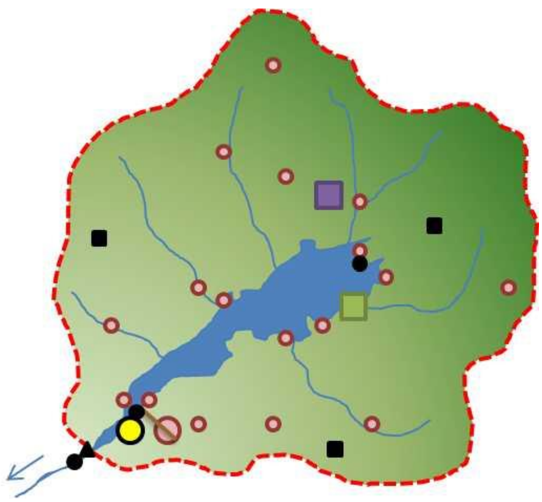
THE REPUBLIC OF UGANDA

Ministry of Water and Environment

FRAMEWORK AND GUIDELINES FOR WATER SOURCE PROTECTION

Volume 3: Guidelines for Protecting Water Sources for Point Water Supply Systems



3

May 2013

Guidelines for Protecting Water Sources for Point Water Supply Systems

Introduction

The Water Sources Protection Guidelines for Point Source Water Supply systems describe steps to follow to prepare a Water Source Protection Plan. The description in this Volume is derived from overall Framework for Water Sources Protection Guidelines (Volume 1). The document emphasises those steps, actions and considerations that are particularly relevant to protecting a water source for a piped water supply scheme.

The Volume is intended to be a standalone document for ease of its application by those concerned with piped water supply systems. However, the user may wish to refer to Volume 1 where appropriate so as to ensure that the guidelines in this Volume are correctly interpreted in context of the overall framework for protecting water sources.

Table of Contents

List of Tables

List of Figures

Acronyms

CBO	Community Based Organisation
CLTS	Community-Led Total Sanitation
CMO	Catchment Management Organisation
DEA	Directorate of Environmental Affairs
DIM	District Implementation Manual
DWD	Directorate of Water Development
DWO	District Water Officers
DWRM	Directorate of Water Resource Management
EIA	Environmental Impact Assessment
FSSD	Forestry Sector Support Department
iNGO	International Non Governmental Organisation
IUCN	International Union for the Conservation of Nature
JAF	Joint Assessment Framework
JSR	Joint Sector Review
MoAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MoEMD	Ministry of Energy and Mineral Development
MoFPED	Ministry of Finance, Planning and Economic Development
MoLHUD	Ministry of Lands, Housing and Urban Development
MWE	Ministry of Water & Environment
NEMA	National Environmental Management Authority
NFA	National Forest Authority
NGO	Non-Governmental Organisation
NWSC	National Water and Sewerage Corporation
OPM	Office of the Prime Minister
T/P/WS	Threat-Pathway-Water Source model
TSU	Technical Support Unit
UWA	Uganda Wildlife Authority
WMZ	Water Management Zones
WRM	Water Resources Management
WSDF	Water and Sanitation Development Facility
WSPC	Water Source Protection Committee
WSPP	Water Source Protection Plan

Glossary

Water Source	For the purpose of these guidelines, a Water Source is a geographical point, or piece of infrastructure, where water is taken from the environment and used for a specific socio-economic purpose, such as water supply, agriculture or hydroelectricity generation.
Abstraction	Taking water from the environment, generally by motorised or manual pumping from a well, borehole, lake, river or spring.
Aquifer	Any body of water-bearing rock that is sufficiently porous and permeable that water can be taken, often from natural springs or from artificially drilled or dug wells or boreholes.
Contributor	A stakeholder that contributes to the development or implementation of a Water Source Protection Plan through facilitation, information sharing, financial or in-kind contributions.
Catchment/ Watershed / River Basin	A drainage basin or area of land from which surface water drains to a single exit point (usually a point on a river or the estuary where a river enters the sea). Where there is groundwater, the movement of water is generally more complex because groundwater drainage does not always follow the same pattern as the overlying topography. In this report 'Catchment' is used by preference but some the literature refers to 'watersheds' or 'river basins', which usually have the same meaning.
Control Measure	Actions that can be taken to protect a Water Source.
Hazard	The nature of problem arising from the Threat that can harm the Water Source.
Implementer	The organisation that is the primary user of these guidelines to prepare a Water Source Protection Plan. For new schemes this will be the developer organisation, for existing schemes it is likely to be the owner of an asset (for example a Water Authority who owns a pumping station or a power company that owns an hydro-electric scheme), or a proxy (for example a Water User Committee who manages a multi-purpose reservoir although ownership lies ultimately with MWE).
Pathway	The physical route through the environment by which a Threat affects a Water Source. For example, a fuel spillage from a petrol filling station could affect a Water Source through groundwater flow or a surface watercourse.
Piped Water Supply	A water supply system where water is delivered to the end user through a pipe network. This includes both gravity flows schemes fed by spring and pressurised pumped systems from boreholes or surface water.
Point Water Source	A water supply where the user collects the water from the water source (well, borehole with handpump or spring)
Risk	The likelihood, or probability, of a Hazard having an adverse impact on a Water Source.
Threat	An activity, process, built structure or natural feature that presents a potential threat to water quality, water quantity or reliability of water in the environment which is subsequently used by a Water Source. For example, a Petrol Filling Station is a Threat because if petrol or diesel gets into public water supply it will cause health problems.
End Water Users	The people who benefit from the Water Source through supply of drinking water, water for agriculture and livelihoods, water for fisheries, or water for energy production.
Water Infrastructure (3a):	A borehole or well with a handpump A spring collection tank or spring water collection point

Acknowledgements

These documents were prepared by the Directorate of Water Resource Management of the Ministry of Water and Environment under the coordination of Dr Callist Tindimugaya, Commissioner, Water Resources Planning and Regulation. Technical support was provided by Sean Furey (Skat Foundation) with assistance from Alex Muhweezi (Future Dialogues International Ltd). Input and guidance was gratefully received from a number of people and organisations who took part in the consultation process. Financial support for preparation of the documents was provided by the Danish Government through Danida.

