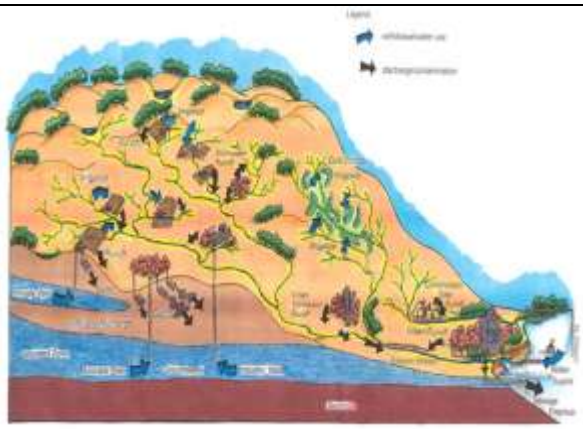

SUPPORT ORGANIZATIONS BASED OPERATION AND MAINTENANCE MANAGEMENT MANUAL HAS 8 PARTS

PART - A	INTRODUCTION TO O&M MANAGEMENT
PART- B	DESCRIPTION OF WATER SOURCES AND TECHNOLGIES
PART - C	INSTITUTIONAL SUPPORT REQUIREMENTS FOR OPERATION AND MAINTENANCE OF RWS
PART - D	RURAL WATER SUPPLY SCHEMES MANAGEMENT
PART - E	RURAL WATER SUPPLY SPARE PARTS MANAGEMENT
PART - F	M&E AND REPORTING SYSTEM
PART - G	**WATER SUPPLY SAFETY PLAN**
PART - H	PREPARATION OF ACTION PLAN

Support Organizations Based Operation and Maintenance Management Manual for Rural Point Water Supply Schemes: Part – G: Water Supply Safety Plan

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7 INTRODUCTION TO WATER SUPPLY SAFETY PLAN

7.1 Project Background

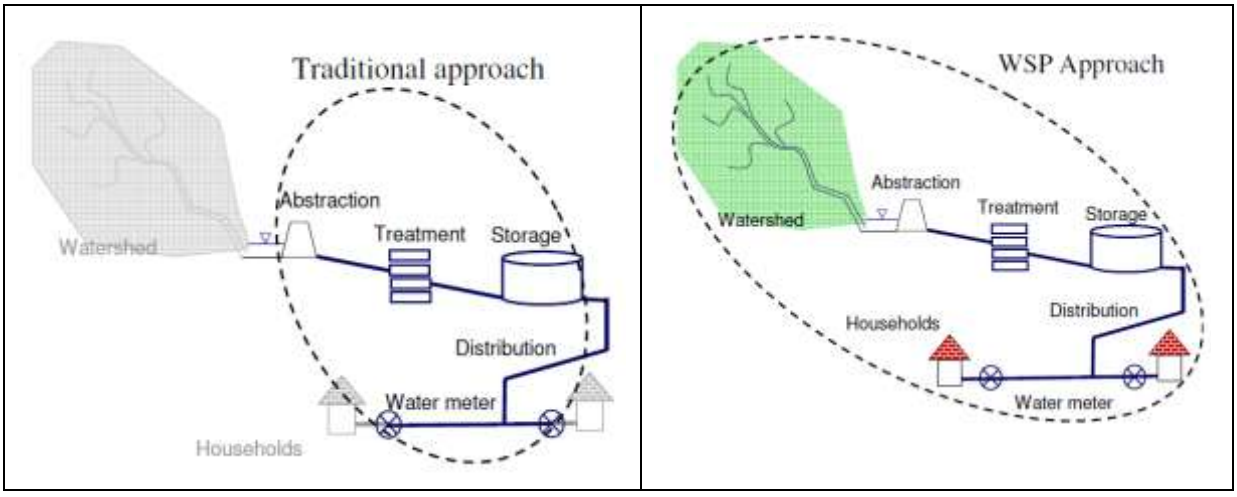
Although the application of Water Safety Plan requires to apply, it is need prior to include the climate change issues in water resources policy and implementation of sector strategy, however this manual developed to create awareness among various stakeholder involved in the implementation of WSP as one part of the Operation and Maintenance Management of rural water supply schemes.

Many challenges face in terms of providing water that meets the minimum standards for acceptable drinking water. These challenges are a result of:

- Heavy rainfall eroded the soil in the catchment area and improper farming practices,
- Temporal and time variation of rainfall causes the deficiency of water quantity to satisfy the demand of the community.
- Deforestation of trees to have more farm land as a result of population pressure,
- Application of fertilizer in the farmlands that could be washed and percolated to deep and contaminate the ground water.
- Poor sanitation – Poor access to sanitation may result in the contamination of the water source and may also lead to the potential cross contamination of spring and HDW
- Animal dung around water sources affect the quality of water

This guideline describes what Water Safety Plans are, why they are used, and how they can be developed and implemented. It demonstrates how they contribute to ensuring that consumers, suppliers and regulators can have confidence in the quality and quantity of water supplies. It is intended for those who have responsibility for the quality as well as the quantity of water supplies and are involved in developing, implementing or reviewing Water Safety Plans.

Figure 7-1: Traditional and WSP Approaches



Traditionally, the water utility companies have only focused from the point of abstraction to the water meter.

The WSP approach includes an evaluation of the water supply system from the water source to the point of consumption. First we concentrate on the management of the surface water and/or ground water source; second, we optimize the operations to eliminate and deactivate the hazards that affect water quality and quality. Finally, we work to prevent the recontamination and deficiency of the treated water during distribution, storage, and handling at the household level.

