TRAINING MANUAL ON CLIMATE RESILIENT WATER SAFETY PLAN (CR-WSP)

PARTICIPANT'S WORKBOOK

October 2017

Government of Nepal
Ministry of Water Supply & Sanitation
Department of Water Supply & Sanitation
Panipokhari, Kathmandu, Nepal

Preface

Water Safety Plan (WSP) is a comprehensive risk assessment and management approach for improving and maintaining drinking water quality from catchment to consumers. There are more than 42,000 water supply schemes. At the beginning, most of them started supplying safe water, however these schemes have been polluted over the years dues to natural and human activities and operational deficiencies. Considering this, WSP has been piloted in Nepal since 2006 with the support of the World Health Organization (WHO). WSP has played a very important role in addressing these issues during pilot stage.

As WSP proved itself as an effective tool to improve water quality, Department of Water Supply and Sewerage (DWSS) has included it in its regular programme. Similarly it has been piloting climate resilient water safety plans in some district in order to address climate change issues in water quality. In mean time, some other organisations have also started implementing WSP in water supply schemes.

WSP follows various steps that allow the assessment and management of risks involved in maintaining quality of water. The awareness and orientation is considered one of the first steps to develop WSP in any water supply schemes. All organizations commence developing WSP by organizing these kinds of capacity building activities. However, these training programmes are conducted differently as there is no standardized module as such. It is now necessary not only to standardizes the existing training materials but also to consider new issues such as climate change. With this background, this training manual is developed. It has three major parts i.e. facilitator's handbook, participant's workbook and presentations structured in eight modules, which can be customized to the extent applicable.

This training manual is structured according to the WSPs developed by WHO and DWSS and draws from practical experiences on emerging issues such as climate change. It has been prepared considering available national and international training materials and is based on the experiences obtained from the implementation of WSP since 2006 with WHO-Nepal's support and on the consultations provided by various experts on this subject matter. It is expected that this manual is useful for all, who has been working on implementation of WSP and for all agencies in water and sanitation sector like regulating bodies, executing/implementing agencies and water suppliers (water users' committee or water utilities).

This manual is the result of untiring efforts of many individuals. Department of Water Supply and Sewerage (DWSS) acknowledge the inputs of Dr. Dinesh Raj Manandhar, Dr. Bandana Pradhan and Dr. Rijan Bhakta Kayastha. The department also recognizes the valuable contribution of WHO Nepal especially of Er. Raja Ram Pote Shrestha and Dr. Sudan Raj Panthi to finalise this document. The development and production of this document were coordinated and managed by Sr. Divisional Engineer Kiran Darnal, Mr. Ganga Datta Nepal and Mr. Krishna Bhakta Maharjan. It is to be acknowledged the financial as well as technical support provided by the WHO Nepal to prepare this document under DfID funded project "Building adaptation to climate change in health in LDCs through resilient WASH."