1 Guidelines for Point Water Sources

What is Water Source Protection?

The water that we pump from the environment is part of a global process called the Water Cycle (Figure 1) which deposits fresh water on the land, in the form of rain, which then flows over the surface of the land or through soil and rock into the ground. The quantity and quality of the water available for our water supply systems depends on a healthy environment in our river catchments and aquifers.

Figure 1: Water Cycle

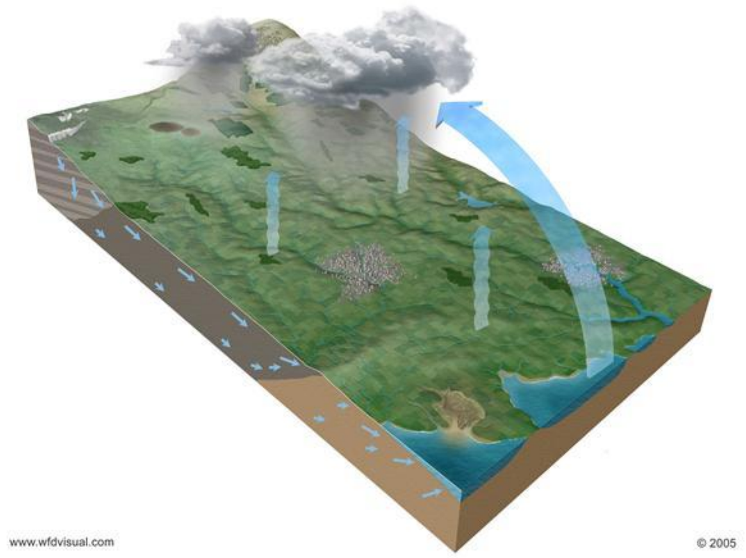
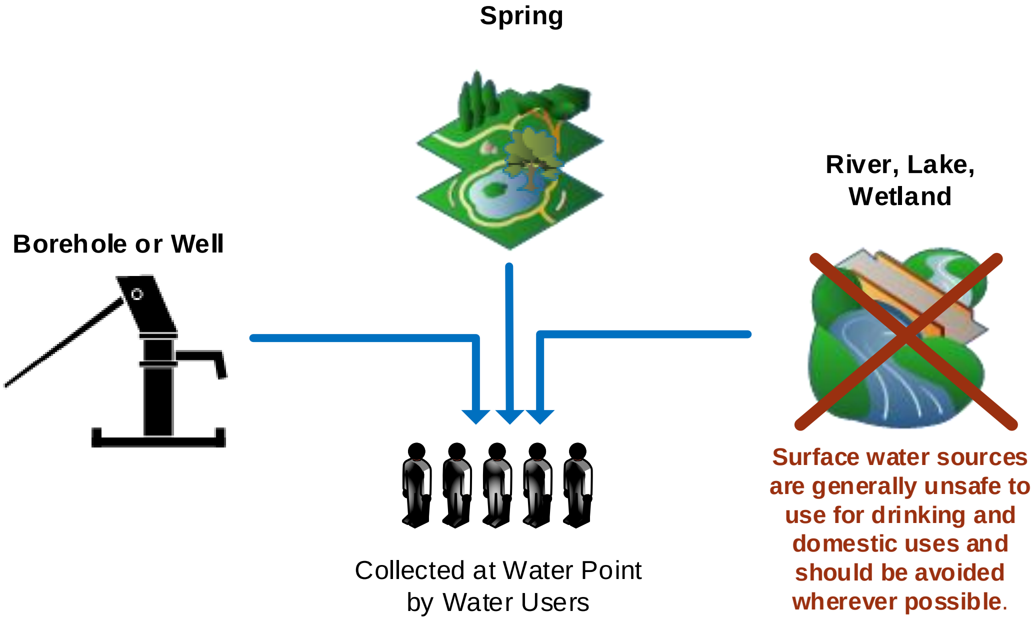


Figure 2 illustrates what Point Sources are. They are generally smaller than abstractions for piped schemes and water treatment is less common (though household water treatment may be used). The water is generally collected by the user from the Water Source: the well, borehole or protected spring. Rivers, lakes, ponds and scoop holes can be considered Point Sources, but these are generally too poor quality and too difficult to protect to be considered safe.

What is Water Source Protection?