7.2 What is a Water Safety Plan?

A **Water Safety Plan** (WSP) is the most effective way of ensuring that a water supply is safe and reliable for human consumption and that it meets the health and demand based standards and other regulatory requirements. It is based on a comprehensive **risk assessment** and **risk management** approach to all the steps in a **water supply chain** from **catchment** to **consumer (see more on water safety plan).**

A water safety plan (WSP) is a methodology to improve the operations and management of a water supply system. The WSP approach emphasizes preventive risk management. It requires that risks to water supply safety are identified, prioritized and managed to protect drinking-water quality and quantity before problems occur. This approach draws on the methodology of sanitary inspection (see example on page 21), which offers quick results and clearly identifies action points for improvements. Water safety planning also requires regular monitoring of control measures and periodic confirmation of water quality and quantity (verification/compliance monitoring). The WSP itself documents the process and practice of providing safe and relaible water at the community level. It is vital to remember that the WSP document in itself is not the end; rather, it is a beginning. Dedicated implementation of the WSP is key. The aim of employing a WSP approach is to consistently ensure the safety and acceptability of a drinking-water supply in a practical manner.

7.3 Purpose of WSP

Water Safety Plans aim to:

- seek to prevent contamination of water from the source to the point of consumption;
- to treat the water to reduce or remove contamination that could be present to the extent necessary to meet the water quality targets;
- To prevent re-contamination during storage, distribution and handling of drinking-water.
- Give consumers greater involvement and control over maintaining water quality.
- To ensure the reliability of water supply to satisfy the demand requirement of the consumers.

Water Safety Plans can be used for new or existing water supply schemes, both for piped urban utility supplies and rural or peri-urban community supplies.

7.4 Benefits of using the Water Safety Plan

Water Safety Plans (WSPs) implies that actions are required at all stages in the process of producing and distributing water in order to protect water quality and to ensure the water quantity. This includes source protection, treatment (when applied) through several different stages, prevention of contamination during distribution (piped or non-piped) and maintenance within households.

The process provides consistency with which safe water is supplied and provides contingency plans to respond to system failures or unforeseeable hazardous events. Water safety plans can be developed generically for small supplies rather than for individual supplies.

A Water Safety Plan includes three key components (WHO[2]):

- ***System assessment*** – determines whether the water supply chain (up to the point of consumption) as a whole can deliver water of a quality and quantity that meets health- and demand requirement based targets.
- Identifying ***control measures*** in a water supply system that will collectively control identified risks and ensure that health based targets are met. For each control measure identified, an appropriate means of ***operational monitoring*** should be defined that will ensure that any deviation from the required performance is rapidly detected in a timely manner.
- ***Management*** plans describing actions taken during normal operation or incident conditions and documenting the system assessment (including upgrade and improvement), monitoring and communication plans and supporting programmes.

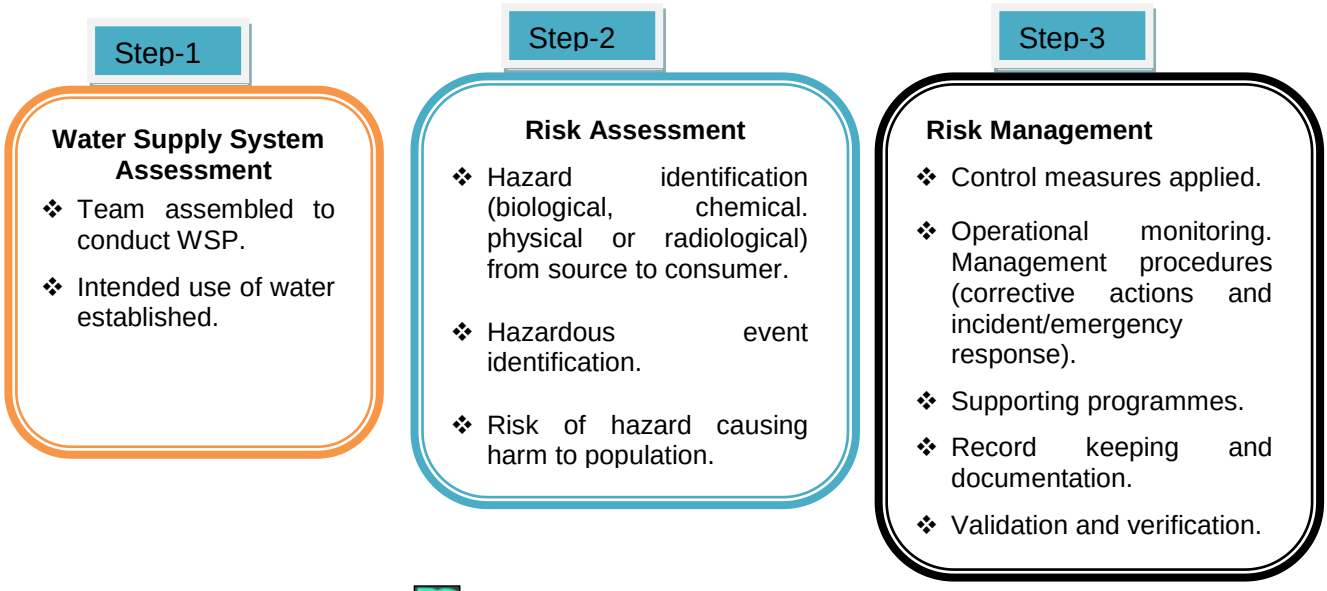
The WSP will guide both day to day actions and long term planning. It will identify crucial aspects that collectively ensure the provision of safe water and aid system managers and operators in gaining a better understanding of the water supply system and the risks that need to be managed (WHO[2]).