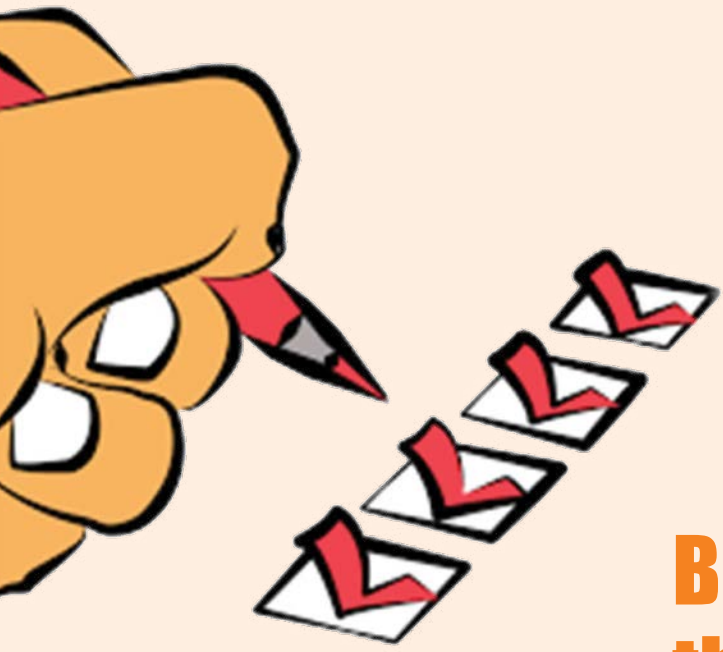
Contents

Glossary

Control measure	:	Any action or activity that prevents, eliminates or reduces water safety hazards to an acceptable level
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.
Corrective action	:	Remedial actions or steps taken after the results of monitoring indicate a failure of control measures to maintain the water quality
Critical limit	:	A threshold that separates the limit of acceptability and unacceptability
Flow diagram	:	A systematic representation of the sequence of steps or operations for the production or manufacture of a particular water item.
HACCP	:	(Hazard analysis and critical control points) a systematic preventive approach during the water tapping, treatment and conveyance processes from preventing water quality against physical, chemical and biological risks during its consumption
Hazard analysis	:	The process of recognizing hazards that may arise from contamination in a system or its environment, documenting their unwanted consequences and analyzing their potential causes.
Hazard	:	Any agent (physical, chemical, biological or radiological) that can cause harm to public health
Hazardous event	:	Any process that introduces hazards to, or fails to remove them from, the water supply
Operational monitoring	:	The act of conducting a planned sequence of observations or measurements of control parameters to assess whether a control measure is operating within design specifications
Risk assessment	:	A process to identify potential hazards in the water supply system as well as water quality, and analyze what could happen if a hazard occurs
Risk score	:	The score assigned to a hazard based on the risk analysis process
Supporting programmes	:	Actions such as training and management practices that are catalyst to ensuring drinking water quality, water safety and better management of water supply schemes
Unaccounted-for-water	:	(Also called non-revenue water) the difference between the quantity of water supplied to a city's network and the metered quantity of water used by the customers.
Validation	:	Investigate activity to identify the effectiveness of control measures
Verification	:	Application of system procedures, tests and other evaluations to determine compliance with WSP, and its effectiveness
Water Safety Plan	:	Water supply management plans that, when implemented, provide the basis for system protection and process control to ensure that numbers of pathogens and concentrations of chemicals present a negligible risk to public health and that water is acceptable to consumers.
Surveillance	:	Verification by an independent person or a body to check whether or not the components devised under water safety plans are operating properly and effectively.

Acronyms

BPT	Break Pressure Tank
CCA	Climate Change Adaptation
CM	Control Measure
DDG	Deputy Director General
DDRC	District Disaster Relief Committee
DRR	Disaster Risk Reduction
DWSS	Department of Water Supply and Sewerage
GoN	Government of Nepal
HH(s)	Household(s)
NDWQS	National Drinking Water Quality Standard
ODF	Open Defecation Free
SDE	Senior Divisional Engineer
SOP	Standard Operating Procedure
ToT	Training of Trainers
UFW	Unaccounted for Water
WASH	Water Supply Sanitation and Hygiene
WHO	World Health Organization
WSP	Water Safety Plan
WUSC	Water Users and Sanitation Committee
MWSS	Ministry of Water Supply and Sanitation



Before starting the training

- ☑ Make sure you read this workbook thoroughly and familiarize yourself with its contents.
- ☑ Make sure you have given detailed information about your water supply scheme (the technical details) to the organizers of the training programme. In case you haven't, collect detailed information of water supply schemes you are related with.
- ☑ Ensure that you have set aside at least five days for the training programme, excluding the travel time. Assign your responsibilities to other responsible and capable people for the time being.

PART ONE

PREAMBLE

INTRODUCTION

1. Introduction

Water safety plan is a plan to ensure the safety and quality of drinking water through the implementation of a comprehensive risk assessment and management approach that encompasses all steps in water supply from catchment to consumer. The significance of WSP in water supply projects can be understood from this definition of WSP: it is essentially comprehensive, and thus keeps into account the broader picture of ensuring water quality by mitigating risks from the source itself through to the transmission and distribution processes. Therefore, this training attempts to promote system sustainability of the water supply projects under consideration (those of the participants) by fulfilling the following objectives:

- Help make all the stakeholders understand the significance of WSP.
- Make the participants aware about the key terms and steps to implement water safety plan so that they can assure water quality and minimize risks in their water systems.

1.1 Introduction to the workbook

This workbook is a part of the water safety plan manual toolkit. It is accompanied by the facilitator's handbook, the PowerPoint presentations and reference materials for the training. This handbook is to be used by the participants who have little or no knowledge of the concepts and steps of WSP, and who intend to learn about it in training on WSP based on the guidelines and manuals set by WHO and DWSS. The workbook is divided into four parts:

- Part one: Overview of this workbook and the approach to learning
- Part two: Ice breaking session
- Part three: Module learning material, which includes module objectives, key points and exercises
- Part four: Annex and reference materials

The target recipient is basically the water supply service providers, consultants, contractors and line agencies personnel, the members of the water supply and sanitation users committee. These people are the ones responsible to implement the WSP in the water and sanitation system. However, other members from outside the water supply sector such as health sector staffs or school/college teachers or agricultural and forestry sector people could also participate.

Water supply schemes in Nepal differ as urban and rural type on the basis of the size of the systems, the number of communities or people being served or the sophistication in treatment facilities. As such, it is essential to discriminate the plans for these two. This workbook intends to cover the needs to conducting and participating the training in either of these schemes. Therefore, the workbook has been made flexible enough to allow the participants understand the components of WSP that they could utilize in either of the urban or rural water supply schemes. However, the content has been made such that the workbook can be used as generic for any type of system.

A reference case has been included in Annex D of this workbook to allow all the participants to practice their exercises for a common water supply project, so that different views of the participants can be determined for a common set of problems.

1.2 Objective of this workbook

This workbook is a supporting document required to complete the training programme and help accomplish its objectives. All participants are to use this workbook and follow the instructions mentioned here, as well as those given by the facilitators. The objective of this workbook can be outlined as following:

- To provide a tool to write down and practice exercises based on the lessons and presentations from WSP experts and facilitators.
- To provide a brief summary of the lessons and presentations to be delivered in the programme.

1.3 Proposed schedule for the training programme

The numbers in the parentheses represent the time allotted for the exercise of that particular session.

