time of drilling, and can be a useful reference to indicate future deterioration in the borehole or pump performance, or overpumping of the aquifer unit tapped by the borehole. Source owners are advised to keep records of borehole water levels during the operational life of the borehole.

Borehole records

Source owners should obtain a copy of the driller's log, showing construction details and strata penetrated, as well as the pumping test results, from their contractor at the time of construction and testing.

Drillers are required by law to give prior notification to the British Geological Survey of their intention to drill any boreholes over 15m deep, and to send their completion records to them.

Other useful guidance

Other relevant guidance and references include:

SEPA's Groundwater Protection Policy for Scotland, 2003
Pollution Prevention Guidelines, which gives advice on certain potentially polluting activities:

- PPG 2 - Above ground oil storage tanks
- PPG 4 - Disposal of sewage where no mains drainage is available
- PPG 8 - Safe storage and disposal of used fuel oils
- PPG 9 - The prevention of pollution of Controlled Waters by pesticides
- PPG17 - Dairies and other milk handling operations

Scottish Executive

- Keeping It Safe: Is your water supply safe?
- Prevention of Environmental Pollution From Agricultural Activity: Code of Good Practice (1997) The Scottish Office - revised edition anticipated 2004.

Drinking Water Inspectorate (DWI)

- Manual on Treatment of Private Water Supplies (1993)

Health & Safety Executive

- Information Document HSE 847/4: Water Boreholes - Potential Hazard from Methane Evolution (July 1990)

Others

- Groundwater Regulations 1998 (SI NO.2746)
- Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations, 2003
- Institute of Electrical Engineers (IEE) Regulations, 16th Edition
- Control of Substances Hazardous to Health (COSHH) Regulations, 1995
- The American Water Works Association Standard for Water Wells (ANSI/AWWA A100-90)
- Monitoring Maintenance and Rehabilitation of Water Supply Wells. Ciria Report 137
- BS 879 Part 1 and 2, 1985 - water well casing

At a Glance

	Good Practice	Bad Practice	Objectives
Location	Remote from and up-slope of any pollution sources. In general it is recommended that drinking water supplies be located at least 50m from any potentially polluting activity.	At low points where contaminated drainage can collect. Close to or down slope of sources of pollution e.g. – fuel/chemical tanks, storage/handling areas, septic tanks.	To minimise the risk of pollution to the abstraction.
Water Well Drilling	Drilling fluids should be free from contaminants and as far as practical be limited to clean water, air and approved foaming agents.	Equipment is potentially contaminated e.g. may have been used to drill boreholes on contaminated sites or has been lying on ground occupied by livestock.	To minimise the risk of contaminants being introduced by the drilling equipment or fluids.
Permanent Casing: *Type*	British Standard, oil industry (API) standard or waterwell standard casing[2].	Drainage or sewer pipes.	To seal off shallow unstable or contaminated ground.
Permanent Casing: *material*	Steel[3] /waterwell grade plastic.	Plastic casing if installed in holes which may be liable to collapse.	To seal off and to prevent tracking shallow groundwater and surface water via the borehole to the water table.
Permanent Casing: *jointing*	Welded, screwed and socketed.	Push-fit.	
Permanent Casing: *diameter*	Large enough to allow installation of dip tube(s) as well as rising main and power cable. Small enough to provide an annulus of at least 50mm to allow effective pressure grouting[4].	Too small to allow installation of dip tube(s). Too large to allow effective pressure grouting of annulus between casing and borehole wall.	To prevent interconnection of different aquifer layers. To prevent uncontrolled artesian discharges.
Permanent Casing: *depth*	Normally at least 15m. In the case of open boreholes In rock, casing should be inserted at least 3m into solid rock. A greater depth may be necessary to seal off unstable or contaminated ground or different aquifer units[5].	Casing too shallow so that ingress of water from contaminated horizons occurs.	
Flange/seals	Threaded joint. Square-cut casing, welded flange. Flange and bolted borehole cap with neoprene seal[6].	No seal/flange plate/rough cut casing. Cut off too close to base of chamber.	
Grouting	Pressure grouted from base of permanent casing up to surface. Allow minimum of 24 hours for grout to set before drilling deeper. Minimum annulus 38mm.	Grout poured form surface. Casing just driven not grouted. Drilling recommended before grout has set and hardened[7].	To seal off and prevent tracking of contaminated shallow groundwater and surface water via the borehole to the water table.
Completion	Above ground either in a pump house or protected area not subject to traffic.	Below ground, and not sealed.	