Some of these aspects include:

- regular monitoring and inspections that signal deteriorating water quality (and prompt action)
- regular on-going maintenance to reduce the chance of failure by contamination
- guidance for improvement and expenditure
- additional training and capacity building initiatives
- a list of where to get help, who needs to know details of water quality, and how quickly the need to know

A diagram of the steps involved in conducting an assessment based on the WSP approach is presented in Figure 7.2.

Figure 7-2: Steps used to guide an assessment of water supply based on the WSP approach



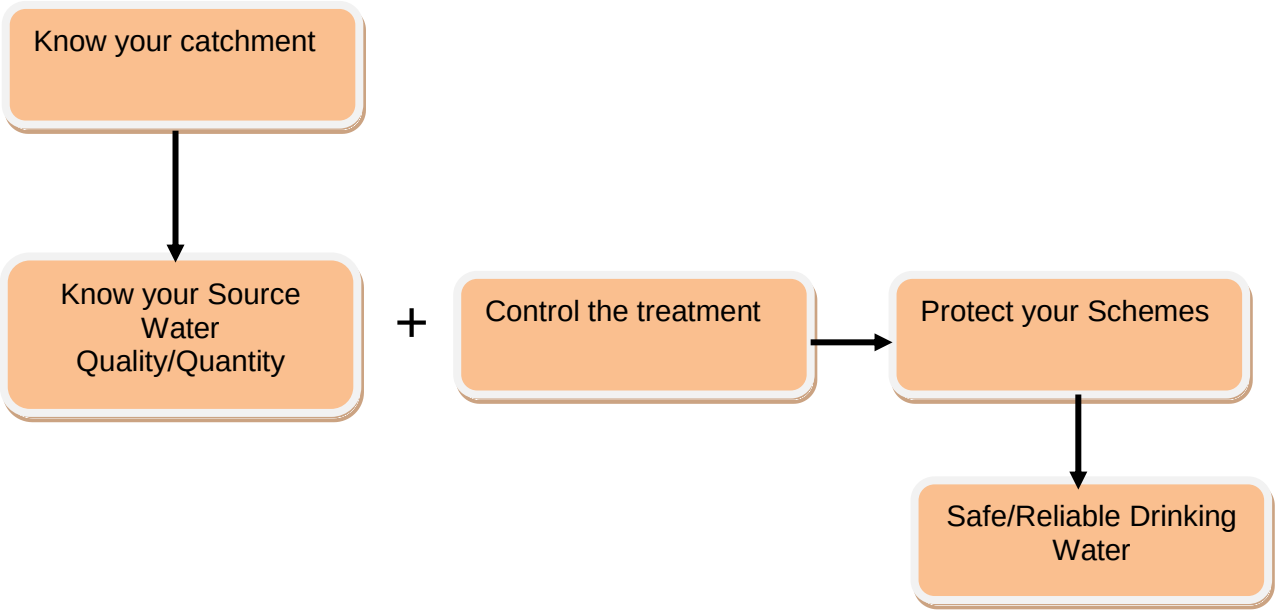
This document is a guideline that focuses on the methodology that can be used to develop a water safety plan for rural water supply system. A comprehensive checklist has also been included to ensure the proper development and maintenance of a Water Safety Plan.

7.5 Information required

To form a Water Safety Plan, it is imperative that the water supplier has an understanding of the complete supply system from the catchment to the consumer. This involves a thorough understanding of the source(s) of contamination, depletion, the pathway / movement of contamination, along with any barriers, and ultimately to the user (receptor) who may be impacted by any contamination (Figure 7.3).

Decisions about the extent to which water supply staff and community members should be involved should be made locally.

Figure 7-3: Catchment to consumer approach to risk management of drinking water safety



7.6 Who use this Manual?

This manual is developed for all government sectors offices starting from MoWIE to Woreda Water Office and community representatives (e.g WASHCOs). Not only from water sector, it is also encompasses the agriculture, health, education and other concerned sector offices.

7.7 Developing a WSP

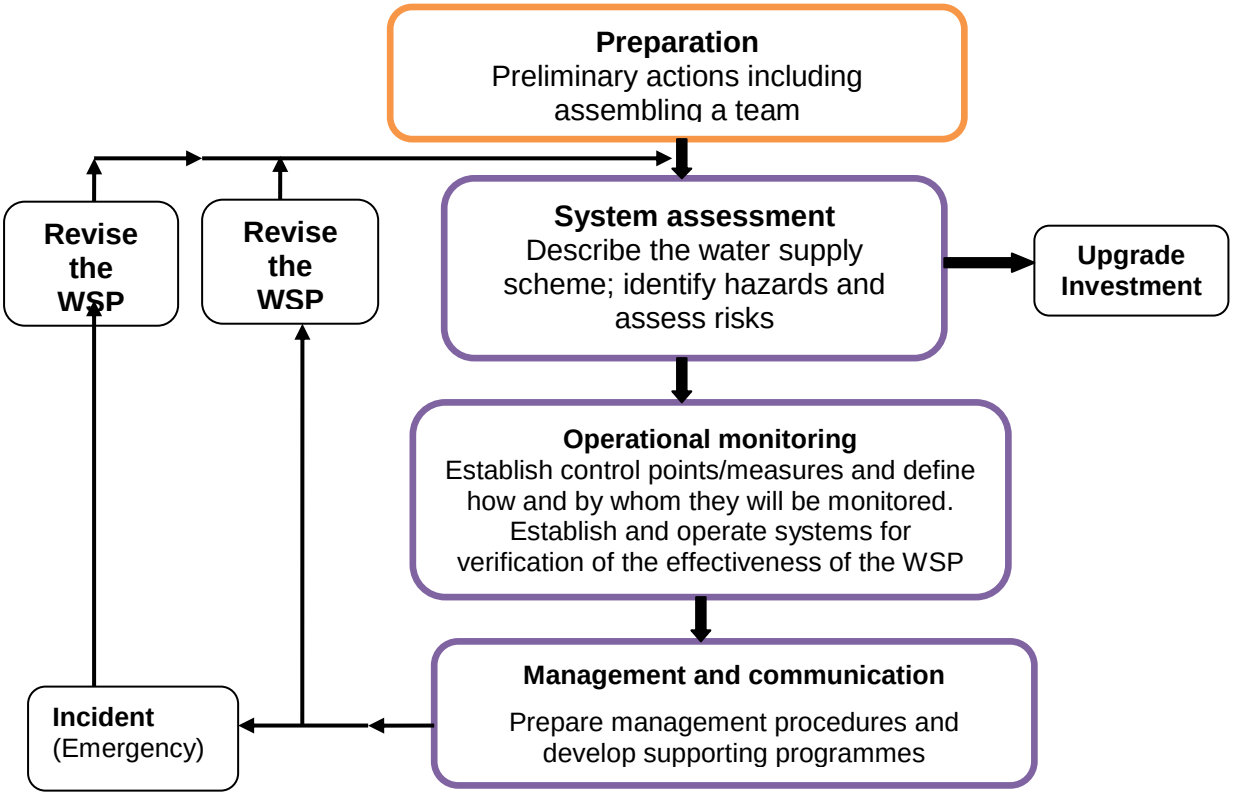
Before developing a WSP, it may be important to identify, and reach agreement upon, health based targets or outcomes. This is particularly important for some communities, where people need to understand the objectives and potential benefits of a WSP before committing themselves to developing and implementing a WSP.

