Protocal

30 YEARS 1981-2011
WaterAid

Water quality standards and testing policy

This document provides a framework to support improved access to safe water for low-income communities through the enhancement of water facilities. It is intended to help WaterAid's partner organisations in Nepal deliver safe water facilities to the communities they work with. This document will reinforce WaterAid's initiatives for ensuring the quality and sustainability of water supplies for millions of users. It is also hoped that this document will be of value to other organisations involved in improving safe water access, particularly for poor people. This document was prepared with reference to the *Guidelines for Drinking Water Quality* (WHO, 2004), *National Drinking Water Quality Standards* (MPPW, 2005) and I*mplementation Directives for National Drinking Water Quality Standards* (MPPW, 2005).

The production of this document was led by Kabir Das Rajbhandari from WaterAid in Nepal . Colleagues from WaterAid's partners in Nepal , and Vincent Casey from the Technical Support Unit in WaterAid's office in London undertook reviews of the document, providing valuable input. Colleagues from the Advocacy team in Nepal also reviewed the document.

This document should be cited as WaterAid in Nepal (2011) *Protocol - Water quality standards and testing policy*.

The document can be found in the documents section of the WaterAid in Nepal country programme website – www.nepal.wateraid.org

A WaterAid in Nepal publication

September 2011

WaterAid transforms lives by improving access to safe water, hygiene and sanitation in the world's poorest communities. We work with partners and influence decision makers to maximise our impact.

Cover picture:

Top and middle: WaterAid's partner organisation – Centre for Integrated Urban Development (CIUD)'s colleagues teaching the water users community to test water quality in the training.
ENPHO

Bottom: WaterAid's partner organisation – Nepal Water for Health (NEWAH) staff testing water in rural Nepal.
NEWAH

Contents

Abbreviation

AAS	-	Atomic Absorption Spectrophotometer
ADB	-	Asian Development Bank
BCHIMES	-	Between Census Household Information, Monitoring and Evaluation System
BCM	-	Billion Cubic Metre
BGS	-	British Geological Survey
BSF	-	Bio Sand Filter
CBS	-	Central Bureau of Statistics
CIUD	-	Centre for Integrated Urban Development
CSP	-	Country Strategy Paper
Cumec	-	Cubic Metre
CWRM	-	Community Based Water Resource Management
DDCs	-	District Development Committees
DEO	-	District Education Office
DOLIDAR	-	Department of Local Infrastructure Development for Agriculture Road
DPHO	-	District Public Health Office
DTO	-	District Technical Office
DTWs	-	Deep Tube wells
DWSS	-	Department of Water Supply and Sewerage
ENPHO	-	Environment and Public Health Organization
FEDWASUN	-	Federation of Water and Sanitation Users of Nepal
FINNIDA	-	Finland International Development Agency
FRC	-	Free Residual Chlorine
GDP	-	Gross Development Product
GoN	-	Government of Nepal (The then HMG)
GW	-	Ground Water
HDI	-	Human Development Index
HMG	-	His Majesty's Government
IDA	-	International Development Agency

IEC	-	Information, Education and Communication
INGO	-	International Non-Government Organization
IRP	-	Iron Removal Plant
IWRM	-	Integrated Water Resource Management
KAF	-	Kanchan Arsenic Filter
Km	-	Kilometre
m	-	Metre
mld	-	Million Litres per Day
MCM	-	Million Cubic Metre
MF	-	Membrane Filtration
g/lit	-	Microgram per litre
mg/lit (mg/l)	-	Milligram per litre
MoH	-	Ministry of Health
ML	-	Million Litre
ml	-	Millilitre
MLD	-	Ministry of Local Development
MOE	-	Ministry of Environment (Previously it is Ministry of Population and Environment)
MOU	-	Memorandum of Understanding
MPPW	-	Ministry of Physical Planning and Works
NBSM	-	Nepal Bureau of Standards and Metrology
NDWQS	-	National Drinking Water and Quality Standards
NESS	-	Nepal Environment and Scientific Services
NEWAH	-	Nepal Water for Health
NGO	-	Non Government Organization
NGOFUWS	-	NGO Forum for Urban Water and Sanitation
NPC	-	National Planning Commission
NRCS	-	Nepal Red Cross Society
NTU	-	Nephelometer Turbidity Unit
NWP	-	National Water Plan
NWSC	-	Nepal Water Supply Corporation
PoU	-	Point of Use
ppb	-	Parts per billion
ppm	-	Parts per million
RCS	-	Rapid Convenient Survey
RW	-	Rain Water
RWSSFDB	-	Rural Water Supply and Sanitation Fund Development Board

RWSSP	-	Rural Water Supply and Sanitation Programme
SIS	-	Sanitary Inspection Survey
Sq. Km.	-	Square Kilometre
STWs	-	Shallow Tubewells
SW	-	Surface Water
TCU	-	Total Colour Unit
TON	-	Threshold Number
UCs	-	Users' Committees
UEMS	-	Urban Environment and Management Society
UMN	-	United Mission to Nepal
UNICEF	-	United Nations Children's Fund
USAID	-	US Agency for International Development
VDCs	-	Village Development Committees
WA	-	WaterAid in London
WAN	-	WaterAid in Nepal
WATSAN	-	Water and Sanitation
WB	-	World Bank
WECS	-	Water and Energy Commission Secretariat
WHO	-	World Health Organization
WQ	-	Water Quality

1 Background

Although Nepal is rich in water resources, its history of supplied drinking water is not very old as planned development of water supply and sanitation started since Fourth Plan (1970 – 75) of the country when the national coverage of the water supply system was only about 4%. A separate institution named “Department of Drinking Water Supply and Sewerage” (DWSS) was established during that period.

By the end of the UN water supply and Sanitation Decade (1981-1990), the coverage substantially increased to 36% of the total population with 33% and 67% coverage in rural and urban areas respectively. The recent report produced by NMIIP, GWSS, 2009 indicates that national water coverage is to 80%.

1.1 Physical setting

Nepal is predominantly a mountainous country formed due to the uplift of the Indian tectonic plate following a collision with the Asian Plate. The country is a land locked in South Asia, between China and India with a total geographical area of 141,800 sq. Km. Topographic variations is extreme and the terrain has a general southward slope. The topography ranges from rugged High Himalayan in the North, to the central hill region, to the lower-lying Siwalik range (south – central) and down to the Terai or Flat River Plain in the south. Thus, the country can be divided into five physiographic regions viz:

a. High Himalayas (High Mountains)
b. Lesser Himalayas (High Mountains)
c. Middle Mountains (Mahabharat Range)
d. Siwaliks (Churiya Range)
e. Terai Plains

Due to orographic features, Nepal experiences a wide range of climates varying from the sub-tropical to the alpine type as the elevation varies from 64 m above sea level (Kanchan kalan, Terai region in the south) to

8848 m (World's highest peak - Mount Everest on the north border with China) within a span of less than 200 km. These large topographic variations give rise to a variable climate, ranging from cool summers with severe winter in the north to sub-tropical summers and mild winters in the south.