At a Glance

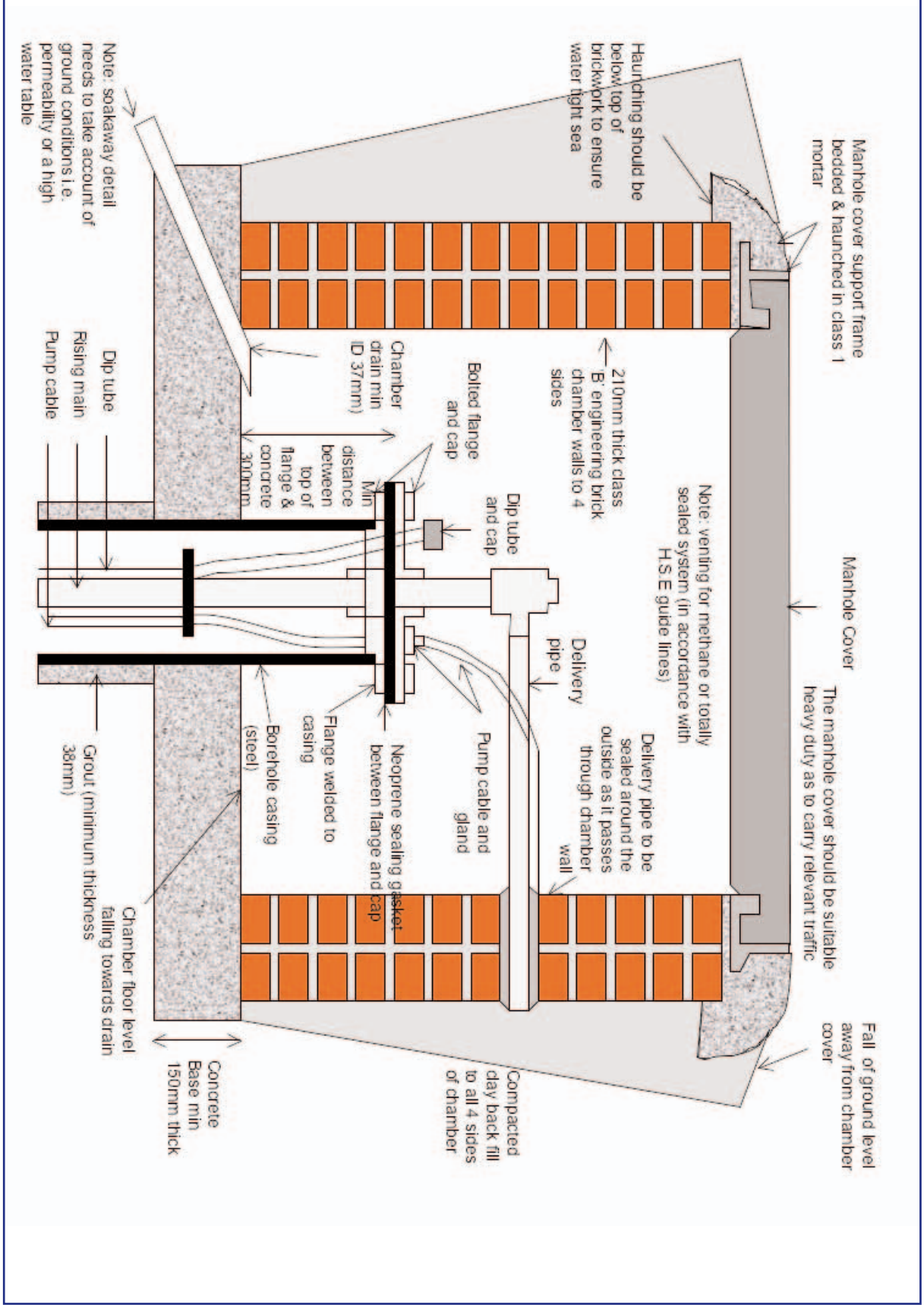
	Good Practice	Bad Practice	Objectives
Manhole: Chamber[8] *base*	Concrete, 150mm thick.	Concrete <100mm or natural ground.	To prevent water or contaminated drainage accumulation in the manhole chamber, by minimising water entry and providing drainage out of the manhole chamber.
Manhole: *sides*	Precast concrete sections, engineering brick or waterproof rendered brick/blockwork (bonded to base).	Brick or blockwork,not waterproofed.	
Manhole: *cover*	Load bearing to suit traffic. Cover frame haunched and bonded to sides. Water-tight seal.	Lightweight cover (potentially damaged by traffic). Frame not Sealed to sides.	
Manhole: *drain*	25mm ID min diameter with vermin screen, leading to surface outlet or effective soakaway[9].	No drain, no soakaway, blocked drain or manhole constructed below the water table or in water logged or poorly drained ground.	
Manhole: *chamber backfill*	Low permeability material such as clay.	High porosity material in waterlogged or poorly drained ground.	
Dip Tubes[10]	25mm ID min. diam. Bottom 3m perforated at 100mm centres. Base with plug/bar to prevent dipper running out of dip tube. Bottom at least 2m below the pump intake level or sufficiently below water table to accommodate future changes in water level (pumping and natural). Removable plug in top.	None provided. Not deep enough. Open ended (allows dipper to run out of bottom). Not perforated.	Safe access to allow reliable water level measurement. Prevent splashing/high level seepages giving spurious readings. Sealed to prevent contamination of borehole, artesian discharge or gas escape as appropriate.
Venting	Either totally sealed system for artesian boreholes for example or manhole chamber/building and storage vessels vented according to guidance from HSE[11]. Borehole completed above ground in an open atmosphere.	Siting in a building or a chamber which would constitute a confined space. Potential sources of ignition from electrical equipment (including switchgear and lights) close to borehole or in a confined space (where there is a risk of gas accumulation).	To avoid risk of accumulation of toxic or explosive gases in borehole chamber storage vessels or buildings [12].
Flowmeter	Accurate, located close to the source, away from the pump, not to be by passed. Well maintained.	Fitted on short pipe runs, close to bends and valves.	Where required by SEPA a meter should be calibrated installed and maintained to ensure accurate measurement of abstraction quantities.

