

DPHE-ITN

Water Safety Plan

For Pond Sand Filter in Rural Water Supply System



April, 2006

Introduction

The first edition of the model water safety plan for Pond Sand Filters (PSF) was prepared in December, 2004 for use in Bangladesh. The model WSP was then tested by several organizations in their respective pilot projects to observe its appropriateness for application under local context. The pilots were implemented over a period from February to November 2005 with slight difference in their durations. The experience of the pilots has been captured and documented in March, 2006. Based on the experience and lessons gained from the pilots projects the first edition has been revised.

Below is the process through which WSP for PSF was developed and revised:

- A workshop was organized by APSU in November, 2004 with the sector professional from government organization, NGOs and Development partners.
- During the workshop one group was assigned to prepare the outline of a model WSP for PSF through systematic analysis and consultative process.
- During November and December, 2004 a complete WSP document for PSF was prepared as a first edition.
- During March, 2006 APSU organized a workshop to review the first edition in the light of the experience gained from the pilots.
- During a period from February 2005 to November 2005 WSP for PSFs were tested in the field in pilot projects
- Based on the review results and recommendations of the March, 06 workshop ITN-BUET and DPHE has revised the first edition to form the second edition of the model WSP fro PSF as of April 2006.

Now, it is expected that the government and non-government organizations can apply this version of Water Safety Plan (WSP) directly. However, if they feel that there is need to make further changes based on their own water supply system the concerned organization can do that keeping a record of the changes made. A separate sheet is added in the following page to keep record of the changes already made or to be made in future.

Document Change Record Sheet

Location	Changes made	Remarks
General Page-2	Insertion of <i>Document change record sheet</i>	To be filled in by individual organization making changes in the document
Page-3	Insertion of <i>Document development history and approval table:</i>	To be updated by individual organization implementing the WSP
Table 2	Rewrite description of process steps: i) 'water treatment', ii) 'distribution of water' and iii) 'special control'	
Table 3	Shifting of 'iron' from safety parameters to aesthetic parameters	
Table 6	Add a column for additional control measures Delete last 2 columns: 'Basis' and 'action required'	To make it simple and understandable
Table 6 PSF0	Delete 2 nd item of social exclusion	
Table 6 PSF2 PSF3	Add a hazard event on leafy trees overhang on pond Add a hazardous event on contamination by lizard and vermin at water chamber	
PSF5-8	- Rewrite existing control measures - Rewrite additional control measure column	At present no specific control measures are in place except some general hygiene messages
Table 7	Change of order of the Tables. Table-8 was brought to front as Table 7 and renamed as <i>Operational Monitoring schedule</i> Table 7 was brought down as Table-9 and renamed as Improvement Action Plan. Specify the support programmes and link them to Table 10:Improvement Action Plan	
Table-8	Add one monitoring activity for vermin protection	
Table10	Add this table to delineate various support programmes for smooth implementation of WSP	

Proformas

1. The WSP Team

The first step of implementing the WSP is to form a team of people from implementing organization/s and DPHE working on water safety plans for pond sand filters. It is preferred that the team will include people having different discipline and those with technical ability to develop and implement WSP.

Table 1. The WSP Team

Name	Organization	Title	Role in WSP team	Contact Information	
				Address	Telephone, E-mail

The WSP documents are dynamic documents. As new information and experience becomes available about the water supply technology system and as the system improves the WSPs can be improved and modified to reflect these changes. Therefore, the implementing organizations should assign a person who will be responsible for updating the WSP and disseminate it to WSP team members through a set process of the organization.

Document development history:

Edition	Date
<i>1st edition</i>	<i>November 2004 by Guy A. Howard, APSU</i>
<i>2nd edition</i>	<i>April 2006 by SG Mahmud , ITN</i>
<i>3rd edition</i>	<i>.....</i>

Document Approved by:

Name:

Date:

Table 2. Water Supply Process Description.