The country also experiences heavy rains during June to September due to the south-westerly monsoon, which accounts for 80% of the total rainfall, and winter rains, during November to January, accounting for the rest of the rainfall. The climatic conditions of Nepal are summarized in Table – 1.1.

The average annual rainfall of the country is about 1530 mm whereas of Kathmandu valley alone is 1300 mm (Jacobson, 1996). But there is a sharp spatial and temporal variation in rainfall. The pattern of rainfall distribution varies in both north – south and east – west directions. The monsoon rain is more intense in the east and goes on declining westwards, while the winter rain falls heavily in the west and goes on declining to the east. The rainfall pattern and the existing rugged and mountainous topography have resulted in the existence of a rich natural bio-diversity in Nepal, the importance of which is yet to be adequately realized.

1.2 Social setting

Nepal is inhabited by more than sixty caste and ethnic groups of people belonging to Indo-Aryan and Tibeto-Mongoloid stocks. The majority of people practice Hinduism whereas Buddhism is the second largest religion. The population of Nepal was 23.15 million in 2001 (CBS 2001) and with the assumed growth rate of 2.25%, the population in 2006/07 is estimated at 25.9 million with 21.5 million rural and 4.4 million urban population (NWP, 2005). The density of population has now reached 164 per sq. km.

Poverty in Nepal has persisted for decades and is widespread with around 38% of the population living below the prescribed poverty line. The Human Development Index (HDI) of Nepal has been computed at 0.504.

Agriculture is an important part of Nepalese Economy, with over 80% of the population being employed in the agriculture sector, generally on small and dispersed plots of low quality land.

Table – 1.1: Climatic Conditions of Nepal

Ecological Belt	Climate	Average Annual Precipitation	Mean Annual Temperature
Mountain	Arctic / Alpine	Snow/150 mm – 200 mm	⇠ 30C – 100C
Hill	Cool/Warm Temperate	275 mm – 2300 mm	100C – 200C
Terai	Sub - Tropical	1100 mm – 3000 mm	200C – 250C

The demand for such agriculture labor, however, is highly seasonal, and the opportunity for non-farm employment is low. As a result, there is insufficient work and underemployment lingers around 50%. Around 34% of the land is given over to arable or permanent pasture and around 42% of the land area is forested, although deforestation is widespread and resultant soil erosion has become a major environmental issue.

1.3 Economic setting

Agriculture is the main source of livelihood for a majority of the population of Nepal. More than 80% of the population is engaged in agriculture, which is still the dominant and largest sector of the economy, having a share of around 40% of the GDP. Agriculture sector is thus broad-based and any development in this sector will have balanced geographical spread. Agriculture sector in Nepal is, however, characterized by a subsistence orientation, low input use and low productivity.

1.4Geology

Geology controls the topographic variations in Nepal. High mountains of the Himalaya and central hill regions are dominated by ancient crystalline rocks. These have variable compositions, including metamorphic rocks, granites and old indurate sediments and have been strongly contorted and faulted as a result of the uplift of the Himalayan Mountains.

Young sediments (of Mesozoic to Quaternary age) are largely restricted to the southern, lower - laying parts of Nepal and to isolated intermountain basins in the hill regions (e.g. Kathmandu Valley, Mugu Karnali Valley). Sediments of Tertiary age (mixed sandstone and shale) outcrop the length of southern Nepal in the Siwalik range. To the south of these deposits, unconsolidated recent alluvial sediments form the low laying Terai plain along the Indian border. The Kathmandu valley is a down – faulted intermountain basin is filled with young sediments (of Pliocene-Quaternary age) up to 500 m. thick (Khadka, 1993; Jacobson 1996). The Mugu Karnali Valley is also infilled with recent alluvial deposits.

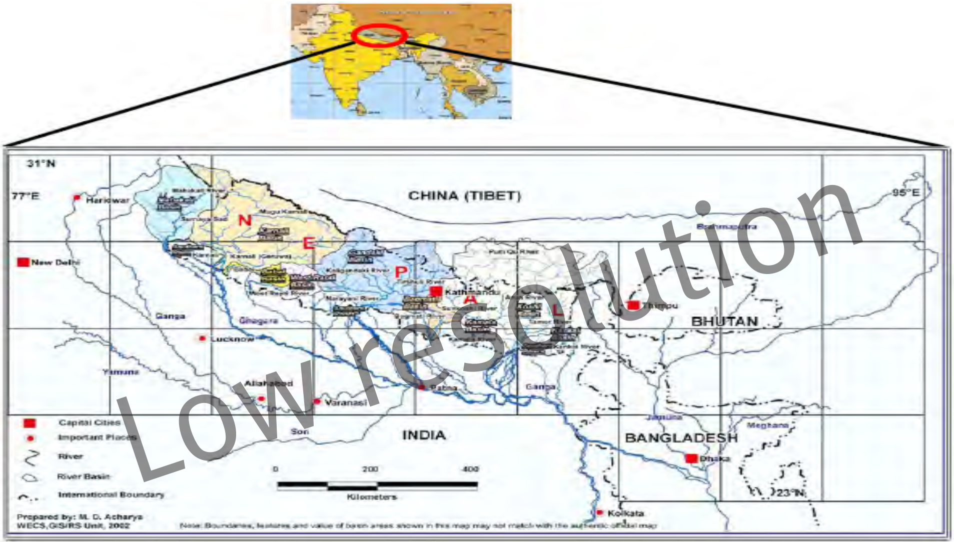
Mineral veins are present in some areas of the crystalline rocks. veins of sulphide ores (including pyrite, chalcopyrite, arsenopyrite, galena) occur in several areas, including Wapsa, Siddhi Khani, the Mrkhu-Kulekhani-Arkhaule area, Baaiis Khani (Baglung), Nangre – Bhorle area, Gyazi Sikpasor and Jantar Khani. Pyrite (iron sulphide) has also been recorded in black shale deposits in the Andhi Mohan Ghat area, Gandaki Anchal (Zone) (Khan and Tater, 1969).

1.5 Water resources

High rainfall totals generally give rise to abundant water supplies, at least seasonally and both surface water and groundwater are important sources for domestic, industrial and agricultural use.

Water is Nepal's largest known natural resource. Nepal has more than 6,000 rivers, which provide a dense network of rivers with steep topographic conditions. All the river system drain from north to south towards the Ganges. The major sources of water are rainfall, glaciers, rivers and groundwater.