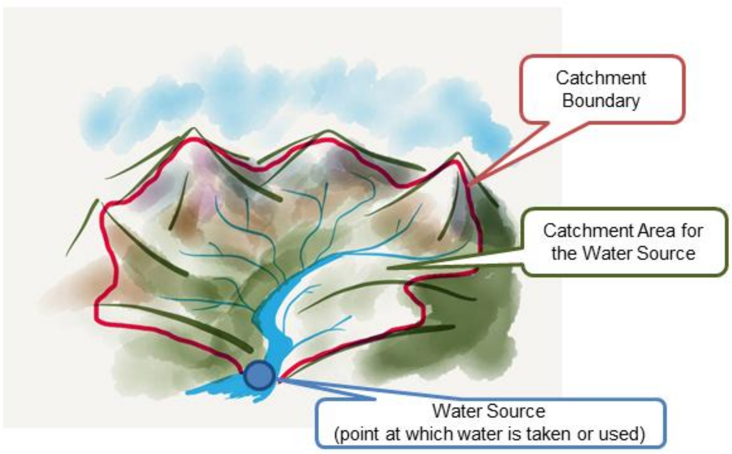
Figure 2: Water Source Collection Points



Water Source Protection is about working with others to maintain and improve the quality of the local water environment. Doing this not only maintains good quality water, keeps water treatment costs down, but creates many other benefits for people and environment in the area.

A catchment is an area of land that drains to a specific point (Figure 3). For these Guidelines, a catchment is the area of land that drains water to a pumping station, a spring, a well, a borehole, a reservoir or a hydroelectric power plant.

Figure 3: A catchment area (river example)



The quantity and quality of water reaching the Water Source will vary over time according to many natural and human factors. For low volume point water sources, this involves looking for potentially harmful activities near the source and trying to avoid or mitigate their effects. The two main types of Threat are:

- Pollution – which impacts water quality and may cause health problems
- Competing abstraction – which may reduce water availability from your source.

What is Water Source Protection?

What are the guidelines for?

These Water Source Protection Guidelines should help the user identify the risk to a water source and to engage the people and organisations responsible for the problem in a positive way that lead to a mutually beneficial outcome.

Quite often, the activity or practice that is causing pollution (or is disrupting natural water flows) is harmful to a wide range of stakeholders. These guidelines help the user bring those stakeholders together to identify feasible solutions and agree on a Water Source Protection Plan to achieve them.

While each plan will set its own specific aims, they should work towards the general aims and objectives set out in Table 1 below.

Table 1: Over-arching objectives for Water Source Protection

Aim	Objectives
1. Improved Water Quality	1.1. Health: Minimise the risk to human and livestock health 1.2 Equipment: Minimise risk of damage to pumps and water services equipment (e.g. through corrosion)
2. Reliable Water Quantity	2.1 Yield: Ensure adequate yield to meet water supply demand 2.2. Reliability: Minimise seasonal disruption or halt long term declines in water flows/levels
3. Better Livelihood Opportunities	3.1 Sustainable Land Management: Increase level and reliability of household income from better farming and forestry practices. 3.2 Poverty Reduction: Develop new sources of income and socio-economic security through better catchment management.

Who should use these guidelines?

These guidelines are intended for anyone planning, designing, building or maintaining a point water supply source:

- A technical advisor to a Water User Committee;
- A WASH engineer working for an NGO, CBO, private contractor or government agency;
- A District Water Officer.
- Any private water user who is improving their water access through self supply.

Why and when use these guidelines?

There are likely to be a number of reasons for referring to these guidelines:

- Your water point is facing major problems: water quality is getting worse, turbidity of the water is increasing, water levels or flows are declining or increasingly unreliable.
- You have been required to prepare a Water Source Protection Plan as part of an application for a Water Permit, or because it was specified in a contract for a new scheme.

What is Water Source Protection?

- You have been tasked with finding and designing a suitable location for a borehole, well or spring and you want advice that will help you decided where the best abstraction point would be and what would need to be done to protect it.
- A Catchment Management Plan has been developed and the area around your water source, or proposed water source, has been identified as being at high risk of having water quality or water quantity problems.

What is being protected?

Point Water Sources are locations where people come to collect water for domestic and other uses. These include: wells, boreholes and springs.

Rainwater harvesting is also a Point Water Source but only needs basic protection measures because the opportunity for contamination is low.

Surface water sources such as lakes, streams, rivers and wetlands are generally unsafe to use for drinking and domestic uses and should be avoided wherever possible. If there is not alternative they should only be used in association with household water treatment. While boiling water is effective at removing microbes and pathogens, it does not treat turbidity or chemical pollution. Boiling also needs a lot of energy – which increases fuel-wood consumption, which encourages deforestation, which in turn damages water quality and availability.

In Uganda, Point Water Sources are the dominant water supplies in rural areas, but they are also found in some small town and per-urban areas where piped water supplies are not available – or not reliable.

What is water supply being protected from?

The water that reaches your water works fell as rain and has flowed across the land surface, in streams, rivers or lakes, through the soil and rock. On its journey, this fresh water may have been changed and the quality, quantity and reliability of the water supply may not be as good as it should be. Human activity in the catchment area that supplies water to the point from which you take the water is likely to be a major factor and a major cost.

Do I need to produce a Water Source Protection Plan (WSPP)?

Ideally a detailed plan should be produced but this Volume sets out a pragmatic approach for smaller water points where the volumes of water used and the catchment sizes are relatively small. The additional risk reduction from a full Water Source Protection Plan may not offset the cost of undertaking the process – and were resources are scarce this is an important factor.

However, you may be required to prepare a WSPP as part of an EIA, a Water Permit application or as a contractual requirement imposed by a client or development partner. If that is the case then use the guidelines for Piped Water Schemes (Vol. 2) or Multipurpose Reservoirs (Vol.4).

What skills do I need to have in my team to implement these guidelines?

- **Leadership:** the ability to take the initiate and to get people from other organisations involved, give them tasks and provide support and encouragement.
- **Stakeholder engagement:** understanding different government and non-government organisations and how to engage them in Water Source Protection in a constructive way.