Footnotes

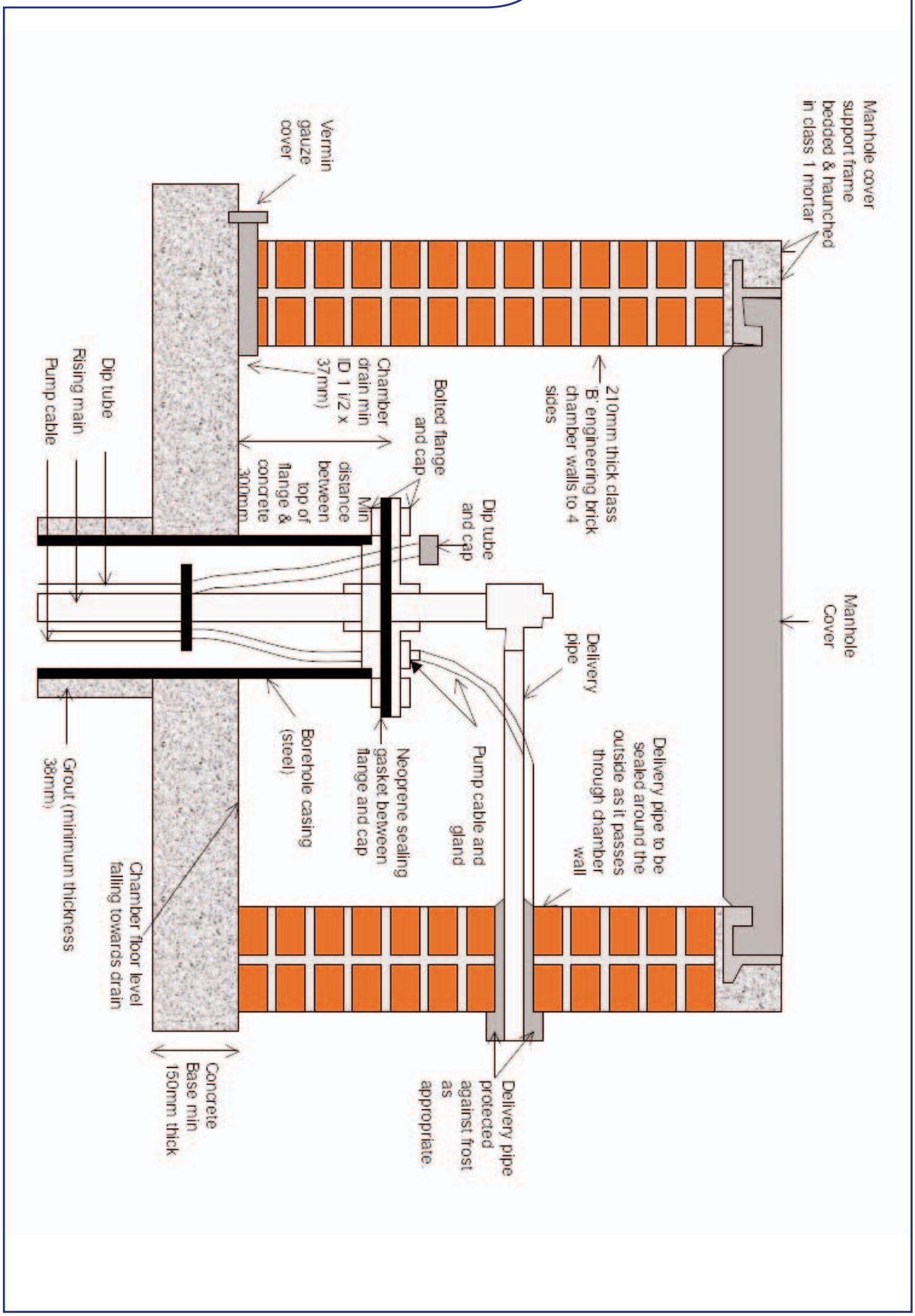
1 The Environmental Health department of the Local Authority has responsibility for checking the quality of private water supplies, and has powers to condemn sources unfit for human consumption
2 The casing strength should be designed to suit the ground conditions and installation depth.
3 Steel is more rigid, robust and does not bend.
4 Requires a large enough diameter borehole from the outset. Reductions may be necessary because of unstable ground.
5 Additional secondary casing or a slotted screen with or without a gravel pack may be required in unconsolidated aquifers or unstable ground.
6 Essential if the borehole is artesian.
7 Many boreholes have been found to have a cavity at the base of the permanent casing. This is likely to be due to poor grouting or not drilling deeply enough into solid ground before inserting the permanent casing.
8 Where an above ground completion is not possible.
9 A soakaway will not work effectively if the manhole chamber is constructed in low permeability ground or below the water table.
10 Two dip tubes should be considered where water level measurement is to be by manual dip meter and data logger.
11 Health & Safety Executive – "Water Boreholes – Potential Hazard from Methane Evolution" HSE 847/4 July 1990. If a methane problem is envisaged the HSE should be contacted for advice.
12 Methane can be found naturally or be derived from landfills or other sources. Hydrogen sulphide and carbon dioxide can be emitted naturally. These pose a potential hazard where man access is necessary into a confined space.

