About WEDC

The Water, Engineering and Development Centre is one of the world's leading education and research institutes for developing knowledge and capacity in water and sanitation for sustainable development and emergency relief.

We are committed to the provision of effective, evidence-based and appropriate solutions for the improvement of basic infrastructure and essential services for people living in low- and middle-income countries. With over 45 years of experience, we offer expert advice and quality learning opportunities for sector professionals.

Founded in 1971, WEDC is based in the School of Civil and Building Engineering at Loughborough University, one of the top UK universities. Being a part of a leading university gives us a recognised platform of independence and quality.

What makes us stand out from the crowd is our outreach to practitioners. We use our knowledge base and our applied research work to develop the capacity of individuals and organizations throughout the world, promoting the integration of social, technical, economic, institutional and environmental activities as foundations for sustainable development.

Visit our website to find out more about our postgraduate and professional development programmes (MSc, Diplomas and postgraduate certificates available at the University or by distance learning); our research; our advisory services; our international conferences; and our extensive range of information resources which are free to download from our knowledge base.

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WEDC Developing knowledge and capacity in water and sanitation

GUIDE 15

Water source selection

Water is essential for life, but for many people, the quantity of water available may be minimal, and the water may be of poor quality. This guide outlines some of the issues which need to be considered when planning improvements to supplies, to ensure that the most appropriate sources of water are selected.

Contents

The three types of water source considered in this guide are rainwater, surface water and groundwater.

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Designed and produced by WEDC Publications

Published by WEDC, Loughborough University

ISBN: 978 1 911252 07 8

For a comprehensive list of all published guides, please visit:
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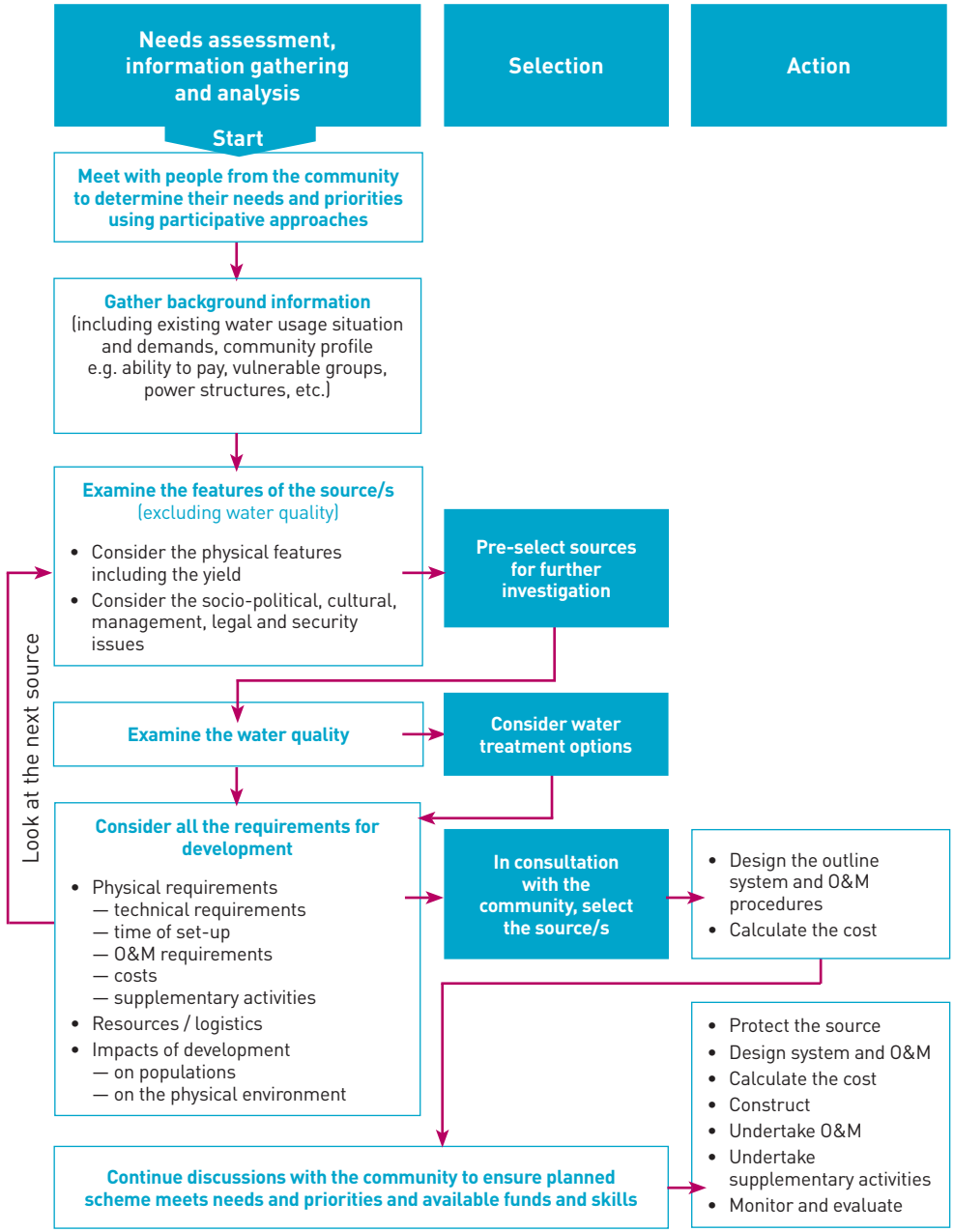
Steps for selecting alternative water supplies