Table 1: Proposed tentative schedule for the training

Day 1				
SN	**Activity**	**Time**	**Interval (minutes)**	**Reference**
1.1	Opening ceremony and Participants' Introduction	9.00-10.00	60	Ice-breaking session
1.2	Water quality, impacts on public health and WSP	10.00-10.45	45	Module 0
	Break	10.45-11.00	15	
1.3	Climate change and WSP	11.00-11.45	45	Module 0
1.4	WSP team formation: leadership, roles and responsibilities	11.45-12.30	45	Module 1
	Lunch	*12.30-13.30*	*60*	
1.5	Water supply system analysis	13.30-15.00	45+(45)	Module 2
	Tea Break	*15.00-15.30*	*30*	
1.6	Identification of hazards and risks to water supply systems	15.30-17.00	45+(45)	Module 3
1.7	Summary	17.00-17.15	15	
Day 2				
2.1	Recap of day 1	9.00-9.15	15	
2.2	Preventive and control measures	9.15-10.00	30+(15)	Module 4
	Break	*10.00-10.15*	*15*	
2.3	Improvement/upgrade plan	10.30-11.15	30+(15)	Module 5
2.4	Define monitoring of the control measures	11.15-12.45	45+(45)	Module 6
	Lunch	*12.45-13.45*	*60*	
2.5	Verify the effectiveness of the WSP	13.45-15.15	45+(45)	Module 7
	Tea Break	*15.15-15.45*	*30*	
2.6	Briefing of field visit and WQ Kit demonstration	15.45-16.45	60	
2.7	Summary	16.45-17.00	15	

Day 3				
3.1	Field visit	8.00-13.30	330	
	Lunch	*13.30-14.30*	*60*	
3.2	Feedbacks and preparation for group presentation of field findings	14.30-16.30	120	
	Tea Break	*16.30-17.00*	*30*	
3.3	Summary	17.00-17.15	15	
Day 4				
4.1	Recap of Day 3	9.00-9.15	15	
4.2	Group presentation on field findings -I	9.15-10.15	(20*3=60)	
	Break	*10.15-10.30*	*15*	
4.3	Group presentation on field findings -II	10.30-11.15	(20*2=40)	
4.4	Evaluation and discussions of observed scenario at the site	11.15-12.00	45	
	Lunch	*12.00-13.00*	*60*	
4.5	Reporting exercise (including group/individual exercise) -I	13.00-14.30	45+45	
	Tea break	*14.30-15.00*	*30*	
4.6	Reporting exercise (including group/individual exercise)-II	15.00-16.30	45+45	
4.7	Summary	16:30-17.00	30	
Day 5				
5.1	Recap of day 4	9.00-9.15	15	
5.2	Presentation on Chlorination and Dosing	9.15-10.15	45+(15)	
	Break	*10.15-10.30*	*15*	
5.3	Develop supporting programmes (including financial and administration of implementation of Water Safety Plan)-I	10.30-12.00	45+45	Module 8
	Lunch	*12.00-13.00*	*60*	
5.4	Develop supporting programmes (including financial and administration of implementation of Water Safety Plan)-II	13.00-13.45	45	Module 8
5.5	Evaluation and feedback	13.45-14.30	45	
5.6	Closing	14.30-15.00	30	

PART TWO

ICE-BREAKING SESSION

ICE-BREAKING SESSION

2. Ice-breaker: Introduction of the participants

This is the first session of the training in which all the participants, including the facilitators and the support staffs should introduce themselves. This session also covers the time required for a brief outline of the training program, its objective and format.

2.1 Session goals

- To introduce the facilitators to you, the participants.
- To give an overview of the training schedule, and the need to adhere to the schedule and time allotted for each session and activity
- To clarify what the objective of this training is, and what is expected of you all.

2.2 Time allotted for this session:

60 minutes in total/ 30 seconds for the introduction of each participant

2.3 Session approach

Follow the instructions and guidelines provided by the facilitators to introduce yourselves. Do not take more than 30 seconds to do so; you may hear a bell ring to guide you with the time. As a guide, you may state the following credentials for your introduction.

a) Name
b) Water supply project
c) Position

Expectations (optional)

PART THREE

LEARNING MATERIALS AND RESOURCES TO CONDUCT THE TRAINING

MODULE 0: INTRODUCTION TO WSP

3. Learning materials

This section encompasses information regarding WSP, climate change and public health though effective use of the materials and exercises. It begins by introducing the WSP context and framework, followed by the WSP steps and different WSP approaches, and then moves on to climate change and public health sessions.

3.1 Introduction to WSP (Module 0)

3.1.1 Exercise(s)

In this session, the participants will exercise about the impacts of climate change and impure water supply on the health.

For the climate change part, the facilitator will show pictures of different climate change impacts, as well as ways to mitigate its effects. The participants will have to discriminate which is which: either the impact or the mitigation measure.

The details of this session have been included in section 3.1 of the facilitator's handbook, along with PowerPoint presentations entitled Supplementary presentation 1-Climate change and WSP, and Supplementary presentation 2-Public health and WSP.

Exercise 1: Introduction to WSP

Climate change

In this exercise, the facilitators will show a few pictures of either the impacts of climate change on water resources or the impact of WSP in conserving them. Try to distinguish the pictures in the two categories.

Public health

This is a group exercise. Discuss and complete the following tasks. Make assumptions as necessary but check that they are practical and realistic!

1. Calculation of average amount of water required for

(a) Consumption

Average water consumption per person per day =
Average water required for consumption per house per day =
Total water required for consumption per house per year =

(b) Domestic activities

Average minimum water required for domestic activities/person /day =
Average water required for domestic activities per house /day =
Total water required for domestic activities/house /year =

Inference: If we could ensure about ……..water for consumption and …….. for domestic activities about 80% of our diseases related to quality of water will be prevented.