- **Technical/Engineering:** understanding of how the water supply system works and what costs and risks result from declining water quality/quantity coming into the works.
- **Environmental/water resources management:** understanding of hydrology, hydrogeology, ecology and human land and water management.
- **Rural livelihoods:** understanding the socio-economic fabric of the catchment area so that Threats can be diagnosed and win-win situations found.

2 Protecting Deep Boreholes

Description

Deep boreholes are defined in Uganda as small diameter wells that are deeper than 30 metres. Water lifting for rural water supply is generally done with a U2 or U3 handpump. They often take water from a deep aquifer, which is capped by an impermeable layer or rock or clay soil. Because the water is coming from depth it is generally protected from most surface contamination.

Main Threats

Water Quality and Pollution

The main threat to water quality in a deep borehole is contamination from material entering the borehole itself. Therefore the following measures should be taken:

Possible Threat	How to find out	What to do
Pollution entering the borehole	» Check for gaps or cracks around the opening of the borehole (both down the inside and the outside of the borehole casing) » Check with local residents about any history of flooding in the area. Floodwater can wash contaminants into the borehole, if it is unprotected.	» The borehole should be covered and sealed so that dirt, water, sand and other debris cannot fall in. » The borehole should have a concrete apron around its base to prevent dirty water seeping back into the hole. » Avoid drilling in flood-prone areas, or raise wellhead by building earthworks.
Naturally high levels of arsenic or fluoride in the water	» Find out from a hydrogeologist or the local District Water Officer whether it is a high risk area. » If in doubt, get the water tested. » Talk to the District Health officer about whether there are causes of fluorosis or arsenic poisoning in the local population.	» If arsenic or fluoride is present then assess the relative health risks of using this source compared to others available – also take into account accessibility. A borehole that is close with slightly high fluoride levels may be better than a surface water source several hours walk away. » Look at household treatment options (such as bone char filtration) to remove fluoride. » If levels in the water are above WHO guidelines then look for alternative water sources (rainwater harvesting, shallow wells, springs)
Persistent industrial or agricultural pollutants (such as heavy metals, organic compounds and some pesticides)	» Find out where the recharge zone is for the aquifer and identify any Prescribed Trades or Premises (Annex A1). » If there are threats nearby then get water quality samples tested for Prescribed Substances (Annex A2) and make sure that the water meets the national rural water quality standards (Annex A3) or WHO guidelines.	» If there is evidence of industrial or agricultural pollution of the groundwater then alert the District Water Officer and/or NEMA. » If levels in the water are above WHO guidelines then look for alternative water sources (rainwater harvesting, shallow wells, springs)

Water Quantity and Yield

The yield of the borehole will depend a lot on the geology in which it is sited. Deeper wells have the advantage over shallow wells that they often have higher yields if they tap into many productive aquifers. If yields are declining, the possible causes to investigate are:

Possible Cause	How to find out	What to do
Erratic rainfall	Find local rainfall records, or install a rain gauge and take daily or weekly rainfall measurements.	If there is a long term trend (due to natural cycles, climate change, or changes to the local microclimate) then it may be necessary to develop other water sources to supplement this borehole.
Declining groundwater recharge	Consult an experienced hydrogeologist to find out where the recharge zone is for the aquifer that you are using. If that area is suffering from rapid land use change (urbanisation, deforestation, soil erosion) then the recharge of the groundwater supplying your borehole may be affected.	Report the problem to your District Water Officer, Water Management Zone or Catchment Management Committee. Get involved with catchment management planning that could improve land management and restore groundwater recharge. Encourage contour ploughing, mulching and other agricultural practices that increases soil water retention and percolation into the underlying aquifer.
Over-pumping at your source	Is the borehole or well being over-used? Keeping records of how much is being pumped (either volumes or number of hours for which the pump is being used per day).	Reduce the amount of water being taken – if demand in the area is growing then look at developing new water sources (but see below)
Interference from another water source	Another abstraction may be competing with yours for water. Motorised pumping (for irrigation, factory or public water supply) is most likely to have an effect on other boreholes, such as yours. However, when looking for potential causes consult an experienced hydrogeologist because the way that water flows through the ground may mean that it is not necessarily the nearest abstraction point that is causing the largest impact.	1. Take regular (preferably daily) water level measurements in the borehole and find out if sudden drops in level correspond to pumping activity elsewhere. 2. If there is evidence of derogation then discuss the matter with the District Water Officer or local Water Management Zone office. 3. Negotiation of the issue through a mediated forum, such as the local Water User Committee should be done to reach an equitable solution.

Checklist for designing protection for deep wells and boreholes

- ☐ Concrete apron and drainage channel to prevent water entering well/borehole.
- ☐ Fenced off area around borehole to prevent livestock breaking up the ground around the borehole – however, access should allow for disabled water users (e.g. those in wheelchairs).
- ☐ If water is to be used for livestock watering, provide a pipe or channel to trough outside the fenced area.
- ☐ Avoid drilling in locations that are liable to flooding. If such areas are unavoidable, then construct an earthwork (such as a mound reinforced with stone or rock gabions) so that the opening of the well or borehole is above the maximum anticipated flood level.