Rainwater

Collecting rainwater from either an existing roof structure or a ground catchment area can provide a useful supplementary source of water even if it is not used as the main supply. Storage tanks are usually required to make the best use of rainwater.

Figure 1. Rainwater catchment

Surface water

When rain falls to the ground it becomes *surface water*, where it may move across the ground in the form of streams or rivers, or remain in one place in the form of ponds or lakes. Surface water is easily polluted and can be affected by wide seasonal variations in *turbidity* ('muddiness') and flow. Variations in turbidity present a challenge for the effective operation of treatment processes, while variations in flow affect the location and design of abstraction structures. Surface water, however, is often the easiest to access.

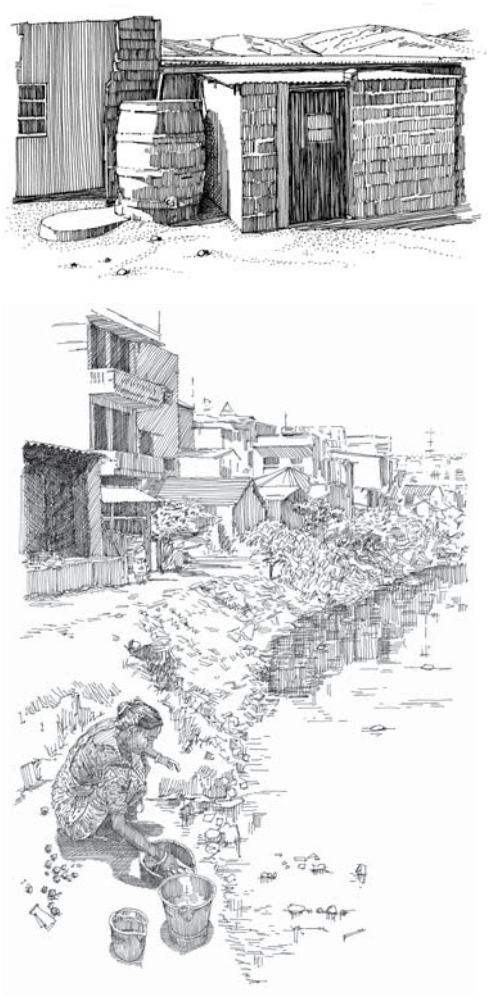


Figure 2. Surface water

Groundwater

Some surface water sinks into the ground and becomes *groundwater*. Here it can remain for long periods in *aquifers* – spaces underground which can hold water because the surrounding earth and rock is impervious (does not let water through).

Groundwater may be obtained in several ways:

Water from mountain springs can often be transmitted to areas of demand by gravity, limiting the operation and maintenance requirements of a supply system.

Shallow wells can also provide a supply system with minimal operation and maintenance requirements – particularly if they are well-constructed, protected, and fitted with a handpump. For larger supplies, diesel or petrol pumps may be used in place of handpumps. Shallow wells can often be constructed using local techniques and labour.