Step	Description
Water source	Protected ponds in villages, pond use restricted solely for supplying PSF for water for drinking and cooking
Water treatment	Water is passed through one roughing filter and a slow sand filter.
Distribution of water	Water is collected at the PSF site from taps attached to it and carried to the households by villagers, generally using clay/metal pitchers or plastic jar
Storage after treatment	Water is transferred into a kulshi for storage in the kitchen area. Storage kulshis are generally kept above the floor but are not covered.
Any special controls required?	Algal blooms in ponds must be controlled because of risk from cyanobacterial toxins The pond must be protected from human activities (bathing, washing etc.) and fish culture. Contamination of stored water must be controlled.
Water quality requirements?	Water quality is compared against the Bangladesh Standards for drinking water (GoB, 1997) and will be informed by the results of the QHRA.

Table 3. Intended uses and consumers.

Intended Use	Intended Consumer
<ul style="list-style-type: none"> <input type="checkbox"/> Water is obtained from pond sand filter and is intended for use in the home for drinking and cooking. <input type="checkbox"/> A caretaker looks after the pond sand filter. <input type="checkbox"/> Water should meet safety and quality (aesthetic) standards i.e. the Bangladesh Drinking Water Standards (GoB, 1997): <input type="checkbox"/> Safety (subset of parameters): <ul style="list-style-type: none"> <input type="checkbox"/> <i>E. coli</i> <input type="checkbox"/> Free chlorine residual (where chlorinated) <input type="checkbox"/> Arsenic <input type="checkbox"/> Nitrate <input type="checkbox"/> Manganese <input type="checkbox"/> Sanitary Inspection Score <input type="checkbox"/> Aesthetic requirements (includes sanitation and clothes washing issues): <ul style="list-style-type: none"> <input type="checkbox"/> Taste not unpleasant <input type="checkbox"/> Colour <input type="checkbox"/> Turbidity <input type="checkbox"/> Iron 	<ul style="list-style-type: none"> <input type="checkbox"/> The users of the water are people residing in villages and include the healthy, young, old, pregnant and immunocompromised. <input type="checkbox"/> Misuse of the source water has been observed through people using ponds for bathing and laundry and by using the ponds for fish farming. <input type="checkbox"/> A number of users transport water in vessels that are not kept solely for drinking water use and store water in unsanitary conditions, which can lead to contamination. Controlling these risks requires hygiene education about the safe water chain by hygiene education staff working at the Union and Upazila level.

Table 4. Technology description (should be supported by community water and sanitation maps prepared for individual communities and sanitary surveys)

To be completed by each organisation applying WSP for Pond Sand Filter









Issue	Information	Attached documents
Standard design		
Usual setting		
Materials specification		
Source protection measures required		
People served by an individual facility		
How technology is managed		
Training requirements		
Requirements for tests prior to commissioning		
Data on facilities constructed		

Date Prepared:

Date Revised:

Date Approved:

Table 5. Process flow diagram.

<u>Code</u>	<u>Step</u>	<u>Description</u>	<u>Responsibility</u>
PSF1		Source (catchment)	Community
PSF2		Source (pond)	Community
PSF3		Pond sand filter	Caretaker
PSF4		Tap	Caretaker
PSF5		Water collected in vessel	Villagers
PSF6		Water transported in vessel	Villagers
PSF7		Storage at point of use	Villagers
PSF8		Use	Villagers

Symbols:






<u>Key:</u>		
		Operation
		Transport
		Storage
		Inspection
		Delay

Table 6. Hazard analysis

Process Step	Hazardous Event	Hazard Type	Existing Control Measures	Risk	Additional control Measures
PSF0 Social exclusion	Poor members of community excluded from use of source because of income, gender to other social barriers	Social	Ensure that all members of the community involved in water supply development from start	U	Design of programmes and involvement of communities in water source development
PSF1 Catchment around pond	Seepage from pit latrines into pond	Microbial (B,V,P)	Latrines located at minimum safe distance (Control Point)	I	Establish with community a minimum safe distance for pit latrines Community commitment
PSF2 Pond water	Cows washed in pond introduces pathogens	Microbial (B,P)	Pond reserved for use solely for drinking	S	- Ensure community make commitment to reserve pond only for drinking use - Construct fences around pond
	Washing of clothes in pond introduces pathogens	Microbial (B,V,P)	Pond reserved for use solely for drinking	I	-Ensure community make commitment to reserve pond only for drinking use - Construct fences around pond
	People swim or bathe in the pond	Microbial (B,V,P)	Pond reserved for use solely for drinking	S	-Ensure community make commitment to reserve pond only for drinking use - Construct fences around pond
	Latrines directly discharge into pond	Microbial (B,V,P)	Existing law against water body pollution Overhanging latrines excluded from pond (CP) Pond reserved for use solely for drinking	S	Ensure community make commitment to reserve pond only for drinking use Increase awareness on health and hygiene
	Contaminated surface run-off or household wastewater into pond	Microbial (B,V,P) Chemical	Embankment higher than historic flood level (Control Point)	S	-Ensure design has appropriate embankment slopes and that flood level is determined -Embankment slopes stable
	Pesticide and nutrient application in pond for fish culture	Chemical	Fish farming prohibited Community and owner commitment	S	Ensure community make commitment to reserve pond only for drinking use
	Blooms of cyanobacteria due to nutrient load from surface run-off and fish farming	Chemical	Fish farming prohibited	S	-Ensure community make commitment to reserve pond only for drinking use -Raise bank of the pond to stop surface run-off
	Presence of naturally occurring chemicals from soil or seasonal supplementation from tubewells	Chemical		U	Prevent supplementation by tubewell water and test water for major chemicals before construction through awareness-raising among community
	Pond dries up	Quantity	Pond selected has required depth and volume	S	Design takes volume and depth into consideration and are shown to be sufficient for use with pond sand filter

	Leaves drop from overhanging trees into pond	Chemical		U	-Leafy trees should not be planted in future along the bank of pond. -Pruning of overhanging branches
PSF3 Pond sand filter	Strainer damaged and allows excessive suspended sediment into filter	Turbidity	Ensure strainer on the intake pipe is in good conditions and not damaged	S	Caretaker training in inspection and repair
	Roughing filter and fine filter bed are overloaded with suspended solids and filtration impaired	Turbidity Microbial (B,V,P)	Intake is properly sited to prevent excessive suspended sediment entering system Strainer on intake piped Filter is of sufficient size for required flow rate Cleaning of roughing filter every month for turbid water and every 2 months for clear water	S	-Caretaker training in PSF operation -Establish required design on the basis of water demand and availability
	Media dries and biologically active layer is inactivated	Microbial (B,V,P)	Ensure that there is a constant head of water above the sand bed during operation	S	-Ensure constant head device included in design -Caretaker training
	Insufficient contact time due to short-circuiting or hydraulic overload (filtration rate too high)	Microbial (B,V,P)	Ensure minimum depth of media	S	Ensure design takes into account slow sand filtration flow rate requirements
	Filter clogging	Physical, Microbial (B,V,P)	Filter media cleaning and replacement schedule followed	S	Caretaker training
	Improper grading of filter media	Microbial (B,V,P)	Ensure filter media in each bed is of appropriate size and follows standard design	S	Ensure standard design specifies filter media size for each filter bed
	Contamination of water by lizard and vermin	Microbial (B,V,P)		S	Provide lizard and vermin proof cover
	Handpump, bucket or valves damaged	Quantity	regular maintenance of handpump, bucket and valves to keep in good condition	U	Caretaker training
PSF4 Tap	Outlet tap leaks	Quantity	Taps do not leak and are kept in good condition	U	Caretaker training
PSF5 Collection of water	Collected water becomes contaminated due to dirty container	Microbial (B,V,P)	Vessel should be cleaned regularly with clean water and if possible soap	S	Hygiene education in community targeting women who carries and handle water on cleaning of vessels before collection
	Water becomes contaminated from unclean hands used to scoop off extra from vessel	Microbial (B,V,P)	General hygiene message	S	Hygiene education in community targeting women who carries and handle water
PSF6 Transport of water	Water becomes contaminated during transport in an uncovered container	Microbial (B,V,P)	General hygiene message	U	Hygiene education in community targeting women on safe handling of water