Knowledge Check in Public Health

2. Fill in the blank with the correct answer

A. Pandemic B. Intervention

C. Epidemic D. Prevention

A_____ is a disease occurrence among a population that is in excess of what is expected for a given time and place.

Knowledge Check in Public Health

3. Match each stakeholder to its role in public health

A. Academia	1. Vehicle for public discourse
B. Employment and business	2. Health in all policy
C. Government	3. Education and training
D. Media	4. Wellness initiative and benefits

Knowledge Check in Public Health

4. Match each component of the public health approach with the questions they answer.

A. Risk factor identification	1. What is the problem?
B. Surveillance	2. What is the cause?
C. Implementation	3. What works?
D. Intervention Evaluation	4. How do you do it?

MODULE 1- WSP TEAM FORMATION

3.2 WSP team formation (Module 1)

3.2.1 Exercise(s)

In this session, you will try to think of a list of ideal WSP team for your water supply project. Remember to include people from different backgrounds, and proven competency and capability in your team. You may use the following checklist to aid you with the selection.

- ☐ Technical expertise and operational system-specific experience required to develop the WSPs;
- ☐ Capacity and availability to undertake the WSPs development, implementation and maintenance;
- ☐ Organizational authority to report through to the relevant controlling authorities, such as the executive of an organization, or leaders of a community;
- ☐ Understanding of the organizational and people management systems and processes that turn plans into actions and that communicate the results of monitoring and reporting;
- ☐ Understanding the health based targets to be met;
- ☐ General appreciation of the water quality needs of the end users;
- ☐ Understanding of the practical aspects of implementing WSPs in the appropriate operational context;
- ☐ Understanding of climate issues, DRR/CCA and impact in water supply system and WQ
- ☐ Appreciation of the regulatory and policy environment of the organization, have knowledge of NDWQS of Nepal; and
- ☐ Familiarity with training and awareness programs.
- ☐ Ability to provide inputs during the time of crises or natural disasters

The details of this session have been included in section 3.2 of the facilitator's handbook.

Exercise 2: WSP team

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
S. No.	Name	Position	Affiliated organization and designation	Role/responsibility	Contact address/Telephone no.
1					
2					
3					
4					
5					
6					

MODULE 2- WATER SUPPLY SYSTEM ANALYSIS

3.3 Water supply system analysis (Module 2)

3.3.1 Exercise(s)

- In this exercise, you should give details of the water supply components by using a map and/or flowchart (Exercise 3), and filling a description form (Exercise 4). These should essentially have the following components:
  - ✓ general information on the supplier,
  - ✓ source of water, including catchment and extraction from source and raw water quality,
  - ✓ stakeholders and their responsibilities,
  - ✓ treatment processes,
  - ✓ distribution system,
  - ✓ customers' practices and water delivery point,
  - ✓ required water quality, including a list of the key parameter limits in summary form,
  - ✓ intended users and uses of the water, and
  - ✓ persistent problems

The details of this session have been included in section 3.3 of the facilitator's handbook.

Exercise 3: Space to map schematically the participant's water supply system mechanism

Exercise 4: Details of WS components and hazard risks associated

Col. 1	Col. 2
S. No.	**Name and detail of components**
1.	Catchment/Source (Discuss activity influence the water quality normal and abnormal cases, during rainy season, flood, landslide, pesticide use in agriculture field upstream of catchment and any possible contamination from settlement existing)
2.	Intake (type, safe yield, Protection work against flood, landslide, if any, O & M practices). Any diversion during emergency incidents.
3.	Transmission and Distribution Pipeline (length, pipe type and sizes, crossing and possible hazardous events, bursting of pipe due to landslide, flood, frost)
4.	Treatment Plant/Reservoir (location, type, capacity and more information related to possible hazardous events, water quality during rainy season, storage during dry period, algal blooming, eutrophication in ponds)

Col. 1	Col. 2
S. No.	**Name and detail of components**
5.	Consumers Point (Tap stand) (private, public, maintenance and other information)
5.1	Water Use (Domestic, Irrigation, cottage industry, etc)
5.2	Water Use Practices (Storage vessel, Storage tank, Fetching behaviours, internal plumbing)

3.4 Identification of hazards and risks (Module 3)

3.4.1 Exercise(s)

In this exercise, risk assessment of the water supply project is to be done as per the instructions of the facilitators. For urban water supply systems, assessment is to be made on Exercise 5 based on a 3X3 semi-quantitative matrix.

The details of this session have been included in section 3.4 of the facilitator's handbook.