Figure 1: River network of Nepal *(Refer Annex – 1 for enlarged version)*



Out of 6,000 rivers in Nepal, 33 rivers have a catchment area exceeding 1000 sq. km (CBS). The total average annual runoff from all these river systems is estimated at about 225 billion cubic metres (BCM). Thus, these rivers are the most important running surface water in terms of water volume and their potential development. High rainfall (average 1530 mm/year) generally gives rise to abundant water supplies, at least seasonally, and both surface water and ground water are important sources for domestic, industrial and agriculture use.

1.5.1 Surface water resources

a. The major river systems of Nepal, which originate in the Himalayas, are Koshi, Narayani (Gandaki), Karnali and Mahakali and are presented in the following Table – 1.2.

b. There are five medium river basins, viz: Kankai, Kamala, Bagmati, West Rapti and Babai. Each of them are primary, rain-fed and originate in Mahabharat Range. These rivers are also perennial, with groundwater and springs sustaining the river-flow during the dry period. The total catchment area of these rivers that lie inside Nepal is computed at around 17,000 sq. km. while the average combined runoff (at various gauging stations) is estimated at 461 cumec (14.5 BCM per annum).

c. The southern rivers, also called Siwalik rivers, originate in the Siwalik hills, are shallow in depth and mostly dry up during the dry season. The total catchment area of these rivers is estimated at around 23,150 sq. km. with average combined runoff estimated at 1,682 cumec (53 BCM per annum).

Table – 1.2: Major river systems of Nepal

River Basin	Catchment area (sq. km.)		Main Tributaries	Annual Average Runoff Discharge (cumec)
	Total	Within Nepal		
Koshi	60,400	46%	Sunkoshi, Arun and Tamur	1,409 (45 BCM)
Narayani (Gandaki)	34,960	90%	Trishuli, Budhi Gandaki, Marsyangdi, Seti and Kaligandaki	1,600 (50 BCM)
Karnali	43,679	94%	West Seti, Bheri, Humla Karnali, Mugu Karnali, Singa Tila, Lahore and Thuli Gad	1,397 (44 BCM)
Mahakali	15,260	34%	Not Available	

Table – 1.3: Availability of surface water and annual withdrawal trend for 5 Years

	1994	1995	1996	1997	1998
Total annual renewable surface water (km•/year)	224	224	224	224	224
Per capita renewable surface water (‘ooo m•/year)	11.20	11.00	10.60	10.50	10.30
Total annual withdrawal (km•/yr)	12.95	13.97	15.10	16.00	16.70
Per capita annual withdrawal (‘ooom•/yr)	0.65	0.69	0.71	0.75	0.76
Sectoral withdrawal as % of total water withdrawal					
a. Domestic	3.97	3.83	3.68	3.50	3.43
b. Industry	0.34	0.31	0.30	0.28	0.27
c. Agriculture	95.68	95.86	96.02	96.22	96.30

Source: WECS (1999); Yogacharya (1996,1998); Bhusal (1999)

a. Surface water availability and its use in Nepal

The following table shows the availability of surface water in Nepal and its annual withdrawal trend for five years.

1.5.2 Groundwater

Groundwater is abundant in the aquifers of the Terai and Kathmandu valley; however groundwater availability is more limited in the populated hill regions because of the lower permeability of the indurated and crystalline rock types. Despite abundant rainfall, agricultural development is restricted by the limited development of irrigation.

a. Groundwater in Terai

The hydro-geological mapping indicates that the Terai has tremendous potential of groundwater resources. The Terai, with a thick sequence of saturated detrital sediments of alluvial and colluvial origin, is one of the most productive aquifers in the sub-continent.

Groundwater is abundant in the aquifers of the Terai. It is estimated that the Terai region has a potential of about 12 billion m• of this, with an estimated annual recharge of 5.8 to 9.6 billion m• (the maximum that may be extracted annually without any adverse effects) (WECS 1999). Current withdrawal is about 0.52 billion m• per year. The aquifer in this region, which consists of sediments of alluvial origin, is very favourable for water accumulation beneath the surface area.

Shallow and deep aquifers are also present in the young alluvial sediments throughout most of the Terai region (e.g. Jacobson, 1996). The shallow aquifer appears to be unconfined and well developed in most areas, although it is thin or absent in Kapilvastu and Nawalparasi (Upadhyaya, 1993). The deep aquifer of the Terai (depth unknown) is reported to be artesian ie free-flowing. (Basnyat, 2001)

b. Groundwater in Kathmandu Valley

Though Kathmandu valley has an abundant groundwater, it is under immense pressure as it is being heavily used for drinking and for other activities such as carpet industries for instance.

In Kathmandu valley (area around 500 sq. km.), groundwater is abstracted from two main aquifers within the thick alluvial sediment sequence. A shallow unconfined aquifer occurs at around 0-10 m depth and a deep confined aquifer occurs at around 310-370 m (Khadka, 1993). Exploitation of these aquifers, especially the shallow aquifer, has increased rapidly in recent years as a result of the increasing urbanization of the region. About 50% of the water used in the Kathmandu valley is derived from the groundwater (total supply in dry season is 80,000 m• per day). This has resulted in a decline in water table.

In 1993, groundwater was abstracted from the aquifers of the Kathmandu valley via 22 government production wells and 334 private wells (out of which 188 were STWs and 146 were DTWs). Recent abstraction of groundwater from the deep aquifer has led to a decrease in the groundwater level by 15-20m since the mid 1980s (Khadka, 1993).

The recent study conducted by Metcalf and Eddy in 2000 revealed that the ground water table for deep aquifer in Kathmandu Valley has declined from 9m to as much as 68 m over a few years (Metcalf and Eddy, 2000).

c. Groundwater in other areas

The erosion of Siwalik Hills and the outwash fans of rivers form the northern-most Bhabhar Zone. The aquifers are unconfined and sediments being coarse materials have very high permeability in the range of 100 – 150 m/d. The Bhabhar Zone is considered to be the main source of recharge for the Terai groundwater.

Groundwater recharge at specific area is estimated to be as high as 600mm per annum; however, it is assumed that overall 450 mm is a recoverable recharge figure for all of the Terai areas. Inner terai areas such as Chitawan, Dang and Surkhet are estimated to hold good groundwater potential. It is, therefore, estimated that rechargeable groundwater in the Terai is anywhere between 5.8 BCm and 11.5 BCM.

d. Groundwater use in Nepal

At present, it is estimated that about 76 million cubic meters (MCM) of groundwater resources are being used for irrigation purposes and 297 MCM for domestic uses. Hence, there is huge potential of groundwater use in the form of shallow tubewells (STWs) and deep tubewells (DTWs) for different uses in the terai areas.