Checklist for designing protection for deep wells and boreholes

Figure 4: Drilled Well Platform Design (District Implementation Manual, 2007)

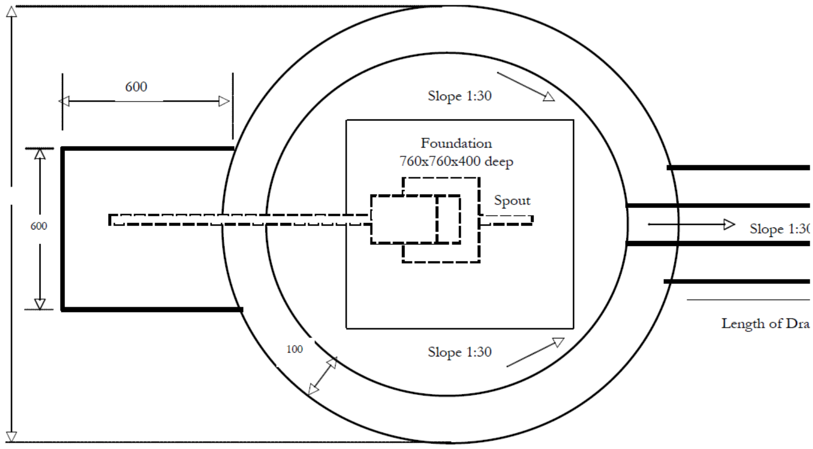


Figure 5: A U3M pump on a sealed borehole with concrete apron

Photo: Karl Erpf, Skat

3 Protecting Shallow Boreholes and Wells

Description

Shallow wells or boreholes are generally those less than 30 metres deep. They are usually dug, or drilled, into unconsolidated formations (such as sands, gravels and silts). They can be vulnerable to surface pollution sources and seasonal variations in groundwater level if they are very shallow.

Main Threats

Water Quality and Pollution

Because the water entering shallow wells is closer to the land surface there is a greater risk that it can become contaminated with microbes, pathogens and chemicals than can be harmful to health. Therefore the following measures should be taken:

Possible Threat	How to find out	What to do
Pollution entering the borehole or well	» Check for gaps or cracks around the opening of the well or borehole (both down the inside and the outside of the casing or well lining – if present) » Check with local residents about any history of flooding in the area. Floodwater can wash contaminants into the borehole, if it is unprotected.	» The well or borehole should be covered and sealed so that dirt, water, sand and other debris cannot fall into the well or borehole. » The well or borehole should have a concrete apron around its base to prevent dirty water seeping back into the hole. » Avoid drilling in flood-prone areas, or raise wellhead by building earthworks.
Pollution from nearby surface activities	» Identify an nearby potential polluting activities (see Checklist, below)	» Locate the well or borehole at least a minimum distance away from potentially polluting activities: ○ **Within 50 metres (80 metres if downhill) from:** latrines, open defecation, soakaways, septic tanks, graveyards, livestock pens/kraals, waste storage or dumping, livestock spaying/dipping, bathing or washing activities. ○ **Within 250 metres:** No Prescribed Trades or Premises (Annex A1), petrol filling stations, or fuel/oil/chemical storage tanks or depots. » If there is limited choice for siting a new well or borehole, or if an existing water source is being examined, then engage the potential polluter through a suitable forum (e.g. a Water User or Catchment Committee) to come up with a plan to improve the pollution-prevention being done at those risky premises. » If the Threat is a latrine or septic tank, get advice on alternatives (such as EcoSan urine diverting latrines). Paying for the installation of lower risk latrines may be cheaper than drilling a new borehole in a safer location.
Naturally high levels of arsenic or fluoride in the water	» Find out from a hydrogeologist or the local District Water Officer whether it is a high risk area. » If in doubt, get the water tested.	» If arsenic or fluoride is present then assess the relative health risks of using this source compared to others available – also take into account accessibility. A borehole that is close with slightly high fluoride levels may be better

Main Threats

Possible Threat	How to find out	What to do
	» Talk to the District Health officer about whether there are causes of fluorosis or arsenic poisoning in the local population.	than a surface water source several hours walk away. » Look at household treatment options (such as bone char filtration) to remove fluoride. » If levels in the water are above WHO guidelines then look for alternative water sources (rainwater harvesting, shallow wells, springs)
Persistent industrial or agricultural pollutants (such as heavy metals, organic compounds and some pesticides)	» Find out where the recharge zone is for the aquifer and identify any Prescribed Trades or Premises (Annex A1). » If there are threats nearby then get water quality samples tested for Prescribed Substances (Annex A2) and to make sure that the water meets the national rural water quality standards (Annex A3) or WHO guidelines.	» If there is evidence of industrial or agricultural pollution of the groundwater then alert the District Water Officer and/or NEMA. » If levels in the water are above WHO guidelines then look for alternative water sources (rainwater harvesting, shallow wells, springs)

Water Quantity and Yield

The yield of the shallow well/borehole will depend a lot on the geology in which it is sited. Shallow groundwater may be affected by nearby wetlands, lakes and rivers, and is likely to respond more quickly to rainfall events than deep groundwater. If yields are declining, the possible causes to investigate are:

Possible Cause	How to find out	What to do
Erratic rainfall	» Find local rainfall records, or install a rain gauge and take daily or weekly rainfall measurements.	» If there is a long term trend (due to natural cycles, climate change or changes to the local microclimate) then it may be necessary to develop other water sources to supplement this borehole.
Declining groundwater recharge	» Consult an experienced hydrogeologist to find out where the recharge zone is for the aquifer that you are using. » If that area is suffering from rapid land use change (urbanisation, deforestation, soil erosion) then the recharge of the groundwater supplying your borehole may be affected.	» Report the problem to your District Water Officer, Water Management Zone or Catchment Management Committee. » Get involved with catchment management planning that could improve land management and restore groundwater recharge. » Encourage contour ploughing, mulching and other agricultural practices that increase soil water retention and percolation into the underlying aquifer.
Over-pumping at your source	» Is the borehole or well being over-used? Keeping records of how much is being pumped (either volumes or number of hours for which the pump is being used per day).	» Reduce the amount of water being taken – if demand in the area is growing then look at developing new water sources (but see below)