PSF7 Storage of water	Water becomes contaminated from animals in home	Microbial (B,V,P)		S	Hygiene education in community targeting women Ensure vessel is covered at all times Water stored at elevated levels
	Water becomes contaminated because dirty utensils used to collect water	Microbial (B,V,P)		S	Hygiene education in community on: -Use clean dipper or cup to withdraw water -Tip water from container into drinking vessel
	Water becomes contaminated because users dip unclean fingers into the pot or use unclean cover	Microbial (B,V,P)		S	Hygiene education in community on: -Use clean dipper or cup to withdraw water -Tip water from container into drinking vessel -Use clean cover
PSF8 Use of water	Water contaminated before consumption because dirty drinking utensil used	Microbial (B,V,P)		S	Hygiene education in community on: Use clean cup for drinking

NB: B = bacteria; V = viruses; P = protozoa CP = Control point
S = significant; U = uncertain; I = insignificant

Table 7. Operational Monitoring Schedule.

Process Step	Performance Indicator	Monitoring		Critical Limit	Corrective Action		Supporting Programs	
Catchment around pond	Latrines located minimum safe distance	What:	Latrine proximity to pond	Latrines closer than minimum safe distance	What:	Re-locate latrines	Community education programme; see section #1 of Table 10: Improvement Action Plan.	
		How:	Sanitary inspection		How:	Through local bye-law or use of committee powers		
		When:	Monthly		When:	Within 4 months		
		Where:	Area around pond		Who:	VDC(Village Development Committee)		
		Who:	Caretaker					
Pond water	Protection of pond	What:	Fence around pond	Fence damaged	What:	Repair fence	Community education programme; see section #1 of Table 10: Improvement Action Plan.	
		How:	Sanitary inspection		How:	From stock		
		When:	Monthly		When:	Within 1 day		
		Where:	Area around pond		Who:	Caretaker		
		Who:	Caretaker					
Pond water	Appropriate use of ponds and exclusion of bathing, washing and swimming	What:	Use of pond	People swimming, bathing or washing clothes, cattle washed in pond; overhanging latrines on pond Fence damaged	What:	Prevent use of pond for non-drinking purposes	Community education programme; see section #1 of Table 10: Improvement Action Plan. -Caretaker training	
		How:	Sanitary inspection		How:	Through local bye-law or use of committee powers		
		When:	Monthly		When:	Within 7 days		
		Where:	At pond		Who:	Caretaker and VDC		
		Who:	Caretaker					
Pond water	Reserving use of pond solely for drinking water	What:	Protection and use of pond	Fish farming practiced	What:	Prevent use of pond for non-drinking purposes	Community education programme; see section #1 of Table 10: Improvement Action Plan. -Caretaker training	
		How:	Sanitary inspection		How:	Through local bye-law or use of committee powers		
		When:	Monthly		When:	Within 7 days		
		Where:	At pond		Who:	Caretaker and committee		
		Who:	Caretaker					
	Protection against run-off		What:	State of embankments	Embankment damaged or height insufficient	What:	Raise embankment	Community education programme; see section #1 of Table 10: Improvement Action Plan. -Caretaker training
			How:	Sanitary inspection		How:	Additional of earth to embankment	
			When:	Monthly		When:	Within 12 months	
			Where:	At pond		Who:	Caretaker and VDC	
			Who:	Caretaker				