1.5.3 Rain water resources

This is water obtained from roof catchments and normally stored in tanks. Rainwater is the purest form of water unless and until it is intercepted by the contaminants within the air and the surface it falls upon, otherwise it is clear. Thus, it is liable to contamination from bird droppings, dust, and bird nests found on or within the catchment surface it falls upon. This source of water may contain biological contaminants that may impart health risks provided the surface it falls upon is already contaminated. Rainwater may also contain some dissolve contaminants (as rainwater can pick up the dust particles near industrial, crowded areas and dust particles made air borne brought by high winds) and their by products which in the atmosphere may be in the suspended form. Though it is rare, however, some and airborne dust particles can be picked up by rain falling nearby industrial areas or dust particles made airborne by high winds.

2 Policy on water quality management

2.1 WaterAid's principles and objectives

WaterAid's vision is of a world in which all people have access to safe water and effective sanitation, so that health benefits are maximized. WaterAid and its partners, work with communities through projects which integrate domestic water supply facilities with sanitation, and hygiene promotion.

WaterAid has recognized the need to develop a consistent approach to problems of water quality in the countries where it operates, and to develop a water quality policy in the context of each country that it works. General guidelines have been developed by WaterAid International Operations Department (Ref. 8) was revised as "Organisational Guidelines for Water Quality Testing" by Vincent Casey, WaterAid in London, in August 2008. According to the guideline, WaterAid's aims are that the quality of drinking water delivered to consumers by the projects that it supports should:

- Be such that no significant health risk arises from its use
- Conform to at least the broadly accepted quality standards of the region or the country where the installation is located (or be better if this can be achieved at reasonable cost and effort)
- Be acceptable in appearance, taste and other local aesthetic aspects

2.2 In the context of WaterAid in Nepal

WaterAid in Nepal (WAN) has already developed its CSP for five years (2005 – 10) which has focused to concentrate its programme activities on the poor, vulnerable, disadvantaged and socially excluded groups of the people of both rural and urban areas where access to safe water is still a problem and critical. In such areas, a clear policy for water quality is essential for delivering integrated water and sanitation services and hygiene promotion activities.

Henceforth, WAN has made its commitment to enact water quality policies adhering to the CWRM approach put forward by WA for addressing the issues of water depletion, source sustainability and pollution control. Similarly, WAN is committed to deliver the water supply and sanitation services by shifting its project approaches to programme approaches streamlining the following approaches and concentrating its project activities in water stressed/scarce areas where access to safe water is still a problem:

- Pro-poor approach through pro-poor policies with affirmative actions
- Community Based Water resource Management (WRM) approaches
- Partnership and collaboration approaches for service delivery etc.

WAN is therefore also committed to the goal of delivering, through its partners, safe and high quality drinking water facilities etc. by including, in its water quality policy, provisions for water quality monitoring and surveillance in the project activities ensuring that these activities minimise health hazards to the consumers of the community.

Giving due consideration to the WAN's commitment and to the fact of providing safe and quality water to the consumers, this water quality policy has been developed and is applicable to all the surface water, ground water as well as to any other alternative water supply technology / options.

2.3 Objectives of water quality policy

The objectives of this water quality policy are to:

- Outline the test procedures to be applied in monitoring the levels of the various potential contaminants.
- Specify and provide information on guideline values or standards set for physical, chemical, and microbiological requirements for safe drinking water.
- Propose appropriate practicable treatment measures for 'contaminated' raw water sources having in view the prevailing environmental conditions and available resources of the country.
- Assure that the quality of water delivered to the consumers for drinking is safe and clean for their consumption
- Ensure that the working partners use and abide by the provisions made in this policy while delivering the water supply facilities to the communities both in rural and urban poor.
- Focus on water quality management for enhancing water quality through effective and efficient water quality monitoring and surveillance programmes to reduce contaminations caused by diffuse source and point source pollution to water bodies.
- Facilitate and promote WRM as per the commitments made.

2.4 Standards

The standards to be achieved should deliver safe drinking water of acceptable quality in terms of health and disease hazards for the consumers. In this document, "standards" means standards appropriate to drinking water that can be measured quantitatively. That is to say, the standards to be adopted for drinking water in this document are capable of verification by the analysis of water samples but of course giving due consideration to the following practical limitations:

- Resources (ie financial and human) which may be available from WAN to its partners and

- Imposed by water supply technology which is sustainable in any given environmental context

Considering the above limiting factors and as mentioned in the WHO guidelines for Drinking Water Quality (Volume 3), in countries where economic and human resources are limited, short and medium term targets should be set in establishing standards so that the most significant risks to human health are controlled first.

The issue of water quality has been kept throughout in a context of environment health and disease burden on the poor. For this, an integrated approach is required by promoting sanitation and hygiene improvement activities with the delivery of water facilities and this can, no doubt, greatly improve the well being of the rural and urban poor of the country.

Therefore, in this document, the minimum criteria for drinking water are outlined within the socio-economic context and availability of human resources in Nepal. The various water sources and likely risks associated with them have also been discussed after which recommendations on specific interventions for testing, and mitigation measures have been offered to guide programme staff, partners and other stakeholders (users of this document).

In keeping a measurable balance between the standard technical quality of water, cost of producing water of such acceptable quality, and the ability to maintain and sustain the facilities within the acceptable and affordable limits of the community beneficiaries, WAN has set the under-listed as the minimum criteria required for the quality drinking water for the consumers.

Under these criteria, water shall be:

- Free from pathogens (disease causing micro-organisms)
- Contain no chemical compounds or by-products (even at very low concentrations) that may have health hazards (short term or long term) to the consumers
- Free from suspended solids, colour (ie water should be fairly clear with very low turbidity and very little or no colour), offensive odour and taste

Whatever be the technologies adopted in delivering water services to the communities, the associated risks should be examined and appropriate recommendations for the solutions should be made to guide all the partner organisations and programme staff to ensure monitoring and evaluation of water quality delivered to the community beneficiaries.

Considering all the facts and discussions made above, water quality standards in this policy document refer to guideline values set for the various water quality parameters to ensure delivery of drinking water of acceptable quality devoid of any health and disease hazards. In the preparation of quality standards outlined in this document, the concerned stakeholders of the country were consulted and exclusive references were also made to the *'National Drinking Water Quality Standards, 2006)'*. During the absence of the water quality standards, Nepal adopted WHO guideline values and sometimes Indian Standards were also adopted wherever appropriate. Thus, references to these documents were also taken at large, particularly WHO Guidelines for Drinking Water (Volumes – I, II, and III).

2.5 Scope of water quality policy

This policy note applies to all WAN funded programmes in Nepal. Typically this will cover household and community based water supply for domestic drinking water including ground water supplies through hand pumps, tube-wells, bore-holes etc., surface (piped) water supplies through gravity flow schemes and small scale alternative water supply technological options such as water points facilities by possible rain water harvesting system. This policy is not intended to cover larger water supply schemes such as town/city supplies beyond the reach of WAN. For such schemes, an individual assessment would be required confirming with standard criteria and procedures as depicted in the National Drinking Water Quality Standards, 2006.