Exercise 5: Risk assessment of water supply project components

Col. 1	Col. 2			Col. 3	Col. 4
Source and type of contamination	Risk assessment (before consideration of the impact of the existing control measures)				Existing control measures only
	Score 1-9			Level (low, medium or high)	
	Likeli-hood	Conse-quences	Score		
Source/catchments area/Intake/Deep boring:					
1. Water gets contaminated due to cattle grazing in the vicinity of intake – (microbial contamination)	*3*	*3*	*9*	*High*	*Fencing around the intake*

Col. 1	Col. 2			Col. 3	Col. 4
Source and type of contamination	Risk assessment (before consideration of the impact of the existing control measures)				Existing control measures only
	Score 1-9			Level (low, medium or high)	
	Likeli-hood	Conse-quences	Score		
Pipelines					
1. Cracks and rupture due to increased temperatures, leakage and poor delivery	*3*	*3*	*9*	*High*	*Protect and provide concrete/steel casing with abutments to the transmission pipelines laid along the historic landslide zones*
Reservoir/Treatment plant					
1. Because of turbidity, pressure filter doesn't work properly (overloaded) which makes water biologically & physically hazardous.	*3*	*3*	*9*	*High*	*We don't use pressure filter during this time we bypass the water from filter and not supply too users.*
Tap and users place					
1. Meters are blocked, leakages and chance of being biologically hazardous.	*2*	*1*	*2*	*Low*	*Old meter replaced by new meter. Installation of household's water meter raised 6-9" above the ground level. It helps to protect water contamination at the meter inlet & outlet points.*

MODULE 4: DETERMINATION OF PREVENTIVE AND CONTROL MEASURES

3.5 Determination of preventive and control measures (Module 4)

3.5.1 Exercise(s)

- This is a continuation of the exercise from the previous module. In this, existing control measure in place (in the participants' water supply systems) as written in column 4 of Exercise 5 is written in column 1 of Exercise 6.
- The risk is reassessed after considering the impacts of these control measures through columns 2 and 3. A verdict is to be given in column 4 in which it must be stated whether or not a new control measure or a rehabilitation/ improvement of the existing one is required.

The details of this session have been included in section 3.5 of the facilitator's handbook.

Exercise 6: Assessment of the control measures

Col. 1	Col. 2			Col. 3	Col.4
Existing control measures	Risk with control measure (Reassessment of risk)				Is there a need for a new control measure or improvement?
	Risk score 1-9			Risk level (low, medium or high)	
	Likeli-hood	Conse-quences	Score		
Source/catchments area/Intake/Deep boring:					
1. Fencing around the intake	*1*	*3*	*3*	*Medium*	*Yes*

Col. 1	Col. 2			Col. 3	Col.4
Existing control measures	Risk with control measure (Reassessment of risk)				Is there a need for a new control measure or improvement?
	Risk score 1-9			Risk level (low, medium or high)	
	Likeli-hood	Conse-quences	Score		
Pipelines					
1. Protect and provide concrete/steel casing with abutments to the transmission pipelines laid along the historic landslide zones.	*1*	*3*	*3*	*Medium*	*Yes*
Reservoir/Treatment plant					
1. We don't use pressure filter during this time we bypass the water from filter and not supply too users.	*1*	*1*	*1*	*Low*	*Yes*
Tap and users place					
1. Old meter replaced by new meter. Instal-lation of household's water meter raised 6-9" above the ground level. It helps to protect water contamination at the meter inlet & outlet points.	*1*	*1*	*1*	*Low*	*No*

MODULE 5: IMPROVEMENT/UPGRADE PLAN

3.6 Improvement/upgrade plan (Module 5)

3.6.1 Exercise(s)

In this exercise, new and improvement on existing control measures are to be listed, as well as the time and cost required for them to take effect.

The details of this session have been included in section 3.6 of the facilitator's handbook.

Exercise 7: Improving and upgrading existing control measures

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
Source and type of contamination	New and improvement on existing CMs	Who?	Possible time of completion	Cost (NRs.)	Remarks
Source/catchments area/Intake/Deep boring:					
1. Water gets contaminated due to cattle grazing in the vicinity of intake – (microbial contamination)	*1. Construction of fencing (barbed wire) around intake at 2 m away.*	*WUSC*	*2 months*	*~100,000/-*	

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
Source and type of contamination	New and improvement on existing CMs	Who?	Possible time of completion	Cost (NRs.)	Remarks
Pipelines					
1. Cracks and rupture due to increased temperatures, leakage and poor delivery	*1. Rebuild transmission pipelines with better alignment and temperature resistant materials*	*WUSC/Contractors*	*2 years*	*~700,000/-*	
Reservoir/Treatment plant					
1. Because of turbidity, pressure filter doesn't work properly (overloaded) which makes water biologically & physically hazardous.	*1. Change Filter media and control high turbid water at intake site by construction of filter plants.*	*DWSS+WUSC*	*3 years*	*~700,000/-*	

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
Source and type of contamination	New and improvement on existing CMs	Who?	Possible time of completion	Cost (NRs.)	Remarks
Tap and users' place					
1. Poor sanitation practice, dirty collection tanks and storage vessel makes water biologically and physically hazardous.	*1. Conduct awareness programme to users about sanitation activities.*	*WUSC*	*4 years*	*~50,000/-*	

MODULE 6: MONITORING OF THE CONTROL MEASURES

3.7 Define monitoring of the control measures (Module 6)

3.7.1 Exercise(s)

- A monitoring plan should be made with a clear indication of what, who, when and how to monitor the control measures.
- All existing and new CMs should be recorded in the Col. 1 of Exercise 8, while other procedural information is given in Col 2-5. Under the Column 6 "Operational Limit" a criteria, which separates acceptability from unacceptability, should be clearly mentioned. In Column 7, note what to do when the operational limit is exceeded.
- Regular monitoring is aimed at ensuring that the control measures are in place and functioning well. All control measures should be regularly monitored. Regular monitoring should be the day-to-day work of the operator of all working components including the CM applied. Monitoring works carried out by staff should be recorded in a logbook, as shown in Exercise 9.

