RWSSHP Resource Manual # 3b

Spring Development

Construction Manual

Introduction

This manual is Part B of Manual#3 – Hand Dug Wells and Spring Development Construction, which in turn is part of a series of technical manuals prepared by the Ministry of Water Resources for the implementation of the Rural Water, Sanitation & Hygiene Program (RWSSHP). The complete series is as follows:

Manual #1 – Contract Management and Supervision Manual
Manual #2 – Community Operation and Maintenance Manual
Manual #3 – Hand Dug Well and Spring Development Construction Manual
Booklet #4 – Training Notes

This Manual is targeted at the Contractors, otherwise known as Artisans and Technicians. These are the people who will be contracted, on behalf of Communities, to construct water points (Hand Dug Wells and Spring Developments) in those communities, and train WaSHComs in Operation, Maintenance and Management.

It is meant to be a reference Manual that Contractors can use and draw on during the construction process. It covers the main aspects of planning, design and technology options as well as construction processes for Hand Dug Wells and Spring Developments. It also gives some guidelines for contract management, including financial management, reporting and administration. Whilst every effort has been made to cover the important aspects of HDW and SD construction, it should be noted that this manual is by no means comprehensive, and Contractors are encouraged to refer to other similar documents as well.

This manual was developed jointly by Alemeshet Tsegaye and Paul Tyndale-Biscoe. It is intended for use within the Program only.

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Spring Development

Spring Development is divided into the following sections:

- Preparation
- Construction
- Completion

You should read through and familiarize yourself with all the sections below and refer to the Technical Detail Sheets as necessary.

Preparation

Overview

Developing spring water source

A spring is a place where ground water emerges naturally from the earth's surface, usually along hillsides, at the base of slopes, or in low areas. The following should be considered when developing or improving a spring.

Location

It is easy for springs to become contaminated if they are located downhill from a source of contamination. For this reason, all sewage systems, barnyards, livestock pastures, fuel tanks, and other sources of pollution must be located at least 30 m away from springs. Depending on the soils, geology, and slope of the land, an even greater distance may be needed. Also avoid extremely wet areas when locating a new spring, because saturated soil can't filter out bacteria.

Construction

Springs should be constructed in a way that protects against surface water contamination and prevents rodents and insects from entering. If the ground around the spring is sloped so that rain water can pool around or enter the spring, a diversion ditch should be constructed so that surface water runoff is kept away from the spring.

Disinfection

All newly constructed or repaired/rehabilitated springs should be disinfected, because during construction, the handling of construction materials can contaminate the spring water. See ***TDS 29 – Disinfection & Cleaning (Springs)*** for details of how to disinfect a spring.

Testing

The spring water should be tested for bacteria several days after the chlorine odor disappears. Springs that are newly constructed or have persistent problems with bacteria should also have a complete physical-chemical and bacteriological analysis.

Site Selection

Springs occur where the natural flow of groundwater emerges at the earth's surface, usually at hillsides or low-lying areas. The water that flows from springs is usually safe from contaminants, due to the fact that groundwater is naturally filtered as it flows through the earth. Therefore, spring water is generally safe for human consumption, requiring little to no treatment. This makes springs relatively inexpensive yet safe as water sources.

The quantity of water from a spring can be substantially increased by digging out the area around the spring down to an impervious layer, to remove silt, decomposed rock and other rock fragments, and mineral matter sometimes deposited by the emerging groundwater. In doing this particular care should be taken, especially in fissured limestone areas, to avoid disturbing underground formations to the extent that the spring is deflected in another direction or into other fissures.

Types of Springs

There are three main types of springs that occur in nature:

Artesian springs are confined by two layers of impervious material. The water from Artesian springs is likely to have been sufficiently filtered naturally through the ground, and typically has little to no chance of being contaminated with surface water that may infiltrate into the spring.

Gravity springs rest on a single impervious layer, and can be thought of as an underground river. The unconfined aquifer will add many "tributaries" or input from local water and rain that seeps into the ground. Any contaminated water that flows into the ground will only have the short flow distance before reaching the spring, giving the input water much less time to be filtered naturally.

Seepage springs occur where water simply seeps out of sand, gravel, and other porous material. Opposed to artesian and gravity springs where flow is directed to one point, seepage springs result from a somewhat unconfined aquifer, where an underground reservoir simply leaches out in different places. This gives seepage springs the highest susceptibility to contamination. Therefore seepage springs need periodic disinfection.

See ***TDS 24 – Spring Site Selection*** for issues around selection of a suitable spring source for a Community water supply.