WaterAid is currently implementing its programmes in partnership with a number of rural and urban focused national NGOs, including NEWAH, LUMANTI, ENPHO, CIUD, UEMS, NGOFUWS, FEDWASUN etc, all of whom are required to adhere to the standards and testing procedures defined within this policy document. And other organisations who will be working with WaterAid in Nepal in future will also require to adhere the protocal.

3 Key sector stakeholders / organisations

National Policy on Drinking Water Quality Standards (NDWQS) and programmes for water quality monitoring was published by Drinking Water Supply and Sewerage (DWSS) / Ministry of Physical Planning and Works (MPPW) /Government of Nepal (GoN). While preparing this document, GoN, the then HMG/N constituted a steering committee including representatives from different government departments, I/NGOs and research institutes.

3.1 Institutional arrangement

In this Chapter, Institutional roles and responsibilities are defined for the implementation and monitoring of as this involves various authorities from central to local levels. This is very important, as there are many stakeholders involved in Water Quality related policies, strategies, monitoring, surveillance and implementation of water systems. The agencies concerned with drinking water and their roles, rights and responsibilities are assigned by NDWQS as follows:

3.1.1 Ministry of Physical Planning and Works (MPPW)

The Ministry has the overall responsibility of planning, implementing and coordinating and monitoring the water supply and sanitation sector development activities in the country to its other sectoral responsibilities such as roads and transportation, housing and urban development. The Ministry is responsible for the formulation of sector policy and strategies, its implementation and monitoring the sector performance. As the sector line ministry of the Government, this ministry will be responsible for updating the Guideline every five years and determine from time to time the community, district, and municipality where the water quality standard shall be imposed.

Most of the water supply and sanitation projects in rural and urban areas are implemented through the following three agencies under this Ministry. They are:

3.1.1.1 Department of Water Supply and Sewerage (DWSS)

This is the largest sector agency of the government entrusted with the task of implementing water supply and sanitation facilities in the rural and urban areas. The Department provides technical, financial and institutional support to communities constructs new facilities and rehabilitates and augments existing facilities (including water quality improvement works) and hands over the completed facilities to communities, Nepal Water Supply Corporation, and municipalities for subsequent operation and maintenance and supplying drinking water to the consumers.

The DWSS has the Water Quality Section in its head office at Kathmandu and sub-division and division offices in each of the 75 district head quarters. The Water Quality Section of the department will be mainly responsible to plan the development of water quality monitoring and surveillance programme in the country with the cooperation and coordination of the sector related agencies and donors. The Water Quality Section carries out research on water quality testing and treatment appropriate to national conditions and disseminates the research work among the implementing agencies, service providers and regulators.

The DWSS is responsible for collecting information on technological development in the area of water quality testing and epidemiological know-how and examines and interprets in the national context. The DWSS provides technical and professional support to the MPPW to update the guidelines every five-year and advises the Ministry where to implement the water quality guidelines in any given area.

The DWSS, as the lead sector agency, will establish a water quality monitoring section, with appropriate number of trained personnel, in each of its sub-division and division offices in phased manner. It will also establish a water-testing laboratory, with facilities adequate to test parameters prescribed for monitoring and surveillance for the district concerned, stocks replacement parts for testing equipment and chemicals, in each of its district-based offices. Tentatively, such facilities will be established.

The sub division and division offices when provided with qualified technicians and lab facilities will commence its own in-house water quality monitoring and surveillance programme. It will also provide its technical services to other agencies that wish to establish water quality monitoring and surveillance programme on a cost basis. The sub-division and division offices of the DWSS will forward its water quality monitoring report to the District Health Office. As per NDWQS, the time span for this to happen is 10 yrs which is divided into two phases; first phase has 5 years span and second phase has next 5 years.

3.1.1.2 Nepal Water Supply Corporation (NWSC)[1]

The Corporation was established with the objective of improving the services in urban areas and operates them on a commercial basis. Initially Kathmandu Metropolitan City and four other municipalities in the Kathmandu valley were included among

1 *In Kathmandu Valley, NWSC is now replaced by Kathmandu Upatyaka Khanepani Limited (KUKL) once the utility reform process was in place*

the towns and cities then operated by the Department of Water Supply and Sewerage. Presently, the NWSC is operating water systems in 24 cities and towns. In the context of implementation of the Melamchi Water Supply Project to alleviate the rapidly deteriorating water supply situation in the Kathmandu valley and the need to substantially improve the management of the utility, HMG (presently GoN) has plans to establish a water authority to own the assets and a water utility company to operate the water services in the Kathmandu valley. Under the new arrangement, NWSC will transfer the ownership of the assets to the authority and transfer the operation responsibility to the company. For the initial 5-year period the company is envisaged to hire the services of a performance based management contactor. The Government will also establish an independent committee to determine appropriate tariffs on a periodical basis.

Various other options of institutional arrangement for inside and outside Kathmandu towns are under consideration at present. The options include: 1) abolition of the NWSC and creation of a urban water authority to own the assets and plan and invest in the development of the urban water and sanitation sector in all the towns and cities under the of NWSC. Each town and city or their group need to have a separate company for operation and 2) NWSC to continue functioning outside Kathmandu valley towns.

The NWSC has moderately equipped central water quality laboratory and qualified manpower, for in-house water quality monitoring and surveillance purposes, at its Head Office in Kathmandu. The NWSC or its successor will update its central laboratory equipment and facilities to fully comply with the requirements of this guideline. It will also establish a water-testing laboratory, with facilities adequate to test parameters prescribed for monitoring and surveillance for the district concerned, replacement parts and chemicals, in each of its town-based offices. The town water supply offices of NWSC will forward its water quality monitoring report to the District Health Office.

3.1.1.3 Rural Water Supply and Sanitation Fund Development Board (RWSSFDB)

Most water supply schemes taken up by RWSSFDB and other agencies in rural areas are aimed to bring water to consumer household/or near-by to reduce the time and effort spent by local people particularly, women in fetching water from distant sources. Naturally, quality aspect takes only secondary position. In this connection, RWSSFDB, is implementing a demand driven Rural Water Supply and Sanitation Project funded by IDA. Under this project, a large number of rural schemes have been identified and presently, are in various phases of development.

3.1.2 Ministry of Local Development (MLD)

The Ministry of Local Development is mainly responsible for providing technical, institutional and financial support to local bodies, namely, District Development committees (DDCs), Village Development Committees (VDCs), and Municipalities. The funds received through MLD combined with their own funds generated locally are invested for local infrastructure development. Most of the local level investment made by the local bodies goes to the water supply sector. The HMG has created technical section with manpower in each DDC to improve upon the technical capabilities of the local bodies to implement infrastructure development projects.