Pond water	Presence of cyanobacteria!	What	Algal blooms	Blooms occur	What	- Reduce nutrient inflows from fish farming and surface runoff - Raise Bank of the Pond	Community education programme; see section #1 of Table 10: Improvement Action Plan. -Caretaker training
		How:	Visual inspection		How:	Stop fish farming and protect against surface runoff	
		When:	Monthly		When:	Within 1 month	
		Where	At pond		Who:	Caretaker and User committee	
		Who:	Caretaker				
Pond water	Sufficient quantity of water	What	Depth of pond	Pond becomes too shallow for intake	What	Excavate pond	Community education programme; see section #1 of Table 10: Improvement Action Plan.
		How:	Visual inspection		How:	Local labour	
		When:	Weekly towards end of dry season		When:	Within 5 years	
		Where	At pond		Who:	Community	
		Who:	Caretaker				
Filter	Condition and location of intake	What	State of strainer and location of intake in pond	Flow rate very low; large particles enter filter Intake too close to edge or bottom of pond	What:	Repair strainer and reposition intake	Training of Caretaker on O&M of PSF; see section #2 of Table 10: Improvement Action Plan.
		How:	Pumping rate and quality of water at inlet to filter Check position of intake		How:	Replacement strainer, physically move intake so away from edge or bottom	
		When:	Weekly		When:	Within 7 days	
		Where	At intake and inlet to filter		Who:	Caretaker	
		Who:	Caretaker				
	Suspended solids and hydraulic loads on filter	What	Flow rate and suspended sediment load of water from filter	Flow rate falls below that required by users Final water looks turbid	What:	Clean filter beds	Training of Caretaker on O&M of PSF; see section #2 of Table 10: Improvement Action Plan.
		How:	Inspection of the roughing filter and visual inspection of water		How:	Excavate beds and wash with clean water	
		When:	Weekly		When:	Within 7 days	
		Where	At filter		Who:	Caretaker and community	
		Who:	Caretaker				

Filter	Condition of biologically active layer on final filter bed	What	Constant head of water over final bed	No water over final filter bed	What:	Repair/install constant head device	Training of Caretaker on O&M of PSF; see section #2 of Table 10: Improvement Action Plan.
		How:	Inspection of filter, flow rate		How:	Uncover final bed and make repairs	
		When:	Weekly		When:	Within 1 day	
		Where	At filter		Who:	Caretaker	
		Who:	Caretaker				
	Filter clogging	What	The rate of flow through the filter	height reaches overflow pipe	What:	Clean the filter	Training of Caretaker on O&M of PSF; see section #2 of Table 10: Improvement Action Plan.
		How:	Flow rate/height of water over filter bed		How:	Scraping the top sand layer	
		When:	Daily		When:	Within 3 days	
		Where	At filter		Who:	Caretaker	
		Who:	Caretaker				
	Filter integrity	What	Filter bed depth, cracks etc.	Filter bed depth >0.31m	What:	Refill the bed with sand of proper grading as per schedule	-Caretaker training -User committee (or Management committee) training
		How:	Check bed top is above min. mark		How:	Through order of the committee	
		When:	Monthly		When:	Within 3 day	
		Where	At filter and committee meeting		Who:	Caretaker and user committee	
		Who:	User Committee				
	Media grading in filters	What	The quality of water from the outlet	Flow rate either too high or too low and final water turbid	What:	Change flow rate	Training of Caretaker on O&M of PSF; see section #2 of Table 10: Improvement Action Plan.
		How:	Visual inspection of water		How:	Adjust valve and reduce demand	
		When:	After cleaning		When:	Within 7 days	
		Where	At filter		Who:	Caretaker	
		Who:	Caretaker				
Condition of pumping supply	What	Check on condition of handpump, valves and buckets	Handpump, valves or bucket damaged, platform dirty	What:	Repair damage and clean platform	Training of Caretaker on O&M of PSF; see section #2 of Table 10: Improvement Action Plan.	
	How:	Sanitary inspection		How:	Replace work part		
	When:	Weekly		When:	Within 7 days		
	Where	At platform		Who:	Caretaker		
	Who:	Caretaker					

Filter	Condition of outlet taps	What	Whether taps leak	Tap leaking	What:	Repair tap	Training of Caretaker on O&M of PSF; see section #2 of Table 10: Improvement Action Plan.
		How:	Inspection		How:	Replace tap is needed	
		When:	Daily		When:	Within 7 days	
		Where	At filter outlet		Who:	Caretaker	
		Who:	Caretaker				
PSF Structure	Condition of PSF roof	What	Whether there are gaps between roof and PSF wall (for roof vermin proof)	Gaps between roof and wall	What	Close the gap	Training of Caretaker on O&M of PSF; (see section #2 of Table 10: Improvement Action Plan.)
		How:	Inspection		How	Repairing the roof	
		When:	Monthly		When	Within 3 days	
		Where	At PSF		Who	caretaker	
		Who	Caretaker				
Post source	Hygienic water use	What	Hygiene practice during water handling during water collection, transportation and storage	Water collection, transport and storage is hygienic	What:	Key hygiene messages	Community Education Support programme; (see section #4 of Table 10: Improvement Action Plan.)
		How:	Hygiene Inspection		How:	Hygiene education	
		When:	Regularly within community		When:	Ongoing	
		Where	Household and in community		Who:	Community hygiene promoter	
		Who:	Community hygiene promoter				