Main Threats

Interference from another water source	» Another abstraction may be competing with yours for water. Motorised pumping (for irrigation, factory or public water supply) is the most likely to have an effect on other boreholes, such as yours. » However, when looking for potential causes consult an experienced hydrogeologist because the way that water flows through the ground may mean that it is not necessarily the nearest abstraction point that is causing the largest impact.	» 1. Take regular (preferably daily) water level measurements in the borehole and find out if sudden drops in level correspond to pumping activity elsewhere. » 2. If there is evidence of derogation then discuss the matter with the District Water Officer or local Water Management Zone office. » 3. Negotiation of the issue through a mediated forum, such as the local Water User Committee should be done to reach an equitable solution.

Checklist for designing protection for shallow wells and boreholes

- ☐ Concrete apron and drainage channel to prevent water entering well/borehole
- ☐ For hand pumps (shallow wells, boreholes) a fence should be constructed with a minimum distance of 5 steps (3m, or 10ft) around the apron and 1 step (60cm, or 3ft) along the drainage channel. Access should allow for disabled water users (e.g. those in wheelchairs) but not allow livestock to get in.
- ☐ For livestock watering, a separate trough should be provided outside the fenced off area (supplied by a pipe or channel from the handpump)
- ☐ Secure at least 50m x 100m land in the upstream/surrounding area of water point in order to conserve water shed under natural vegetation cover.
- ☐ The well or borehole should **not** be located:
  - ☐ In a wetland or an area prone to flooding
  - ☐ **Within 50 metres (80 metres if downhill) from:** latrines, open defecation, soakaways, septic tanks, graveyards, livestock pens/kraals, waste storage or dumping, livestock spaying/dipping, bathing or washing activities.
  - ☐ **Within 250 metres:** No Prescribed Trades or Premises (Annex A1), petrol filling stations, or fuel/oil/chemical storage tanks or depots.

Note: ANNEX C provides a more detailed methodology for estimating Groundwater Source Separation Distances from Threats

Figure 6: Fenced off handpump with overflow drainage channel to planted soakaway

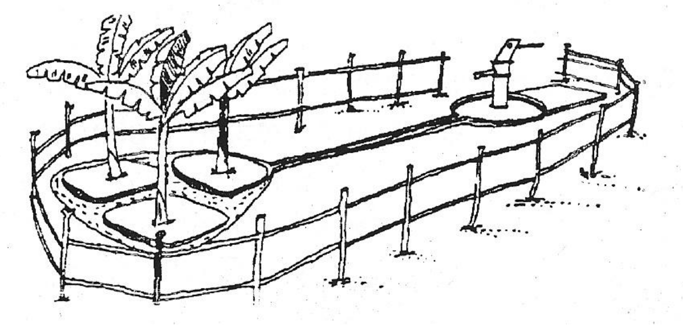


Illustration Source: DWD, 2007

4 Protecting Springs

Description

Springs occurs where a change in geology and topography brings groundwater to the surface. Springs can provide clean and reliable sources of water if well constructed and protected.

Water Quality and Pollution

The main threat to water quality in a spring is activities upslope from the spring head.

Possible Threat	How to find out	What to do
Pollution entering around the spring head/water collection area.	» Check for gaps or cracks around the spring headwall. » Check the ground upslope of the spring to see if there is the potential for sewage, waste or hazardous chemicals to seep into the ground.	» The spring should have a properly constructed water collection point that allows easy access to collect water without contaminating it. » 50 m area upslope should be purchased and fenced off to prevent contamination.
Pollution from nearby surface activities	» Identify any nearby potential polluting activities (see Checklist, below)	» Locate the spring collection point at least a minimum distance away from potentially polluting activities: o Within 80 metres downhill from: latrines, open defecation, soakaways, septic tanks, graveyards, livestock pens/kraals, waste storage or dumping, livestock spaying/dipping, bathing or washing activities. o Within 250 metres downhill from: Prescribed Trades or Premises (Annex A1), petrol filling stations, or fuel/oil/chemical storage tanks or depots. o Within 500 metres downhill from: another well or borehole. » If there is limited choice for siting a new spring point, or if an existing water source is being examined, then engage the potential polluter through a suitable forum (e.g. a Catchment Management Committee) to come up with a plan to improve the pollution-prevention being done at those risky premises. » If the Threat is latrine or septic tank, get advice on alternatives (such as EcoSan urine diverting latrines). Paying for the installation of lower risk latrines may be cheaper, or more accessible, than developing a new protected spring in a safer location.
Naturally high levels of arsenic or fluoride in the water	» Find out from a hydrogeologist or the local District Water Officer whether it is a high risk area. » If in doubt, get the water tested. » Talk to the District Health officer about whether there are causes of fluorosis or arsenic poisoning in the local population.	» If arsenic or fluoride is present then assess the relative health risks of using this source compared to other available – also take into account accessibility. A borehole that is close with slightly high fluoride levels may be better than a surface water source several hours walk away. » Look at household treatment options (such as bone char filtration) to remove hazardous chemicals.