3.1.2.1 Department of Local Infrastructure Development and Agricultural Reform (DoLIDAR)

It is the only technical department under the Ministry of Local Development. It is involved in planning and implementation management of the rural infrastructure development programmes by District Technical Offices especially under Local Bodies (office DDC). Major focus of DoLIDAR is planning and management of rural infrastructures, promotion of suitable and local technology (Labour-based Environment Friendly), providing guidelines and technical backup to Local Government Institutions for sustainable development of rural infrastructure and search for probable resources (Local, Internal, External as from Donors).

The responsibility of DOLIDAR through District Technical Office (DTO) also lies to monitor the water quality of the system built by the government agencies and other non-government agencies after handing over to the water users committees at respective districts. The DTOs also needed to be equipped with necessary manpower and training for the services.

3.1.3 Ministry of Health (MoH)

The Ministry of Health and Population is responsible for providing health care services to the population through its network of sub health posts, health posts, health care centers and district, zonal, regional and national hospitals. The responsibility for surveillance of water related diseases has been given to the Ministry of Health and Population. The District Public Health Office (DPHO) will receive and compile the water quality monitoring report sent by various agencies of the district and publish a Water Quality Report for the district concerned with its own findings, conclusions and recommendations

The DPHOs will observe from the monitoring report of the concerned agencies that whether or not they are complying with the requirements of the guidelines and issue necessary warnings and impose necessary fine. Where prescribed, it will request the District Administrator's Office to prosecute the violator of the law. The Ministry of Health (presently as Ministry of Health and Population) will annually publish a Water Quality Status Report for the country with highlights of all water systems.

3.1.4 Local authorities and water users committee

The local authorities such as DDC/VDC and municipalities including water users committees are also implementing water and sanitation systems mainly of small scale level, at rural and peri-urban areas. The local water users committees may not be equipped with or have knowledge on water quality issues. Therefore, training and capacity building activities are recommended to be carried out at this level. The following Table – 3.1 outlines brief summary list of different Government, Non government and Donor agencies with their responsibility/involvement in water quality assessment.

3.1.5 Donors, INGOs, NGOs, and private sector

Various donor agencies such as World Bank, Asian Development Bank, Swiss Development Cooperation, WHO, UNICEF, UN HABITAT etc.; INGOs like Water Aid, FINNIDA, Helvetas, SNV, Practical Action, CARE Nepal, Concern etc.; and NGOs like Nepal Water for Health (NEWAH), Environment and Public Health Organisation (ENPHO), Nepal Red Cross (NRC), etc. are involved in water and sanitation sector. They are either involved directly or with Government of Nepal (GoN) for implementation of water supply and sanitation systems. The Private Sector Entities like CEMAT, NESS etc. (these are private water and wastewater testing labs) and others are engaged in the domain of water quality issues in Nepal.

3.1.6 Consultation with the stakeholders

While preparing this policy, most of the aforementioned stakeholders were consulted directly or indirectly (formally or informally) and tried to incorporate their suggestions and inputs as relevant. In addition, the comments, suggestions and inputs that were provided in the national workshop on dissemination of National Drinking Water Quality Standards (NDWQS) by different sector stakeholders and practitioners were also considered and taken care of while developing this policy. In addition, the organisations with whom WAN partners with were consulted and sought their inputs as well as field experiences while finalizing this polity keeping in mind that they are the ultimate users of this policy. Similarly, while preparing this policy, Nepal's National Drinking Water Quality Standard, 2006 has been referred and consulted with the people involved during its preparation.

Table – 3.1: Summary list of organisations involved in water quality assessment

Name of the organisation	Responsibility	Type of organisation	Remarks
Ministry of Physical Planning and Works (MPPW)	Policy framework	Government	
Ministry of Population and Environment (MoPE)	Regulation	Government	
Department of Water Supply and Sanitation (DWSS)	Setting and enforcing Drinking Water quality policy	Government	
Nepal Water Supply Corporation (NWSC)	Maintaining the water quality standards within the jurisdictions of its Urban water supply network	Autonomous Public body but requiring government subsidy for operating costs	Manages water supply networks in 28 out of 58 Municipalities including Kathmandu Valley
Rural Water Supply and Sanitation Fund Development Board (RWSSFDB)	Supports local NGOs for Water and Sanitation projects.	Quasi government Public body	
Nepal Red Cross society (NRCS)	Implements Water and sanitation Projects	NGO	

Name of the organisation	Responsibility	Type of organisation	Remarks
Nepal Water for Health (NEWAH)	Helps local NGOs for implementation of water and sanitation projects	NGO	
Environment and Public Health Organisation (ENPHO)	NGO specialized in Water quality testing	NGO	
UNICEF	Working with DWSS on water quality and sanitation	UN Organisation	
UN-HABITAT	Working with government agencies like MPPW/DWSS and DUDBC; MLD and with other sector players in WASH sector of Nepal. Predominantly working in urban water and environmental sanitation under its Water for Asian Cities (WAC) Programme in Nepal	UN Organisation	
WHO	Working with DWSS on water quality	UN Organisation	
WaterAid	Supports NEWAH, Lumanti, ENPHO, CIUD, UEMS and NGO Forum for water and sanitation projects.	INGO	
FINNIDA	Working with District Authority for implementation of Water and sanitation project in Lumbini Zone.	INGO	
World Bank	Funding support to RWSSFDB for implementation of 1st Phase project	International Financial Institution	
Asian Development Bank (ADB)	Funding support to DWSS for rural water supply, small town water supply and Kathmandu Valley water supply project.	International Financial Institution	

4 Roles and responsibilities for water quality testing

The overall responsibility for water quality issues in WaterAid in Nepal (WAN) will lie with the WAN's Country Representative. WAN will assist partners on technical and practical issues and will also support them to prepare their own water quality testing policy, having a testing programme on a regular basis and follow up actions. In WAN, urban programme manager, who at present is assigned as WAN's technical focal person, will be responsible for making partners capable to implement and deal with water quality issues in accordance with this WQ testing policy. Similarly, WAN's programme officers will be responsible for making sure that partners are adhering to WAN's WQ policy. Whereas Partner organisations will be fully responsible for conducting WQ test for all the water points installed for delivering safe water to the poor and deprived communities both in rural and urban areas. Thus, for partner organisations, the head of organisations and their respective technical/engineering division/section will be responsible for water quality issues.

The summary of the roles and responsibilities for Water Quality Testing in WaterAid in Nepal (WAN) is tabulated below:

Table – 4.1: Roles and responsibilities for Water Quality Testing in WAN

S.N.	Roles and responsibilities	Responsible person	Remarks
1	Drafting/Updating a Country Programme Water Quality Standards and Testing Policy	Urban Programme Manager	WAN assigned its urban programme manager as a Focal person for Water Quality and other technical endeavours
2	Implementing a Country Programme Water Quality Standards and Testing Policy	Country Representative	Supports will be sought from respective programme managers and officers for implementing the policy on the ground
3	Conducting Water Quality Testing and making sure that partners are adhering with WAN's WQ policy	Implementing Partners and WAN's Programme Officers	WAN's programme officers will make sure that all the water points (new/rehab) installed by partners are tested for quality of water

The partner organisations with whom WAN partners with in delivering WASH services to the poor and deprived communities of both rural and urban areas are practicing the following formats (Format – 1 and Format – 2) mentioned in the subsequent pages (ie Page – 20) for recording and reporting the water quality test results.