The main stages in developing a WSP are:

- Preparation;
- System assessment;
- Operational monitoring;

- Management, communication and documentation;
- Feedback and improvement.

Figure 7-4: Development and Implementation of a Water Safety Plan



7.7.1 Preparation Stage

The preparation stage involves determining what skills are needed and how large the team should be, identifying suitable experienced personnel (including members of the community who could be members of the team), securing adequate support in terms of finances and other resources, and identifying relevant stakeholders.

Assembling the team may not be simple, because people may need to rearrange their existing duties to accommodate new responsibilities and adapt to the introduction of new procedures.

A multidisciplinary team of experts with a thorough understanding of the water supply system is assembled. These individuals are involved in each stage of the water supply and include:

- Water Engineers and hydro geologists
- Soil and Water Conservation Experts
- water quality specialists
- environmental., public health or hygiene professionals
- Community representatives (WASHCOs)

The team should develop each step of the water safety plan in accordance with the steps outlined in Figure 7.1. Other desirable features of the water safety plan team include:

- knowledge of the water supply system and the types of drinking-water safety hazards to be anticipated;

- authority to implement any necessary changes to ensure that safe water is produced; inclusion of people who are directly involved with the daily operations; and having sufficient people on the team to allow for a multi-disciplinary approach, but not so many that the team has difficulty in making decisions.
- Team numbers will vary according to the size of the organization and complexity of process. The use of sub-teams is common and might for example include water harvesting, water treatment and distribution operations.

7.7.2 System Assessment and Design

This requires collecting detailed information about a water supply scheme. Examples of information required include information about the catchment and abstraction point for the water supply, water supply yield, information about pipes and other components (up to the point of use so may include the transport of water from a public standpost to the home), details of any treatment techniques used, and details of relevant water quality standards and water supply demand to be achieved.

This stage also requires identification of **hazards**, hazardous events, and an assessment of possible risks. Hazards may be physical, biological, chemical or radiological agents that could have a negative impact on human health. Hazardous events refer to possible contamination or interruption of a water supply.

The **risk** associated with each hazard is assessed based on the likelihood or frequency of the hazard occurring, and the severity or consequence of the occurrence. Risks should then be prioritized. One technique for ranking risks in order of priority is to use a scoring system. For example, scores for frequency could range from 1 (rare) to 5 (almost certain), and scores for severity to public health could range from 1 (insignificant or no impact) to 5 (catastrophic impact). The product of these two scores then determines the risk, which could be from 1 (low risk: rare and with insignificant or no impact) to 25 (very high risk: almost certain and with catastrophic impact).

Risk = Frequency X Severity

Sources of potential hazards or hazardous events can be found in each step of the water supply system. These are listed in Table 7. 1.

Table 7-1: Sources of potential hazards or hazardous events in the water supply system

No.	Elements or Processes of A Water Supply System	Potential Hazards or Hazardous Events
1	**Surface Water Sources**	▪ On-site latrines systems ▪ Domestic waste dumping ▪ Land spreading of manure ▪ Feedlot runoff ▪ Municipal sewage effluent ▪ Industrial activities ▪ Leaking pipelines ▪ Pesticide use ▪ Recreational activities ▪ Climate events – flooding, droughts, etc. ▪ Rainfall variability and stream flow reduction

No.	Elements or Processes of A Water Supply System	Potential Hazards or Hazardous Events
2	**Ground Water Source**	▪ On-site latrines systems ▪ Domestic waste dumping ▪ Municipal landfills ▪ Land spreading of manure ▪ Intensive livestock activities ▪ Industrial plants ▪ Pesticide use ▪ Climate events – flooding, droughts, etc.
3	**Treatment systems**	▪ pH correction – inappropriate levels ▪ Disinfection – under/over dose ▪ Reservoir storage – contamination
4	**Distribution System**	▪ Reservoirs – security control failure ▪ Pump stations – security control failure ▪ Distribution transmission mains – geological faults ▪ Distribution water mains – geological faults ▪ Re-chlorination points – under or over dosage ▪ Main breaks – contamination of mains

Likelihood is determined by "how often' or "how likely" a hazard or a hazardous event occurs. It must take into account hazards that have occurred in the past and their likelihood of reoccurrence and must also predict the likelihood of hazards and events that have not occurred to date.