Checklist for designing protection of springs

Possible Threat	How to find out	What to do
		» If levels in the water are above WHO guidelines then look for alternative water sources (rainwater harvesting, shallow wells, springs)
Persistent industrial or agricultural pollutants (such as heavy metals, organic compounds and some pesticides)	» Find out where the recharge zone is for the spring and identify any Prescribed Trades of Premises (Annex A1). » If there are then get water quality samples tested for Prescribed Substances (Annex A2) and to make sure that the water meets the national rural water quality standards (Annex A3).	» If there is evidence of industrial or agricultural pollution of the groundwater then alert the District Water Officer and/or NEMA. » If levels in the water are above WHO guidelines then look for alternative water sources (rainwater harvesting, shallow wells, other springs)

Water Quantity and Yield

The yield of the spring will depend on the geology, topography and the size of the micro-catchment from which the water is coming. Many springs may provide supplies for parts of the dry season but may naturally run dry towards the end, in which case other water sources will be needed to supplement it.

Possible Threat	How to find out	What to do
Erratic rainfall	Find local rainfall records, or install a rain gauge and take daily or weekly rainfall measurements.	If there is a long term trend (due to natural cycles, climate change or changes to the local microclimate) then it may be necessary to develop other water sources to supplement this spring.
Declining groundwater recharge	Consult an experienced hydrogeologist to find out where the recharge zone is for the aquifer that you are using. If that area is suffering from rapid land use change (urbanisation, deforestation, soil erosion) then the recharge of the groundwater supplying your spring may be affected.	Report the problem to your District Water Officer, Water Management Zone or Catchment Management Committee. Get involved with catchment management planning that could improve land management and restore groundwater recharge. Encourage contour ploughing, mulching and other agricultural practices that increase soil water retention and percolation into the underlying aquifer.
Interference from another water source	Springs are likely to be vulnerable to abstraction from wells or boreholes immediately uphill. Such abstractions are likely to intercept the water that	1. Agree bylaws that prevent new wells or boreholes being constructed within 500m upslope of an established spring source. 2. Take regular (preferably daily) flow measurements at the spring and find out if sudden drops in level correspond to pumping activity elsewhere. 3. If there is evidence of inference then discuss the matter with the District Water Officer or local Water Management Zone office. 3. Negotiation of the issue through a mediated forum, such as the local Catchment Management Committee should be done to reach an equitable solution.

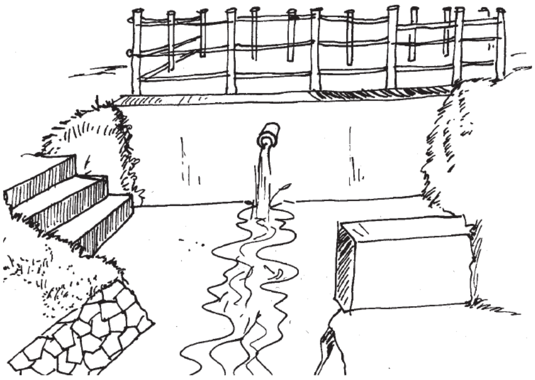
Checklist for designing protection of springs

- ☐ Concrete collection chamber and water collection points, apron and drainage channel to prevent water entering springhead.
- ☐ Around the springhead a fence should be constructed with a minimum distance of 54 to 180 steps (30 to 100 metres) above the spring. Access should be allowed for disabled water users (e.g. those in wheelchairs) but not allow livestock to get in.
- ☐ For livestock watering, a separate trough should be provided outside the fenced off area (supplied by a pipe or channel from the spring)

Checklist for designing protection of springs

- ☐ Secure at least 50m x 100m land in the upstream/surrounding area of water point in order to conserve water shed under natural vegetation cover.
- ☐ The spring collection point should **not** be located:
  - ☐ In a wetland or an area prone to flooding
  - ☐ **Within 80 metres downhill from:** latrines, open defecation, soakaways, septic tanks, graveyards, livestock pens/kraals, waste storage or dumping, livestock spaying/dipping, bathing or washing activities.
  - ☐ **Within 250 metres downhill from:** Prescribed Trades or Premises (Annex A1), petrol filling stations, or fuel/oil/chemical storage tanks or depots.
  - ☐ **Within 500 metres downhill from:** another well or borehole.

Figure 7: Protected Spring Point



5 Technical Support Annexes

ANNEX A: Ugandan Standards

Annex A1: Prescribed Trades and Premises (requiring a Waste Discharge Permit)[1]

▪ Airports ▪ Breweries ▪ Mines and processors ▪ Coffee factories ▪ Commercial fish farms ▪ Fish processing factories ▪ Fruit and vegetable processing factories	▪ Hospitals ▪ Leather tanning factories ▪ Meat processing factories Mineral extraction and processing ▪ Oil factories Plastic manufacturers ▪ Sewerage treatment plants	▪ Slaughtering Works (as may be identified by the Director) ▪ Soap factories ▪ Soft drink manufacturers ▪ Steel rolling mills ▪ Sugar factories ▪ Textile factories

Annex A2: Prescribed Substances (requiring a Waste Discharge Permit)[2]

▪ Aldrin ▪ Atrazine ▪ Arsenic ▪ Azinphos-methyl ▪ Boron ▪ Cadmium and its compounds ▪ Carbon tetrachloride ▪ Chloroform ▪ Chromium ▪ Cyanide ▪ Cyfluthrin ▪ DDT ▪ 1.2-Dichloroethane ▪ Dichlorvos ▪ Dioxins ▪ Endosulfan ▪ Endrin ▪ Fenitrothion	▪ FethionIsodrin ▪ Flucofuran ▪ Hexachlorobenzene (HCB) ▪ Hexachlorobutadiene (HCBD) ▪ Hexachlorocyclohexane (Lindane and related compounds) ▪ Iron ▪ Lead ▪ Malathion ▪ Mercury and its compounds ▪ Nickel ▪ Parathion ▪ Parathion methyl ▪ PCD's ▪ Pentachlorophenol (PCP) and its compounds ▪ Perchloroethylene ▪ Permethrin	▪ Polychlorinated biphenyls ▪ Simaxine ▪ Copper ▪ Tetracliloroethylene ▪ Tributyltin compounds ▪ Trichlorobenzene ▪ Trichloroethane ▪ Trichloroethylene ▪ Trifluralin ▪ Triphenyltin compounds ▪ Vanadium ▪ Zinc ▪ Sulcofuron ▪ Azinphos-ethyl ▪ Substances prescribed by other law in force