Site Preparation

The site needs to be properly prepared before excavation and construction work can begin. If you prepare the site well and have a good layout for tools, materials and other construction equipment, the process of developing the spring will go smoothly and easily. The main steps required for site preparation are as follows:

Clearing the Site

Fencing the Site (See ***TDS 25 – Spring Site Preparation***)
Plan the Site Layout
Casting a mixing slab (See ***TDS 5 – Concrete and Mortar***)
Constructing materials and equipment storage facilities

Once you have completed these steps, you are ready to begin excavation and construction.

Equipment & Materials

The tools, equipment and materials needed to construct a spring development are similar to those needed to construct a Hand Dug Well, but without the need for specialist equipment for shaft excavation and de-watering. See the sections on Equipment and Materials in the Hand Dug Wells Construction Manual for notes on relevant tools, equipment and materials.

A full list of tools and equipment, including relevant storage, handling and maintenance notes is contained in ***TDS 6 – Tools and Equipment***

Details on quantities and types of materials needed for spring developments, as well as notes on handling and storage of materials is contained in ***TDS 7 - Materials***

Information on mixing concrete is contained in ***TDS 5 – Concrete & Mortar.***

Safety

SAFETY IS PARAMOUNT. Although not as dangerous as a hand dug well site, any construction site is still dangerous and care should be taken by all workers entering the site.

Safety is stressed throughout this manual, and specific safety considerations are included in each section as appropriate. The following is a list of general safety considerations that you should always be monitoring and aware of:

- **Tools and equipment** should be checked at the beginning and end of every day. Those not in use should be returned to their storage locations.
- **Children, animals** and onlookers should be kept away from the work site at all times. Only those **actively engaged in construction** should be allowed anywhere near the work site.
- Proper first aid and safety equipment must be available on site at all times.

Be alert to possible danger, and follow the safety rules. If you ensure that everyone working on the site does this then you should have no accidents.

See ***TDS 8 – Safety Equipment*** for full details.

Construction

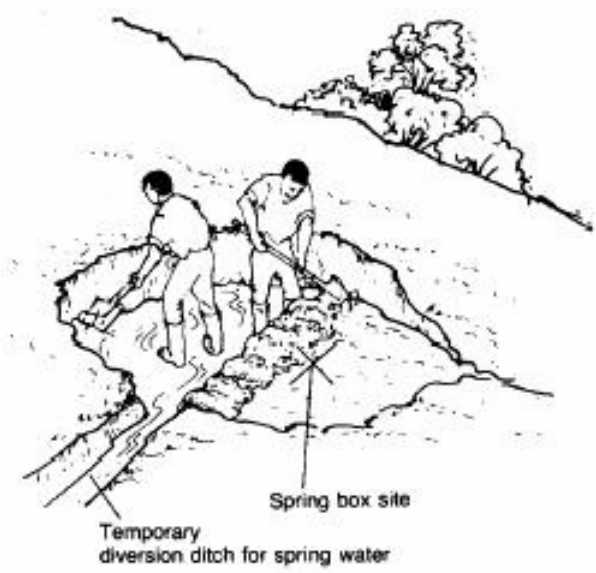
Spring Development (the Spring 'Eye')

Work will be required on the spring itself before the construction of the spring box. Developing and excavating the spring eye will determine what type of spring it is and so what type of spring box is required.

The first step is to dig far enough into the spring to locate the eye, or the point where the water is coming from. You should also dig down until you reach an impermeable layer of clay or rock. This is important as it means the water will all be directed into your spring box, and the spring box will have a sold surface to sit on.

If digging becomes very wet and messy, it may be necessary to divert the water away from where you are digging. This can be done by building a small dam, digging a temporary ditch, or using one of the pipes that is to be used in the completed spring box (see Figure).

If digging on a hillside, be sure to dig slightly upstream of the visible spring outflow so that the spring box can be set into the hill.



Excavating Spring Site

Spring Box Design and Construction

A spring box is a structure made of masonry or concrete that exposes and encloses the spring 'eye' or point(s) from which the water flows. Spring boxes should have the following features:

- **Well Founded**: The spring box should be founded on solid or impervious material. There should be a good seal between the walls of the spring box and the foundation material to prevent seepage under the walls.
- **Covered**: A reinforced concrete cover with a manhole covers the spring box.
- **Capture the Whole Spring**: If there are several spring eyes spread over a wide area, then there will be a collection and channeling system to direct all the water into the spring box.
- **Incorporate Outlets**: There should be an outlet pipe, a scouring or drainage pipe and an overflow pipe incorporated into the spring box. The level of the overflow pipe must be below the spring eye to prevent back pressure in the spring.

The type of spring box used will depend largely on the type of spring being developed. See ***TDS 26 – Spring Box Design*** for details of different types of spring boxes.

Once the type of spring box has been chosen, it needs to be constructed. Generally spring boxes are constructed in-situ (ie in the location where it will be used), however sometimes they are constructed in another location and transported to site when they are ready.