Consequence determines the severity of the results of the hazard/hazardous event and the seriousness or intensity of the impact of the hazard to human health.

Risk Rating = Likelihood X Consequence

Multiplying the derived likelihood ratings with derived consequence ratings from the risk assessment matrix produces a risk rating.

E.g. a likelihood rating of 0.8 multiplied by a consequence rating of 70 would give a risk rating of 0.8 x 70 = 56, which would be ranked higher than an event with a likelihood of 0.2 and a consequence of 2 and a risk rating of 0.2 x 2 = 0.4.

A higher score implies that a bigger risk of a hazardous event occurring exists and should therefore be prioritized. A risk profile based on the calculated score is given in Table 7. 3.

Table 7-2: Risk Assessment Matrix

No.	Likelihood	Rating	Consequence	Rating
1	Almost certain (once a day or permanent feature)	1	Catastrophic (Death expected from exposure)	100
2	Likely (once per week)	0.8	Major (Population exposed to significant illness)	70
3	Moderately likely (once per month)	0.5	Moderate (Large aesthetic impact)	20
4	Unlikely (once per year)	0.2	Minor (Small aesthetic impact)	2
5	Rare (1 in 5 years)	0.1	Insignificant (No impact)	1

Table 7-3: Risk profile based on score calculated from risk assessment matrix

Score	Risk Profile
0 - 10	***Low*** These are systems that operate with minor deficiencies. Usually the systems meet the water quality parameters specified by the appropriate guidelines (Ethiopian/WHO).
11 - 56	***Medium*** These are systems with deficiencies which individually or combined pose a high risk to the quality of water and human health. These systems would not generally require immediate action but the deficiencies could be more easily corrected to avoid future problems.
57 - 100	***High*** These are systems with major deficiencies which individually combined pose a high risk to the quality of water and may lead to potential health and safety or environmental concerns. Once systems are classified under this category, immediate corrective action is required to minimize or eliminate deficiencies.

7.7.3 Operational monitoring

Associated with the identification of hazards and assessment of risks, the team should identify critical control points (where action can be taken to reduce risk) and control measures (suitable actions that will reduce the risk). For example, a control point could be a borehole fitted with a handpump. For this control point, one possible control measure would be to ensure that there is a sanitary seal around the top of the borehole, to prevent surface water washing contaminants into the water source.

Control point: A step at which control can be applied to prevent or eliminate a water safety hazard or reduce it to an acceptable level. Some plans contain key control points at which control might be essential to prevent or eliminate a water safety hazard.

Control measure: Any action and activity that can be used to prevent or eliminate a water safety hazard or reduce it to an acceptable level.

Control measures should be identified for each step in the water supply. Some important factors that need to be considered are listed in Table 7-4 (WHO[2]).

Table 7-4: Factors for consideration

Resource and Source Protection	Source Water and Catchments	Water Abstraction and Storage System	Water Treatment System	Distribution Systems
▪ **Developing a catchment management plan which includes control measures to protect surface and ground waters** ▪ **Ensuring that planning regulations include protection of water resources from potentially polluting**	▪ Designated and limited uses ▪ Registration of chemicals used in the catchments ▪ Specific protective requirements (e.g. containment) for a chemical industry or refueling stations ▪ Control of human activities within the catchment area ▪ Control of wastewater effluents ▪ Regular inspection of catchment area	▪ Use of available water storage during and after periods of heavy rainfall ▪ Appropriate location and protection of intake ▪ Appropriate choice of off-take depth from reservoirs ▪ Proper well protection systems ▪ Storage areas and reservoirs should contain roofs	▪ Coagulation/flocculation/sedimentation/filtration ▪ Alternative treatment ▪ Use of approved water treatment chemicals and materials ▪ Control of water treatment chemicals ▪ Process controllability of equipment ▪ Availability of back-up systems ▪ Water treatment	▪ Distribution system maintenance ▪ Availability of back-up systems ▪ Maintaining an adequate disinfectant residual concentration ▪ Cross connection and back-flow prevention devices implemented ▪ Fully enclosed distribution systems and storage facilities

activities (e.g. industries) ▪ **Promoting awareness in communities of the impact of human activities on water quality**	▪ Land use planning procedures – use of planning and environmental regulations to regulate potential water polluting developments ▪ Diversion of storm water flows ▪ Run-off interception	▪ Access to storage areas should be restricted from animals/birds, etc.	process optimization including: chemical dosing, filter backwashing, flow rate, minor infrastructure modifications ▪ Use of tank storage in periods of heavy rainfall	▪ Appropriate repair procedures including subsequent disinfection of water mains ▪ Maintaining adequate system pressure

In WSPs, distinction is made between **monitoring** and **verification**. Monitoring focuses on assuring compliance of physico-chemical and sanitary risk factors to established operational limits. This is likely to be done on a regular basis (weekly or monthly). **Verification** is designed to verify the compliance of the monitoring programme with selected microbiological organisms.

When the control points have been identified and control measures implemented, verification is needed to determine whether the controls are effective in reducing or eliminating risks to ensure that water quality targets are achieved and maintained. The various hazards and risks can then be reassessed.

7.7.3.1 Control measurement

Tables 7.5 and 7.6 detail the control measures identified for each of the hazards, and associated hazardous event.