The details of this session have been included in section 3.7 of the facilitator's handbook.

Exercise 8: Monitoring Plan- Operational (to be carried out by staff: lab technician, plumber, technicians etc.)

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
Control measures	What?	How?	Who?	When?	Operational limit	What to do if not in order?
Source/catchments area/Intake/Deep boring:						
1. Construction of fencing (barbed wire) around intake at 2 m away.	*Condition of the door and the fence*	*Site visit, inspection (mostly eye judgement)*	*Watchman, Guard*	*Weekend*	*Barbed wire fencing are intact and no cattle grazing inside the fence is seen*	*Repair*
Pipelines						
1. Rebuild transmission pipelines with better alignment and temperature resistant materials	*Check for leakages at multiple points*	*Site visit, inspection (mostly eye judgement)*	*WUSC/ VMW/Technicians*	*Once a month*	*No leakage observed from the pipeline*	*Repair*

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
Control measures	What?	How?	Who?	When?	Operational limit	What to do if not in order?
Reservoir/Treatment plant						

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
Control measures	What?	How?	Who?	When?	Operational limit	What to do if not in order?
Taps and users' place						

Exercise 9: Record keeping of monitoring plans

Date:

Time:

Recorded by:

Col. 1	Col. 2	Col. 3
Control measures	Status	Remarks
1. Construction of fencing (barbed wire) around intake at 2 m away.	*Not okay*	*Repair the fence. Make sure it strongly prevents human and animal interference into the catchment.*
2. Intake structures to be relocated	*Okay*	

MODULE 7: VERIFY THE EFFECTIVENESS OF THE WSP

3.8 Verify the effectiveness of the WSP (Module 7)

3.8.1 Exercise(s)

- Exercise 10 relates to the verification plan. The WSPS team prepares the plan to record when and what parameters have to be tested to check the quality of water. Col. 1 records the sampling point. Col. 2 records how often (frequency) the verification will be done. Col. 3 to Col. 7 record the testing frequency of the water quality parameters. The parameters given here are just for example, there may be more or less parameters as appropriate for the system.
- Exercise 11 to be used to record the results of the verification. A logbook should be prepared to record all the verification data.

The details of this session have been included in section 3.8 of the facilitator's handbook.

Exercise 10: Verification plan

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
Sampling point and condition	**Frequency of observation**	**Water quality testing frequency**				
		Turbidity	pH	E. coli	FRC	…..
Source/catchment/Intake	*Monthly*	*Monthly*	*Monthly*	*monthly*		
Pipelines						
Reservoir tank/treatment plant	*Daily*	*Daily*	*Once a week*	*Once a month*	*Daily*	
Tap and users' place	*Once in a six month*	*Once a month*	*Once a year*	*Once a month*	*Once a week*	

Exercise 11: Record keeping of periodic verification

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8
Sampling point and condition	**Finding from field visit /observation**	**Water Quality Test Results, if any**					**Assessment of the record keeping (Internal Audit)**
		Turbidity	pH	E. coli	FRC	…..	
Source/catchment/Intake	*Barbed wire fencing are intact*	*Below 5 NTU*	*6*	*1 cfu/100 mL*			
	Source is safe from human and animal hazards. Need tree plantation around the catchment area of source.	*1500 during rainy season And <10 during winter season*	*8.2 (average value)*	*>100 during rainy season and <10 during winter season*	*No added chlorine in raw water*	*Source is safe from human and animal hazards. Need tree plantation around the catchment area of source.*	*1500 during rainy season And <10 during winter season*
Pipelines							

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8
Sampling point and condition	**Finding from field visit /observation**	**Water Quality Test Results, if any**					**Assessment of the record keeping (Internal Audit)**
		Turbidity	pH	E. coli	FRC	…..	
Reservoir tank/treatment plant	*All the RVTs and others structures are safe and no chances of any outer contamination.*			*No E-coli in RVTs water.*	*0.3 to 0.5 mg/L chlorine is found in RVTs water*	*All the RVTs and others structures are safe and no chances of any outer contamination.*	
Tap and users' place							

3.9 Develop supporting programmes (Module 8)

3.9.1 Exercise(s)

WSPs activities mentioned in previous steps can be made more effective and fruitful with other supportive programs like training and support to capacity development of water users committee/utility to prepare Standard Operating Procedures (SOP; particularly crucial for treatment plants), emergency management plans etc. Record this on Exercise 12.

The details of this session have been included in section 3.9 of the facilitator's handbook.

Exercise 12: Developing supporting programmes

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5
S. No.	**Documented Standard Operating Procedure (SOP)**	**Emergency management plan**	**Activities under water shed management/ Adaptation for Climate change**	**Awareness program on WASH (planned and or conducted)**
1	*SOPs for treatment plant units (grit chamber, roughing filter, and slow sand filter)*	*N/A*	*Forest user committee has been asked to help for source protection work for which WUSC has paid.*	*Sanitation campaign has been carried out every month.*