Format – 1: Quarterly reporting on water quality

Reporting period	Constructed (Water sources and points)		Tested (Water sources and points)			Not tested (Water sources and points)			Remarks	Notes
	New	Rehab	Exist.	New	Rehab	Exist.	New	Rehab		
Previous year										Detailed WQ findings should be submitted as annex in Annual Report • Highlight key water quality problems and challenges • Explain any mitigation action taken or planned • Achievement in mitigation on water quality (include in Annual Report)
Q1										
Q2										
Q3										
Q4										
TOTAL										

Format – 2: Recording water quality test results

Tested water points	No	Tested parameters													
		Coliform		Ammonia		Iron		Nitrate		pH		Hardness		Chloride	
		Within standard	Out of standard	Within standard	Out of standard	Within standard	Out of standard	Within standard	Out of standard	Within standard	Out of standard	Within standard	Out of standard	Within standard	Out of standard
Tube well															
Dug well															
Public Tap stands															
Community Tap stands															
Kuwa															
Stone spout															

** Standard refers to permissible limit mentioned in WAN's WQ protocol*

5 High risk (principal) contaminants

History of water quality studies in Nepal is not very old. Due to the ineffective institutional capacity and poor economic condition, water quality has not yet been prioritized compared to the focus given to increasing water supply coverage. The first water quality testing laboratory for basic physio-chemical parameters was established in Sundarijal Water Treatment Plant during 1965. Except few studies conducted by USAID in 1971/73 on groundwater quality monitoring of Kathmandu Valley and Microbiological Quality studies of Kathmandu water supply system by Central Public Health Laboratory of Tribhuvan University, there were not any significant studies carried out on drinking water quality sector till mid of 1980 (WHO, 1999).

Although a water quality testing programme existed in the last decade, a water quality data management system does not exist or if it exists, it cannot be accessed easily. Till 1998, the testing of water quality was limited mostly to microbiological quality and a few non-health related chemical parameters. In 1999, different agencies started to look over the growing concerns on arsenic and started to investigate into the possibilities of arsenic contamination in shallow ground water aquifer and finally felt the need of water quality testing programme.

Therefore, it can be said that there is a notable lack of water quality data for Nepal and hence the assessment of the main quality problems is difficult. Many of the documented problems are related to pollution of both surface waters and shallow ground waters from domestic agriculture and industrial wastes.

5.1 Water resources

5.1.1 Surface water

These are surface derived water sources and include rivers, impounded reservoirs, lakes, streams and others. Much of the Nepalese population uses surface water for potable supply which is most vulnerable to pollution caused by untreated sewage, industrial wastes, agricultural run-off, vegetation etc. These sources are distributed to the consumers through gravity flow technology without any treatment. The available data on water quality testing (basically of rural areas) conducted by various agencies over 128 samples indicate that:

- All the chemical quality of water found within WHO guideline values.
- Faecal coliform contamination found to be widespread in majority of gravity fed surface water schemes.
- Faecal coliform contamination situation did not seem to improve even where changes in intake system were made.
- In Terai schemes, the contamination problem, particular due to calcium and magnesium carbonate, seemed to be serious due to the elevated water temperature.
- Scaling potential in gravity flow supply though existed due to calcium and magnesium carbonate; it is not serious in all over the region. Out of the study conducted over 80 schemes, only 10 schemes (ie 13 % of the total 80 samples) showed high scaling potential, 18% of the samples showed moderate whereas 69% of the total samples are free from scaling problem.

Degree to health risk: Owing to the limited resources available for testing, it is recommended that priority be accorded to the contaminants that pose significant threat to the health of the community. Other contaminants that confer aesthetic defects to drinking water could cause consumers to revert to unsafe traditional sources which should also be tested. It is only when there is no alternative that surface water sources should be considered, as surface water has high probability of pathogenic (coliform) micro-organisms and chemical by-products.

Table – 5.1: Percentage of coliform grade in gravity flow surface water supply schemes

Faecal coliform count (Per 100 ml)	Faecal coliform grade	Health risk	% of samples
0	A	No Risk	12
1 – 10	B	Low Risk	23
11 – 100	C	High Risk	26
101 – 1000	D	Very High Risk	38

Note: No of Samples is 128
Source: *"Rural Water Supply and Water Quality Status in Nepal" by Dr. R. R. Shrestha for UNICEF and HMG/ADB/ CBWSS/PPTA in 2002*

Table – 5.2: Percentage of scaling potential grade in gravity flow surface water schemes

Scaling potential grade	Risk	No. of samples	% of samples
A	No Risk (free)	55	69
B	Moderate Risk	15	18
C	High Risk	10	13

Note: No of Samples is 80
Source: *"Rural Water Supply and Water Quality Status in Nepal" by Dr. R. Shrestha for UNICEF and HMG/ADB/ CBWSS/PPTA in 2002*

High risk (principal) contaminants:
The principal contaminants of surface water sources include pathogenic micro-organisms; In addition, iron and manganese and nitrates along with other naturally occurring trace elements also contribute to surface water contamination.

Requirements for distribution systems:
Piped gravity-flow surface water supplies from head works to the consumers draw-off should be disinfected and should have a residual chlorine of 0.5 to 1.0 mg. Water should be conditioned at the head works to attain a ph value within the range of 8 to 8.5 to prevent corrosion of the distribution pipelines. It is therefore recommended that surface water sources derived for mass distribution be subjected to conventional treatment processes at the head works before feeding into the distribution network for consumption.

5.1.2 Groundwater sources

These are derived from aquifers occurring within pervious strata from water which normally originates from the precipitation that percolates through the soil and is confined by an impervious stratum. The water may pick up considerable amounts of dissolved mineral compounds, organic matter, soil particles and mirco-organisms. Fertilizers and pesticides may also be found in dissolved form. Filtration and absorption take place naturally and may result in the removal of bacteria, much of the suspended matter and possibly dissolved minerals as well. Ground water resources include hand dug wells, tube wells and bore holes. Hand pumps on the tube wells and hand dug wells (with or without hand pumps) are common in the Terai regions of the country. Water quality study of groundwater (shallow well and dug well) was started in 1990 by analyzing some physio-chemical (non-health related parameters) and microbiological tests.