Table 8. Verification schedule

Activity	Description	Frequency	Responsible Party	Records
Effectiveness of water safety management	Regular meetings with community and/or water and sanitation committee	Regular sample of communities visited each year	Option provider/NGO or DPHE	Data stored at local levels and transferred to national water supply information centre
Reduction of social exclusion to source	Regular meetings with community and/or water and sanitation committee	Regular sample of communities visited each year		
Sanitary inspection	Inspection form to include all major hazard events that may occur due to poor infrastructure condition and poor catchment protection	Twice per year (dry season and monsoon)		
Testing of microbial quality	Thermotolerant coliform analysis using either field kit (DelAgua, Potatest etc) or laboratory Confirmatory testing for <i>E.coli</i> on 10% of positive samples	Twice per year (dry season and monsoon) to coincide with sanitary inspection		
Testing of chemical quality	Arsenic	On installation		
	Nitrate	Twice per year		
	Manganese Iron	On installation Once per year, In response to complaints		
	Free chlorine pH	If chlorination used Twice per year (dry season and monsoon) to coincide with sanitary inspection		
Testing of biological quality	Identification of species of algae present in blooms in ponds	Dry season (periodic)		
Testing of physical quality	Smell Turbidity Colour Taste	Twice per year (dry season and monsoon) to coincide with sanitary inspection		
Meet with management committee	Review with management committee WSP performance and caretaker performance	Once per year		

Table 9. Validation schedule

Process Step	Hazardous Event	Validation
All processes	Introduction of pathogens and presence of arsenic	Use of verification data in quantitative health risk assessment model to assess changes in potential disease burden
Catchment	Introduction of pathogens and nitrate into source via hazardous events identified in form 6	Combined analysis of water quality and sanitary inspection data from verification to assess whether protection measures have been effective
Pond	Introduction of pathogens and pesticides into source via hazardous events identified in form 6	Combined analysis of water quality and sanitary inspection data from verification to assess whether protection measures have been effective
	Introduction of cyanobacterial toxins due to algal blooms	Analysis of records of algal growth in ponds
	Loss of sufficient volume of water due to hazardous events identified in form 6	Assessment of pond volume and depth
Pond sand filter	Pathogens and raised turbidity in final water via hazardous events identified in form 6	Combined analysis of water quality and sanitary inspection data from verification to assess whether protection measures have been effective
Post source	Introduction of pathogens via hazardous events identified in form 6	Analysis of water quality and sanitary inspection data from verification to assess whether hygiene education has been effective

Table 10: Improvement Action Plan.

Issue Identified		Action Required	Procedures or Records?	Responsibility	Time Frame	Status
No.	Issue					
1	Pond protection	Develop and conduct community education programme. This will cover: -protection of ponds -protection of embankments -preservation of pond solely for drinking and cooking	Follow approved standard protection guidelines and laws	DPHE staff and NGOs responsible for developing and implementing the community education support programme	Short	
2	Proper Operation and Maintenance of PSF	Develop O&M manual for PSF Train Caretakers; the training should cover: -maintenance of filter flow rate; -repair of strainer; -cleaning of filter bed; -change of media; -repair hand pump; -repair/replace tap; -general maintenance of hygiene around the PSF.	Follow standard designs and O&M manual of PSF	DPHE staff and NGOs responsible for developing and implementing the community education support programme	Medium	
3	Chlorination	All pond sand filters should include chlorination	Chlorination guidelines required	DPHE /NGOs to develop guidelines for chlorination -GW Circle of DPHE	Medium	
4	Ensuring safe water handling post source	Provide hygiene education programmes to community to include: -washing of hands before water collection; -washing of vessels before collection of water; -keeping the vessel covered; -storing of water at clean and elevated place; -safe handling of water during usage.	Follow guidelines on hygiene education	NGO/hygiene promoter	Medium	