Shallow or deep boreholes usually require drilling equipment and an experienced drilling team, but they can provide high-yield supplies of good-quality water. Groundwater, however, may be affected by high levels of chemicals, such as fluoride or chloride.

Locating groundwater can be difficult. The presence of existing wells with good, stable yields, other positive hydrological features, or information from satellite images can highlight groundwater potential but following this, extensive field-trials are usually required to determine acceptable borehole locations.

Figure 3. Water from a mountain spring

Figure 4. Drawing water from a well

…m requires careful consideration of a range of factors

…ources in use are the most appropriate and only require minor improvement.
…ources may have to be developed.

…meet the present demand?

…uture?
…he future?

…erations
…ting a water
…village-level
…ply scheme

Technical requirements for development and for operation and maintenance

- Have the users been involved in the planning and design of the system?
- Details for:
  — protection — abstraction — treatment
  — transmission — storage — distribution
  — subsidiary requirements?
- Are the resources (both human, equipment and material) available?
- Are the techniques already used locally?
  Who will be involved in the construction and operation and maintenance of the system (women, men and / or children)?
- Is the required training available?
- Can the system be constructed locally, or will outside support be required for construction and for operation and maintenance over the long term?
- Will the supply be accessible for all members of the community, especially for the main users of water and those who may have accessibility problems such as the aged or disabled members of the community?

Legal and management requirements

- Who owns the land?
- What are the legal requirements to obtain permission to abstract?
- What are the management requirements for the system?
- Who will manage it?
- Will they require additional training and support?

Water quality

- What is the existing, seasonal and predicted future water quality?
- How easily can the source be protected against pollution?
- What is the required quality?
- What treatment is required and is it feasible in the village context?

Selecting a water source for a community supply syste

The illustration below highlights some of these. It may be that the existing sc
In other cases, a new source or sc

Socio-political and cultural considerations

- Has a thorough assessment been undertaken of the needs and wishes of the community, involving all groups (women, men and children and members of any distinct social groups, particularly those who are most vulnerable due to their gender, caste or class?)
- In the village, who does what, where and when?
- Who controls, and who owns resources?
- What are the power structures within the village, and how will they impact on the use and benefits to be gained from the development of the source?
- Are there barriers to the involvement of any groups in the assessment, design, construction, operation and maintenance, and evalulation of any system?
- Is the planned system culturally acceptable to all groups?

Yield versus demand

- Does it have an acceptable yield to
- Does the yield change seasonally?
- Is the yield expected to vary in the f
- Is the demand expected to vary in tl

Conside when selec source for a water supp

Economic considerations

- What will be the financial cost of the system (both capital, and operation and maintenance)?
- Who will pay (individuals or organizations within the community or outside organizations)?
- How much are they willing to pay?
- Who will, potentially, benefit economically from the new system?
- Who will, potentially, lose economically from the new system?

Impacts of development on:

- The health of women, men and children?
- The economic status of women, men and children?
- Time available to women, men and children?
- The environment, e.g. on the aquifer or on vegetation and erosion?
- Domestic and wild animals?

Socio-political and cultural considerations

Socio-political and cultural considerations are as important, if not more so, than the technical requirements for development. If the water supply is not culturally appropriate, and causes security difficulties or restricts access for certain groups such as women or disabled people, the benefits of the new system will be limited.

Women and water

Communities may use a single source or several sources of water for different needs such as drinking, washing clothes and watering crops. It is often the women and children who are most involved in water collection and its use. They are likely to have the most knowledge about existing sources, and are the people most likely to benefit if new supplies are developed. They are also the most likely to suffer if a new water supply system is not appropriate to the needs

Figure 5. Community meeting

Figure 6. Collecting water

of a community. It is essential, therefore, that women and children, as well as men, should be involved in every stage of a water-supply project.

Participative approaches should be used when selecting water sources and designing village-level supply systems. If some sections of the community are not involved and their views are not taken into account, the water supply system is likely to be under-used and may easily fall into disrepair. People may revert to their old water sources which may be more polluted.

Water committees

Water committees are set up in many areas to manage water supply systems. Care must be taken to ensure that all

groups in the community are represented and can make their concerns and needs heard and understood. It is often difficult to achieve this. Women, for example, may form part of a water committee but they still may not have a voice within it because of cultural or social conditions which prevent them from speaking in public. Innovative approaches are required to ensure that representatives of as many groups as possible can participate equally.