Below Ground Completion - Acceptable GOOD Practice

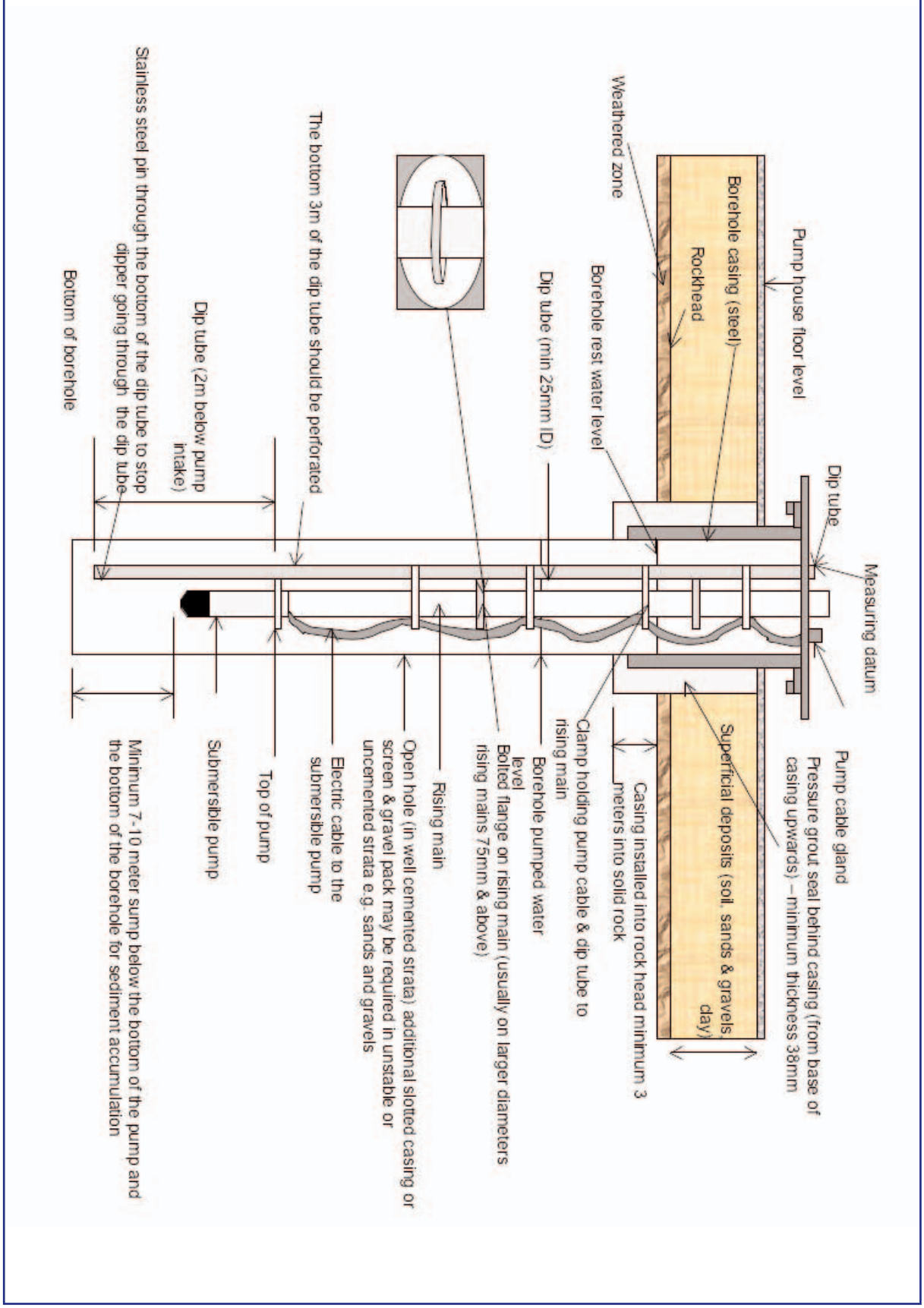
(only where an above ground completion is impractical)



Above Ground Completion - Recommended GOOD Practice



General Schematic Section of an Abstraction Borehole



Below Ground Completion – Example of BAD Practice