FIELD TRIP AND FIELDWORK BASED ACTIVITIES

3.10 Field trip and fieldwork based exercises

3.10.1 During the field visit

- The participants will observe the allotted water supply component in group, as per the prior instructions of the facilitators.
- The facilitators are required to instruct the participants answer the following key questions based on their observations and analysis in the water supply project:
  - ✓ What are the potential risks?
  - ✓ What are the existing control measures?
  - ✓ Are they working efficiently? How should they be improved or upgraded?
- They should write the information of the project on a format as shown below in Box 2.
- At the catchment/intake and water treatment plant:
  - ✓ Each group is to develop at least three hazardous events (using the "X happens to Y because of Z" description) based on their discussions with the operators and their observations.
  - ✓ For these, identify existing control measures used (assuming they exist) based on discussions with the operators.
  - ✓ Identify the risks of the hazardous events allowing for the existing control measures.
- At the distribution system and customer's residences:
  - ✓ Each group is to develop at least two hazardous events for both the distribution system and customers' residences (using the "X happens to Y because of Z" description) based on their discussions with the operators/linesman and/or their observations. One of these must be related to repairs of pipes.
  - ✓ For these, identify existing control measures used (assuming they exist).
  - ✓ Identify the risks of the hazardous events allowing for the existing control measures.

Box 2: Space for recording information during the field visit

Group:

1. Schematic diagram

2. Hazards with photos

3. Existing control measures with photos

4. Suggested improvements

3.10.2 After the field visit

- After the fieldwork, the participants should be able to complete a task to describe the system in a form as shown in Exercise 13.
- The task at hand is to describe the conditions of the catchment/intake, water treatment plant, distribution system and customer's residences.
- At the catchment/intake and water treatment plant:
  - ✓ Each group is to develop at least three hazardous events (using the "X happens to Y because of Z" description) based on their discussions with the operators and their observations.
  - ✓ For these, identify existing control measures used (assuming they exist) based on discussions with the operators.
  - ✓ Identify the risks of the hazardous events allowing for the existing control measures.
- At the distribution system and customer's residences:
  - ✓ Each group is to develop at least two hazardous events for both the distribution system and customers' residences (using the "X happens to Y because of Z" description) based on their discussions with the operators/linesman and/or their observations. One of these must be related to repairs of pipes.
  - ✓ For these, identify existing control measures used (assuming they exist).
  - ✓ Identify the risks of the hazardous events allowing for the existing control measures.

Exercise 13: System assessment of the visited water supply scheme

Table/group number: ……..

S. No.	Hazardous event	Existing control measure	Risk assessment		
			Likelihood	*Severity or consequence*	*Overall risk score*

Bibliography

American Red Cross, 2014. *Water safety instructor's manual,* USA: Krames Staywell Strategic Partnerships Division.

DWSS, 2013. *Water safety plan handbook,* Nepal: Department of Water Supply and Sewerage, Ministry of Urban Development, Government of Nepal.

DWSS, 2015. *Climate resilient water safety plans guideline: rural water supply system,* Kathmandu: Department of water supply and sewerage, Ministry of water supply and sanitation, Government of Nepal.

DWSS, 2015. *Climate resilient water safety plans guideline: urban water supply system,* Kathmandu: Department of water supply and sewerage, Ministry of water supply and sanitation, Government of Nepal.

WHO & IWA, 2009. *Water safety plan manual: Step-by-step risk management for drinking-water suppliers,* Malta: WHO Press.

WHO & IWA, 2012. *Water safety plans-training package (Facilitator handbook),* s.l.: World Health Organization & International Water Association.

WHO & IWA, 2012. *Water safety plans-training package (participant workbook),* s.l.: World Health Organization & International Water Association.

WHO, 2015. *Capacity training on urban water safety planning: Presenter's guide to teaching materials,* New Delhi: World Health Organization: SEARO Library.

WHO, 2015. *Capacity training on urban water safety plannning: participant's handbook,* New Delhi: World Health Organization-SEARO Library.

WHO, 2015. *Capacity training on urban water safety: Worksheets and other resources for participants,* Dew Delhi: World Health Organization: SEARO Library.

Annex A: Feedback form

Training on climate resilient water safety plans
Participant's feedback form

1. Are you satisfied with the course and plan to recommend to others?

   ☐ Yes ☐ No

2. Is the course worth the time and money?

   ☐ Yes ☐ No

3. Is there harmony among the sessions with respect to WSP?

   ☐ Yes ☐ No

4. Does the course consider the importance of WSP in water supply projects?

   ☐ Yes ☐ No

5. Did the facilitators allow discussion of viewpoints other than his/her own and encouraged questions?

   ☐ Yes ☐ No

6. Suggest other topics that should have been changed or covered in the training.

   ☐ Yes ☐ No

7. Suggest improvement for training course and management, if any.

   ☐ Yes ☐ No

8. Please provide topics of training, you deem necessary in future or you and your subordinate staff would like to attend.

   ☐ Yes ☐ No

9. Any other remarks:

Comments:

Annex B: Pre- and post- training programme test

Climate resilient water safety plan training programme

Name: **Date:**

Please circle the correct option:

1. **What do you understand by WSP?**
   a. Domestic water treatment process
   b. Water consumption after treating it with SODIS, chlorine or boiling process
   c. Identifying risks and possible hazards in water supply projects and finding necessary solutions
   d. None of the above

2. **What kind of water supply projects are appropriate for WSP?**
   a. Ones without treatment systems
   b. Only large scale projects
   c. All types of water supply projects, whether large scale or small
   d. None of the above

3. **WSP needs to be implemented even if the source of water being supplied is a clean spring. Why?**
   a. Because the water maybe contaminated when it rains
   b. Because the water may be contaminated by the time it is consumed
   c. Contaminants may pollute water when it is being distributed
   d. All of the above