Table 7-5: Control measures relating to significant risks identified for chlorination of raw water at primary disinfection plants

Hazard	Hazardous event, source/cause	Control measures
Microbial	Inadequate disinfection method	Minimizing ingress of contamination from humans and domestic animals to system (closed catchments) and long reservoir detention times. Source water specifications. Research programme underway to further quantify pathogen loads and disinfection method.
Chemical	Formation of disinfection by-products	Reducing water age through tanks downstream where possible in periods of low water demand. Upstream preventative measures and reservoir management to minimize disinfection by-product precursors (eg managing off takes to avoid higher colored water) Levels of by-products researched and below guideline levels.
Microbial	Less effective disinfection due to elevated turbidity	None downstream of disinfection. Research programme underway to quantify effect of increased turbidity on disinfection effectiveness. Catchment research completed to show very low levels of bacterial pathogens in raw water.
Physical,	▪ Contamination of dosing ▪ chemicals or wrong	Fluorosilic acid has lab certificate from the supplier.

Hazard	Hazardous event, source/cause	Control measures
Chemical, Microbial	▪ chemical supplied and dosed	On-line monitoring controls. Raw material specification contracts.
Microbial	▪ Birds faeces enter through open inspection hatches	Inspection covers are maintained in place and locked to prevent unauthorized entry
Microbial	▪ Contaminated water enters through damaged pipes at road crossings	Pipes buried at depth on roadside, collars reinforce joints; regular maintenance
Microbial	▪ Poor hygiene in repair work allows microbial contamination to enter into the system	Hygiene code for work on distribution mains is distributed and followed by all maintenance staff

Table 7-6: Control measures relating to significant risks identified for protected water harvesting catchments and large storage reservoirs

Hazard	Hazardous event, source/cause	Control measures
Microbial	Animals in catchment	Downstream detention, disinfection control. Research programme to determine types of pathogens present in native and feral animals.
Microbial **Physical**	Storms in catchments	Some creeks can be turned out during storm events (Procedure for Operation of Harvesting Sources During Catchment Rainfall Event). Downstream long storage detention
Depletion of water quantity	Deforestation, shortage of rainfall, degradation	afforestation and soil & water conservation works, reduce carbon emission

7.7.4 Management and communication

It is important that management procedures are documented to detail what actions and procedures are needed during normal operational conditions, and what actions should be taken that a hazard event occur and affect the quality or continuity of water supply. The management procedures should be communicated to relevant management and operating staff, to ensure that they follow correct procedures as and when necessary. Following any staff changes, individuals need to be aware of relevant procedures and responsibilities. Procedures should be reviewed periodically, following any emergency, and staff should be informed of any changes introduced.

Supporting programmes may include aspects of training, research and development for water supply staff and consumers or community members. Programmes may be necessary to educate members of the public about water safety, to improve public relations, to raise the knowledge and skills of staff, to ensure that adequate resources are available, and to make staff and community members aware of quality targets and any changes to these.

7.7.5 Feedback and Improvement

The Water Safety Plan team should meet routinely to review the Water Safety Plan, and to share and learn from experiences. The Water Safety Plan should be reviewed to make sure

that it remains up-to-date, Reviews should be conducted following any emergency or 'nearmiss', and when there are changes to the catchment, treatment facilities or distribution system.

During the review, the following questions should be addressed:

- How well is the WSP working?
- Were the necessary management plans undertaken adequate?
- If not, which areas require improvement to provide long-term sustainability of the WSP?

The WSP should be reviewed:

- Annually.
- After an incident.
- After any significant change to the water supply.
- During depletion/reduction of water quantity
- In response to finding a weakness in the plan.
- Additional information regarding the system is received that might warrant a revised risk level for that system.

7.7.6 Risk Management

Once the cause of a hazard (contamination) event is identified using sanitary inspections, methods for controlling each risk can be established, which are monitored using surrogate parameters (e.g. chlorine residuals, pH, conductivity). Corrective or remedial actions are then established once the guideline value for the parameter is exceeded. Effective risk management, therefore, requires identification of all potential hazards, their sources, possible hazardous events and an assessment of the risk presented by each.

The following information needs to be recorded (see table overleaf for an example).

- Hazard event (and identified cause);
- Assessed risk (based on likelihood and severity);
- Control measure (required to prevent hazard);
- Critical limits (best and worst case scenarios);
- Monitoring (method, frequency and body to monitor hazard and associated risk);
- Corrective action (remedial measures required to reduce risk);
- Verification (test of effectiveness of WSP).

7.7.6.1 Hazard Identification

Hazards may occur or be introduced throughout the water system, from catchment to consumer. A hazard is any biological, chemical, physical or radiological agent that has the potential to cause harm.

A hazardous event is an incident or situation that can lead to the presence of a hazard (what can happen and how).

Risk is the likelihood of identified hazards causing harm in exposed populations in a specified timeframe, including the magnitude of that harm and/or the consequences.

The water safety plan team should also consider influencing factors such as:

- variations due to weather;
- accidental or deliberate contamination;
- pollution source control practices;

- wastewater treatment processes;
- drinking-water treatment processes;
- receiving and storage practices;
- sanitation and hygiene;
- distribution maintenance and protection practices; and
- intended consumer use

7.7.6.2 Hazardous Events

Once hazards are listed it is important to consider the corresponding events that lead to their entry into the drinking-water supply. These might be termed hazardous events or hazard causes.

Hazardous events can cause contamination directly and indirectly. For example, pathogens can enter water supplies directly from faeces.

A sanitary survey of the catchment area, the integrity of the infrastructure of the source headworks and the distribution system should be undertaken. Standardized forms for sanitary surveys and inspections are presented in Annex-D.