Annex A3: Rural Drinking Water Standards[3]

Parameter	Guideline Values/Acceptable Values	Maximum Acceptable Concentration (MAC)
Hardness (CaCo3)	600 mg/l	800 mg/l
Iron total (Fe)	1 mg/l	2 mg/l
Manganese (Mn)	1 mg/l	2 mg/l
Chloride (Cl)	250 mg/l	500 mg/l
Fluoride (Fe)	2 mg/l	4 mg/l
Sulphate	250 mg/l	500 mg/l
Nitrate (NO_3)	20 mg/l	50 mg/l
Nitrite (NO2)	0 mg/l	3 mg/l
TDS – Total Dissolved Solids	1000 mg/l	1500 mg/l
Turbidity	10 NTU	30 NTU
pH	5.5 – 8.5	5.0 – 9.5
E. Coli	0 / 100 ml	50 / 100 ml

[1] Third Schedule, The Water (Waste Discharge) Regulations, No. 32/1998.

[2] Second Schedule, The Water (Waste Discharge) Regulations, No. 32/1998.

[3] MWE (2007) *DISTRICT IMPLEMENTATION MANUAL*, Version 1, 31 March 2007, Annex 9.2

ANNEX B: Further information:

Title	Publisher	Availability
District Implementation Manual	Ministry of Water & Environment – Directorate of Water Development, 2007 (revised version available mid-2012)	www.mwe.ug http://www.washuganda.net/sector-documents/water-supply
Springs Construction Manual (Water and Sanitation Sector District Implementation Manual Annex 6.1)	WaterAid Uganda and Directorate of Water Development *March 2007*	http://www.washuganda.net/sector-documents/water-supply
Shallow Wells Technology Manual (Water and Sanitation Sector District Implementation Manual Annex 6.2)	Ministry of Water & Environment – Directorate of Water Development, *March 2007*	http://www.washuganda.net/sector-documents/water-supply
A Community Resource Book For The Water And Sanitation Sector 2007	Ministry of Water & Environment – Directorate of Water Development, *February 2007*	http://www.washuganda.net/sector-documents/water-supply

ANNEX C: Groundwater Source Separation Distances from Threats

Geology/Vadose Zone Matrix Methodology

The following has been adapted from "Guidelines for separation distances based on virus transport between on-site domestic wastewater systems and wells"[4] and it is recommended that those wanting to understand the scientific basis refer to this document.

Information Needed:

- **Distance between the borehole/well and the nearest sewage discharge to ground** (e.g. latrine or where open defecation is commonly practised. Find out by visiting the area and conducting a survey, including distance measurements - Global Positioning System (GPS) tools may make this easier than older tape measure methods, but reliability of the GPS accuracy needs to be tested in the field.

- **Geology type of the aquifer** – information available from drilling log for the borehole, and geology maps available from DWRM.

- **Vadose Zone type and thickness (metres)** – this is the distance between the ground surface and the water table. This can be found from borehole logs or water level measurements of wells in the area.

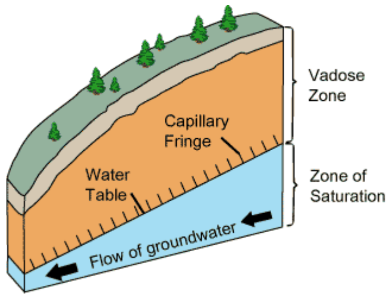


Figure 8: Illustration of the Vadose Zone
(US Geological Survey)

Distance Separation Estimation[5]

Hydrological Settings		Vadose Zone thickness (metres)				
Aquifer	**Vadose Zone**	2m	5m	10m	20m	30m
Gravel	Gravel					
	Sand (alluvial)					
	Silt					
Sand (alluvial)	Gravel					
	Sand (alluvial)					
	Silt					
	Ash					
	Pumice sand					
Karstic or Fractured Rocks	Gravel					
	Sand (alluvial)					
	Silt					
	Ash					
	Pumice san					

Key

Possible within 50 m	
Possible within 100 m	
Possible within 300 m	

---

[4] Moore, C., Nokes, C., Loe, B., Close, M., Pang, L., Smith, V., Osbaldiston, S. (2010) "Guidelines for separation distances based on virus transport between on-site domestic wastewater systems and wells" Environment Science and Research Ltd. New Zealand. http://www.envirolink.govt.nz/PageFiles/31/Guidelines_for_separation_distances_based_on_virus_transport_.pdf

[5] Table 8.2 from Moore *et al* (2010)

Requires 300 m or more separation	

Limitations

If the geology type does not fit with the categories given in the table above, consult a hydrogeologist for more detailed advice.

The distances are broad estimates and they are based on the intentional discharge of treated sewage effluent into the ground from a septic tank through a conventional trench in soil 1 metre thick.

Where soils are thinner or sewage discharges are untreated then the separation distances should be maximised, either by fencing off the area around the borehole, or working with the surrounding community to move or improve sanitation and livestock activities further away.