4. **Who implements WSP?**
   a. District (sub) division office
   b. Engineers
   c. Local governmental agencies
   d. WSP team

5. **What do you understand by faecal coliform?**
   a. Microorganisms present in faeces
   b. Microorganisms that cause diarrhea
   c. Essential nutrient of water
   d. Both (a) and (b)

6. **How should WSP be approached in Nepal?**
   a. A program to improve the quality of water as per the requirements of national drinking water quality standards

7. **Where is FRC test done?**
   a. In cases where coliform has been detected in water
   b. Water containing arsenic
   c. Water containing chlorine

8. **What is the required value for FRC test?**
   a. 0.1-0.2 mg/L
   b. <0.5 mg/L
   c. 0.1-0.5 mg/L

9. **When was the NDWQS implemented in Nepal?**
   a. There are no drinking water quality standards in Nepal
   b. In progression since 2062 BS
   c. Since 2052 BS

10. **Where in the water supply system is the test for contamination conducted?**
   a. Source and intake
   b. Pipe line and chamber
   c. Water reservoir/tank and treatment centre
   d. At point of use/public taps
   e. All of the above

11. **What do you understand by contaminated water?**
   a. Water that adversely affects health due to presence of physical, chemical and biological impurities.
   b. Water containing minerals
   c. Water containing various gases

12. **How can we check the effectiveness of WSP?**
   a. Testing the water quality
   b. Consumer satisfaction
   c. Both a and b

13. **What can be done about WSP if the water supply sytem under consideration requires a massive repair and maintenance work?**
   a. Prioritize the repair and maintenance work first
   b. Initiate WSP, and prepare a long term plan for WSP implementation simultaneously.
   c. Put aside a huge budget for WSP

14. **What should be done if a responsible person of WSP team has to go elsewhere?**
   a. The knowledge and all the information should be passed down to a new or fellow member
   b. Explain all the proceedings to the whole team, and arrange a timely meeting to ensure everything is in order
   c. Both a and b

Annex C: User satisfaction form (to be done before and after the WSP implementation)

For urban systems

Well representation (Not less than 25%) of HHs should be covered during survey in each cluster. The individual answer sheet from HHs may be attached in the WSPs document. Answer in the above table to be given in percentage of HH saying "Yes"

Date:

S. N	Questionnaire	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Average
1.	Are Users aware of importance of water quality on public health?						
2.	What users think about safety measures of water from source to taps?						
3.	Is the intake or other structure safe from landslide or flood?						
4.	Is the pipeline safe during landslide or frost?						
5.	Do you get enough water during dry period?						
6.	Are the users' complaints area addressed by the supplier?						
7.	Are users' satisfied with the tariff (reasonable with the service)?						
8.	Do users' think that system is maintained or improved during emergency and other abnormal incidents?						
9.	Has anyone in the family suffered from water-borne diseases in the last 15 days? Disease (Percentage of household saying "yes")						
	i. Cholera						
	ii. Typhoid						
	iii. Diarrhea						
	iv. Dysentery						
	v. Worms/Helminthes						
	vi. Jaundice						
	vii. Others if any						
10.	How do you treat water fetched from tap before drinking? (Percentage of household)						
	i. Do Nothing						
	ii. Boiling						
	iii. Use Chlorine						
	iv. Filter						
	v. Use SODIS (Solar disinfection)						
	vi. Other Methods						

Annex D1: A case study of a water supply project (Gravity supply)

This is a case study of a water supply and sanitation project of a small town serving for about 3000 households. The source of water is stream intake. In stream intake system, a grit chamber filters out grit, sand, and small pebbles. The water is then sent to a sedimentation tank. The water effluent from the roughing filter goes to the four-chambered slow sand filter. Water is then disinfected in the chlorination unit. Disinfected water is stored in a reservoir tank before distributing to the service area.

There is an overhead tank connected to the system from which water is distributed to the 3000 households.

Few Conditions:

- ✓ The stream source and catchment is in Hill area and there is farmland upstream of the catchment
- ✓ The structures of intake and treatment plant are easily accessible
- ✓ There are risks of damages to the pipes due to landslides and extreme temperature fluctuations.
- ✓ There is no adequate cleaning mechanism of structures
- ✓ There is no proper use of chlorine in treatment
- ✓ There is one primary and another higher secondary school benefiting from the system
- ✓ The service area is more or less flat area and have shallow tube wells in most of the HHs
- ✓ The health post office shows yearly record of water borne diseases, morbidity and mortality due to diarrhea

Annex D2: A case study of a water supply project (Terai)

In a village in Terai, shallow tube wells are used to extract groundwater to meet most of the water supply needs. There are household (private) tube wells and community (public) tube wells.

However, reports have shown that the groundwater is contaminated with bacteria such as fecal coliform. In most cases, the microbial contamination is caused by unsanitary practices of constructing or using the wells. These practices are responsible for such a result have been identified to be:

- ✓ Sludge drilling using cow dung slurry while constructing the tube well.
- ✓ Use of contaminated water to prime (extracting water when the water level is low due to which suction cannot be created) the tube well.
- ✓ Inadequate sealing of the wells
- ✓ Lack of protective measures such as platforms to protect wells.
- ✓ Improper drainage that result in accumulation of wastewater in the pit near the well.
- ✓ Flooding during monsoon.