Operation and maintenance

Care must be taken when identifying personnel both to undertake training, and to be responsible for operation and maintenance.

It is well documented that women often make the most conscientious maintenance workers but are often expected to undertake the task free of charge in situations where men would normally be paid. Care must be taken, therefore, to ensure that both women and men are consulted on the matter, that they are willing to undertake the task, and that they are compensated in a way which is fair and appropriate.

Yield versus demand

The yield must be adequate. If a more convenient supply is developed, then consideration must be given to the potential increase in demand and to the possible migration of outsiders into the community, particularly in areas where water is scarce.

Water quality

All water is susceptible to contamination. It may accumulate contaminants from the air, the ground, or from rocks. Some of these contaminants, such as low levels of certain minerals or compounds, are not harmful to health, whereas others, such as pathogens, may be.

The water quality must also be acceptable and treatment methods suited to the community concerned. What local treatment methods, if any, are already being used in the area? Can they be used in the new system? The benefits of using improved sources of water will be increased if the community practises good sanitation and hygiene. Will their current behaviour pollute the water source or reduce the benefits of an improved supply? Would additional resources be required to help reduce these risks? Some water-quality problems such as high fluoride levels are very hard to treat and have serious health implications, whereas others, such as turbidity, are usually easier to deal with.

Technical requirements

The development of the source must be technically feasible, and the operation and maintenance requirements for the source abstraction and supply system must be appropriate to the resources available. If the supply system cannot be operated and maintained either by the villagers themselves or the organizations or institutions within the area, then the systems are likely to be misused or fall into disrepair.

Economic considerations

Care must be taken to ensure that funds are available for both the construction and the operation and maintenance of the system over the longer term. Who will pay, how will they pay, and how much will they pay? Who will manage and maintain the system, and who will collect the funds? From whom will the resources be obtained and how will they be secured?

Legal and management requirements

Current ownership of the land and the legal requirements of obtaining permission to abstract are also factors to consider when selecting a source. Sources on private land may cause access problems for certain groups which may not be apparent at the outset. The consequences of siting decisions must be considered carefully.

Impacts of development

The use of a particular water source will have impacts on the people who use it, on animals, and on the environment. The impacts on people may be positive or negative, and may be related, amongst other things, to health, economic status or time. If a surface water source is used, there may be impacts on remote users and, likewise, if wastewater enters surface water sources, there may be similar impacts. Impacts on the environment may include loss of vegetation, erosion, or the draining of an aquifer.

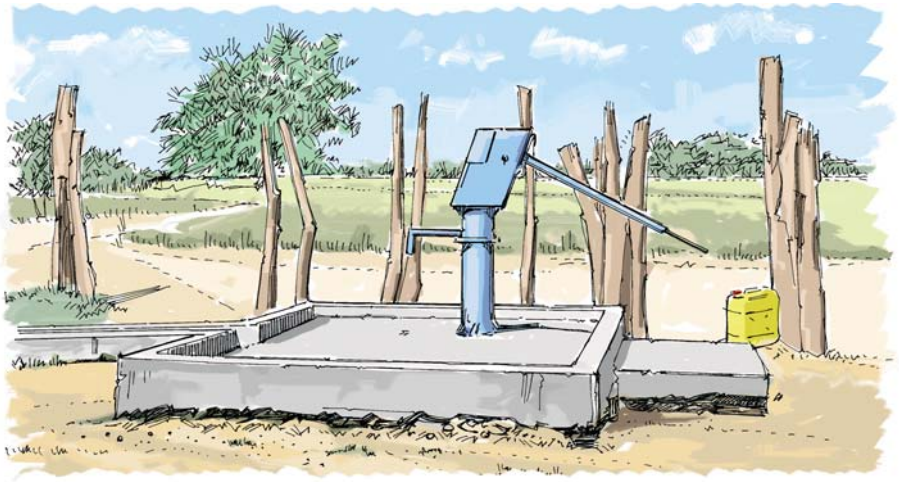


Figure 7. Problems of erosion and poor maintenance of the protective fence around a handpump can lead to contamination of the water source