7.8 Climate Change in WASH

7.1.1 Impact on groundwater sources

One of the key uncertainties surrounding the impacts of a changing climate is the effect it will have on groundwater. Up to 80% of rural water supplies are thought to be dependent on groundwater. This dependence is likely to increase as surface water sources become increasingly seasonal, and demands from domestic, agricultural and industrial users for reliable water increase.

Properly sited and constructed boreholes should continue to supply rural domestic demand, even with likely climate change. Although groundwater systems are likely to respond more slowly to climate change than surface water systems, the impact of climate change on recharge, and hence longer-term availability, remains unchange.

7.1.2 Climate Change Impacts and Risks

a) Changes in water quantity and implications for WASH

Surface water resources are already strongly seasonal as a result of present climate variability. Variability in river flow is marked due to the migration of tropical rain belts in Africa

Superimposed on this seasonal variation are ‘natural’ variations; droughts and floods are already part of the existing climate variability experienced across the world. Soil moisture and small streams are most vulnerable to these changes, whereas deep groundwater drawing on many years’ recharge is largely isolated from short-term fluctuations. Between these two extremes, larger rivers, lakes, and shallow groundwater can all be vulnerable to changes in climate, depending on local circumstances.

Climate change is likely to modify groundwater recharge patterns, as changes in precipitation and evaporation translate directly to shifts in soil moisture deficits and surface

water runoff. Increases in rainfall intensity and evaporative demand will, more likely than not, result in increased irregularity of groundwater recharge. However, groundwater recharge will also be affected by soil degradation and vegetation changes, both of which may be affected by climate and human drivers.

b) Changes in water quality and implications for WASH

Water quality is already under threat as a result of poor sanitation and intensive use of fertilizer. In addition to this pathogenic and organic contamination, within urban and industrialised areas there is often inorganic contamination of water resources. Surface water and shallow groundwater quality is widely reported to deteriorate seasonally. This is as a result of intense rainfall events during the wet season causing increased turbidity of the water (suspended solid content) and enabling higher concentrations of pathogens to be transported through the sub-surface.

Vulnerability of shallow groundwater within the wet seasons can be high due to the high permeability of lateritic soils and high groundwater levels. When the water table is elevated within the wet season, pathogens (and other suspended contaminants) can enter shallow groundwater directly from the base of latrines and other conduits, and travel up to 1 km within the shallow, subsurface whilst still virulent

Deeper groundwater, which is generally buffered from intense recharge events, is of much lower vulnerability to contamination and groundwater quality is generally good.

7.9 Toolkits for climate risk management, screening and vulnerability

7.1.3 Climate risk screening

Climate risk screening is a process-based approach that could be applied to WASH Program. If used effectively, screening aims to: (a) raise the profile of adaptation to climate change in project planning; (b) ascertain the extent to which existing development projects already consider climate risks or address vulnerability to climate stress; and change; (c) reduce the risk of ‘under-performance’ of investments and guide project managers to options that can minimise risks and, (d) identify opportunities and strategies for incorporating climate change into future projects.

1) Water safety plans

One approach that can be adapted to include climate risk screening, or water point vulnerability to climate change, is water safety planning. Originally developed as a tool for assessing threats to water quality (WHO 2004), water safety plans (WSPs) can be extended to include water availability and reliability concerns, and scenario-based planning for climate change.

An ‘extended’ WSP would be designed to ensure the safety and reliability of adequate supplies of water through the use of a comprehensive risk management approach, ideally from catchment through to consumption and use, with significant end user participation in both the identification of risks and in their mitigation. St John Day (2009) identifies three key elements:

- Identification of credible risks to water supply systems;
- The prioritization of those risks; and
- Establishment of controls to manage identifies risks.

At a community level, credible risks and prioritisation areas related to threats posed by climate change (and other drivers of change) can be grouped as follows:

- Ensuring sufficient water quantity for domestic and productive uses in the light of (a) greater climate variability and expected changes in the area (e.g. more droughts and floods), if known; (b) likely changes in the demand for water.
- Ensuring appropriate and realistic water quality for domestic and productive uses in the context of (for example) the risk of contamination resulting from heavy rainfall events.
- Improving the equity of access to water sources, including provision for 'fair' rationing during periods of limited availability (e.g. droughts) and the maintenance of basic needs for all.
- Ensuring that protection and safety considerations have been factored into the selection, design and sitting of water points, for example in terms of the risk of contamination from on-site sanitation under conditions of intense rainfall and flooding.
- Ensuring that longer-term water resource management needs are discussed with communities and factored into decisions around technology choice, sitting, service levels and rules/agreements concerning water withdrawals during drought or periods of peak demand.

7.1.4 Community-based climate risk screening

To ensure that local perspectives are incorporated into project planning, a consortium of NGOs has developed a risk screening tool called Community-Based Risk Screening Tool – Adaptation and Livelihoods (CRiSTAL).

7.10 Monitoring and evaluation, vulnerability reduction assessment

It is now generally agreed that indicators need to be developed to monitor adaptation implementation, to follow-up on project activities and to respond to changes over time. Indeed, given the uncertainty of predicting climate futures, flexibility is a key ingredient of robust and long-term adaptation.

a) Vulnerability reduction assessment

The VRA is designed to measure the changing climate vulnerabilities of communities, and to be comparable across different projects, regions, and contexts, making it possible to determine if a given project is successful or unsuccessful in reducing climate risks.