Note: It is recommended that spring boxes be constructed in-situ.

See ***TDS 27 – Spring Box Construction*** for details of how to construct spring boxes.

Storage Reservoir Design and Construction

The place where water is collected (the taps) is generally located collected away from the spring so that there is no danger of people or animals contaminating it. The collection point normally consists of an overnight collection reservoir (if the yield from the spring is less than that required to meet peak demand) and/or a public fountain (tapstand).

The collection chamber is generally a masonry or concrete structure, properly founded, and of a size as specified by an engineer such that daily peak demand requirements can be met. See ***TDS 28 – Water Collection Point Construction*** for details.

Collection faucets or taps can either be installed directly into the tank, or at tap stand(s) in suitable locations connected by pipes to the tank. Plinths underneath taps should be constructed onto which water collection receptacles can be placed for easy lifting when full. See ***TDS 28 – Water Collection Point Construction*** for details.

A concrete drainage apron, with a raised lip, of at least 4.5 metres square or 4.5 metres in diameter should surround the public fountains. The apron should slope 2 – 5% away from the taps.

There should be a drainage ditch channel which takes water away from the apron to a suitable soakage pit, vegetable garden or animal watering trough. See ***TDS 20 – Apron & Drainage*** for details.

The public fountains should be fenced to prevent unauthorized access by children or animals

Completion

Disinfection and Cleaning

Springs are often contaminated with bacteria during construction or maintenance. All new and repaired water systems should be disinfected using *shock chlorination*. If bacterial contamination occurs on a regular basis because of surface sources above the spring, *continuous chlorination* may be necessary (although this is not recommended).

As a general rule, spring collection boxes and reservoirs should be cleaned and disinfected:

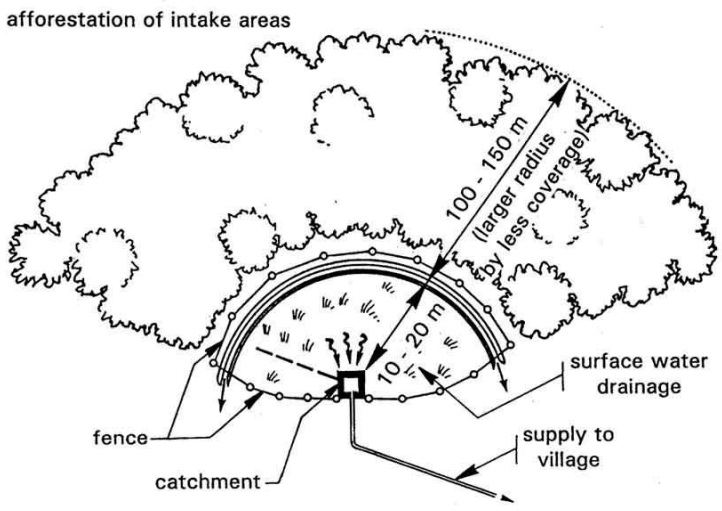
- Prior to use
- Anytime the spring or storage box has been emptied or opened
- When coliform test results are unsatisfactory
- Annually.

Details on disinfecting with chlorine (both shock and continuous chlorination) and cleaning are contained in ***TDS 29 – Disinfection and Cleaning (Springs)***.

Fencing and Spring Protection

The spring should be fenced to prevent unauthorized access by persons or animals.

A drainage ditch above the spring should be constructed to divert surface flood waters from entering the spring box



Any potential sources of contamination upstream of the spring should be identified and addressed.

The essential techniques for protecting a spring are as follows:

- Preventing overland flow from contaminating the source by digging a drainage ditch above the spring to divert surface runoff;
- Constructing a simple collecting structure or reservoir around the spring to increase its yield during the day; and
- Providing an outlet pipe to a discharge point or cattle trough to prevent contamination or destruction of the reservoir.

Operation and Maintenance Training

As the Contractor, you will be responsible for providing training to the Community WaSH Committees in Operation and Maintenance. You need to set aside adequate time for this to ensure that the WaSH Committees fully understand how to use their Spring Development properly, and the importance of maintenance.

If looked after properly, there is not much that can go wrong with a Spring Development, however periodic cleaning and/or de-silting may be necessary, as well as repairing any cracks that may form in concrete. Taps will need periodic maintenance such as replacing washers, and general cleaning around the tapstand and reservoir and repairs to the fence and drainage will also be necessary from time to time.

A separate Manual – **Manual#2 -Community Operation and Maintenance** – has been prepared which details Operation and Maintenance procedures that Communities should follow. This manual can assist you with Operation & Maintenance Training for the WaSH Committees.

Handover of Facilities

Once all construction and completion activities have been carried out to the satisfaction of the Community and the Woreda WaSH Management Team, you can officially hand over the facilities to the Community.