Table 7-7: Vulnerability Reduction Assessment (VRA) methodology

APF Step	VRA Indicator	VRA Questions	Logic
Assessing current vulnerability	1. Vulnerability of livelihood to existing CC and/or CV.	Example: *Rate the impact of drought on your livelihood.*	▪ Addresses present climate-related development issues – often the main climate concern of the community.
	2. Efficacy of coping mechanisms in face of current CC/CV risks.	Example: *Rate your community's ability to cope with negative impacts of drought.*	▪ During the first VRA consultation, this question will describe baseline adaptation. During subsequent consultations, it will assess progress against that baseline.
Assessing future climate risks	3. Vulnerability of livelihood/welfare to developing CC risks.	Example: *Rate the impact to your livelihood if droughts became twice as frequent.*	▪ Once present context of variability has been discussed, this question focuses the community on their perceptions of likely impacts of CC.
	4. Ability of the community to respond to developing CC risks.	Example: *Rate how your community would be able to cope with doubled drought frequency.*	▪ This question compliments the previous one by focusing the community on potential actions to respond to CC.
Formulating an adaptation strategy	5. Magnitude of barriers (institutional, policy, technological, financial, etc) barriers to adaptation.	Example: *Rate how effective you think this project will be in reducing your risks from increasing droughts.*	▪ This question will qualify the above question, and focus it onto the needs of the community in successfully achieving adaptation. ▪ This question will identify policy barriers, forming useful lessons for the country and global programmes.
Continuing the adaptation process	6. Ability and willingness of the community to sustain the project intervention	Example: *Rate your confidence that the project will continue to reduce drought risks after project period.*	▪ This question measures project sustainability and ownership, essential if adaptation to long-term CC is to be successful.
	7. Ability and capacity of community to continue the adaptation process, and to carry it beyond the specific project focus	Example: *Rate your ability to cope with increasing droughts after this project is over.*	▪ This question measures adaptive capacity more directly than other questions, as it seeks to determine to what extent communities will continue to adapt, and to what extent they feel that they are able to do so.

Annexes

Annex A: Checklist for conducting a WSP

No.	Descriptions	Yes	No.
1	Has a multi-disciplinary team of experts been assembled to carry out the water safety plan?		
2	Has the team been informed of their duties and commitment?		
3	Has the water treatment system been described? (i.e. has each step in the system been considered for range and magnitude of hazards that may be present, and the ability of existing processes and infrastructure to manage actual or potential risks)		
4	Following the description of the system above, has all the information been documented?		
5	Has a flow diagram of the entire water supply system been constructed using the symbol chart?		
6	Have existing, as well as potential., hazards in the system been identified		
7	Have these hazards been prioritized using the hazard assessment matrix provided?		
8	Are there any control measures in place to reduce/eliminate the hazards?		
9	Is there a system in place to monitor the control measures?		
10	Have corrective actions been identified for each control measure, especially if the control measure fails?		
11	Are there procedures in place to verify that the WSP is working effectively and will meet the health-based targets?		
12	Have supporting programmes been developed to ensure that health based targets will be met?		
13	Have management procedures been prepared to respond to “normal” and “incident” conditions?		
14	Has all the relevant information regarding the water supply system been documented? (i.e. description and assessment of the system, plan for operational monitoring, plan for verification of drinking water system, management procedures, etc.)		
15	Have communication procedures been established? (i.e. general information on water quality through the media, annual reports and on the internet, procedures for promptly advising of any significant incidents, mechanisms to receive and actively address community complaints, etc.)		
16	Has the WSP been reviewed at the following stages?		
	Annually		
	After an incident		
	After any significant change to the water supply		
	In response to finding a weakness in the plan		
	Additional information regarding the system is received that might warrant a revised risk level for that system		

Annex B: **Risk Assessment Form**

Section A: Description of Water Supply Schemes

Item - 1

Name of Schemes				
Type of Schemes:	**HDW** ☐ **SW** ☐ **BH** ☐ **Spring** ☐ **Others** ☐			
Location	Kebele:		Village:	
	Woreda:		Zone:	
	Region:			
Year of Construction				
Name of WaSHCOs				
Name of Caretaker				
GPS Coordinate				

Item - 2

Diagram of the supply

Provide a flow diagram showing the inter-relationships and various components of the supply source, treatment process and distribution system from the catchment to the consumer. The diagram should include:

- immediate catchment
- wider catchment
- collection point/s
- treatment processes used
- and major distribution pipe work (i.e. pumps, storage systems, pipelines)

Item - 3

In the sections that follow, an evaluation of the system is conducted in order to determine if any hazards exist or if any hazardous events are likely to occur. The hazard assessment matrix shown in Table 7.3 above is a guide to scoring the existing risks that could make water unsafe (i.e. cause a deterioration in water quality) and should be referred to throughout the evaluation.

e.g. a likelihood rating of 0.8 multiplied by a consequence rating of 70 would give a risk rating of 0.8 x 70 = 56, which would be ranked higher than an event with a likelihood of 0.2 and a consequence of 2 and a risk rating of 0.2 x 2 = 0.4.

A higher score implies that a bigger risk of a hazardous event occurring exists and should therefore be prioritized. A risk profile is given below:

Risk Profile: LOW – 0-10

MEDIUM – 11-56

HIGH – 57-100

Section B: EVALUATION OF CATCHMENT AND RAW WATER SOURCE

Name of Catchment	
Name of Raw Water Supply Source	
Location of the Source	

(Mark with a cross where applicable)

What Source of Water Is Used?	HDW	SW	Deep Well	Spring	River	others

Name of caretaker	
Address	
GPS Coordinate	

Is the water source vulnerable to Contamination from the following?	**Upstream Industries (list)**	**Agricultural/ Livestock farms**	**Sewer systems such as leaking septic tanks, etc.**	**Surface Faecal run-off**	**Recreational use by the community**	**Other (Specify)**

Indicate which of the source water protection plans exist?	Zoning	Secure fencing	Locked gates	Limits on agriculture (e.g. phosphorous, pesticides)	Other (Specify)

	Yes	**No**