Degree of health risk

Shallow groundwater is at risk from surface contamination: pathogenic bacteria, pesticides, chemical fertilizers, nitrates, industrial (though nature of industrial effluents is not known in detail but the greatest sources are likely to be from the textiles and carpet-

Table – 5.3: Water quality status of sampled shallow groundwater in Terai region of Nepal

Sites (District)	Chloride (mg/l)	Ammonia (mg/l)	Nitrate (mg/l)	Iron (mg/l)	Manganese (mg/l	Coliform (cfu/100ml)
Panchgacachi (Jhapa)	15.4	0.70	0.2	6.0	0.8	11.1
Baijnathpur (Morang)	16.4	0.50	0.2	4.5	0.5	15.9
Bayarban (Morang)	17.6	0.50	2.4	6.0	0.6	0.0
Takuwa (Morang)	21.0	1.00	1.0	10.4	0.4	45.9
ShreepurJabdi (Sunsari)	37.2	.90	0.2	8.0	0.6	25.5
Bandipur (Siraha)	195.6	0.70	3.5	0.4	0.4	0.0
Naktiraipur (Saptari)	54.5	1.20	0.3	12.0	1.3	16.0
WHO standard	250.0	1.24	10	0.3	0.5	Nil

Source: *ENPHO (1990)*

manufacturing industries) and domestic pollutants (urban, especially Kathmandu and peri-urban areas) are likely to be the greatest problems encountered in shallow groundwater in Kathmandu valley in particular. In Terai region, the shallow aquifer is reported to be largely unconfined; the vulnerability to surface pollution may be relatively high because of the sandy and permeable nature of surface sediments. The following Table – 5.3 shows water quality status of shallow groundwater for seven sites in Terai region.

Spring water from Karstic limestone aquifer at depth in the Kathmandu valley and mid hills in western part of Nepal especially in Lumbini zone are reported/ found to be of calcium-bicarbonate type with good inorganic chemical quality, although the amount of data is limited.

Deep groundwater present in the Kathmandu Valley and the Terai are less vulnerable to surface pollution, but have a different set of potential water-quality problems arising from the anaerobic condition of the aquifers. Increased concentration of Iron, manganese, ammonium and possibly arsenic may occur in these circumstances.

The ground water quality in the Kathmandu Valley is also contaminated due to polluted surface water, leachate, and sewage. The following Table – 5.4 shows that, there is certain degree of contamination of ground water sources. Dug wells and ponds are among the most contaminated water source.

Principal contaminants: The principal contaminants of ground water sources include arsenic, iron and manganese, and pathogenic micro-organisms, In addition, nitrates and nitrites along with other trace elements also contribute to the ground water contamination.

Requirement for the development of groundwater: Wells should not be sited in fissured rocks and Karstic formations especially where fissures reach out to the surface area. Such formations can serve as an entry points for sewage, human waste of all kinds and run-off contamination of the aquifer. Such formations facilitate fast transmission of contaminants over distances of several kilometres.

Wells should be sited as advised below:

- Nearest well should be at least 10 m (30 ft.) away if there is 4 m of fine soil below the base pit of latrines, refuse dumps etc. and up to 50 m distant if the pit is

Table – 5.4: Status of microbiological contamination in groundwater in Terai region

Faecal coliform (Per 100 ml)	Value as % of sample units of 15							WHO guideline value
	Dug well	Shallow well	Deep well	Spring	Stone spout	Pond	Piped water	
0	0	60	80	40	20	0	60	Nil
1-100	40	30	15	30	40	0	20	Nil
101-1000	30	5	5	30	40	0	20	Nil
>1000	30	5	0	0	0	100	0	Nil

Source: *ENPHO (1999); NWSC (1999)* close to the ground water level or if the stratum is very porous or fissured rock.

- The base of the pit latrines, refuse dumps etc. should be at least 1 m above highest recorded or expected ground water level. If otherwise, 5 m (15 ft.) clear vertical distance between the base of the pit and level water table should be maintained at any cost.
- Wells should have a parapet extending about 1 m above the ground level to prevent surface water flooding back into the well.
- *WAN through its implementing partners Will be analyzing the distance to be maintained (both vertical and horizontal) between source of water and source of contamination to avoid possible ground water contamination.*

Wells should be provided with a cover and preferably a hand pump to prevent contamination from ropes and buckets. In addition, the wells should have a water tight inner lining made of any construction materials to provide protection against collapse and prevent crumbling ground from filling up the excavation.

Water from deep boreholes may contain high level of dissolved iron and thus need preliminary treatment like aeration and sedimentation. All newly drilled boreholes should be disinfected and routine monitoring of water quality performed.

5.2 Principal (high risk) contaminants of water and risks to human health

The High Risk (Principal) contaminants of drinking water that present risks to human health in Nepal are discussed in the tables- 5.1, 5.2, 5.3 and 5.4 presented. The most important are microbiological contamination particularly in surface water, and naturally occurring arsenic in groundwater particularly in the shallow aquifers. Concentrations of iron are common in Nepal; however, the ingestion of iron is not a major potential health problem. Taste, odour and colour are natural unacceptable and objectionable to the consumers but do not necessarily present a health risk.

Because the resources available for testing the quality of water are likely to be limited, prior attention should also be given to testing for the presence of those contaminants, which could constitute significant threat to the health of a community. It is commonly recognized fact that the use of contaminated water for drinking purposes poses significant health risks mainly from micro-organisms and chemical contaminants. For example, the microbial contamination should be regarded as an acute and ubiquitous threat to the safety of un-chlorinated community water supplies, although the importance of chemical contamination should not be underestimated as well.

Review of different available literatures in the context of Nepal including BGS risk facts/ assessment sheets at present; consideration of the local or national or expert knowledge during consultation at different stages, forums, meetings etc.; and references of the known national authority on water quality and sector actors in WASH domain and experiences of other agencies working in the field were also undertaken while identifying the High – Risk (Principal) Contaminants of water. Based on this review, the following High – Risk (Principal) Contaminants are identified and discussed below:

High risk (principal) contaminants	Nuisance constituents: Aesthetic parameters:
Microbiological contamination	Iron and Manganese
Arsenic	Chlorine
Nitrate	pH
Fluoride	Ammonia
	Turbidity
	Hardness
	Colour, Taste and Odour

5.2.1 Microbiological contamination

Groundwater should be of good microbiological quality at origin, but can be contaminated due to unsanitary practices. Microbiological quality of shallow groundwater from tube wells was initially thought to be free from pathogens in the past, but this has now been found to be uncertain. Test results showed 47% out of 14394 water samples were found to contain coliforms ie pathogenic contamination was found in groundwater samples taken from shallow tube wells *(Dr. Shrestha, R.S., 2002; Rural Water Supply and Water Quality Status in Nepal)*.

Bacterial quality control of, total coliform, particularly faecal coliforms has, therefore, become a high priority parameter from the health risk aspect, because of widespread contamination of surface and shallow ground water indicated *(Refer Table – 4.4 above)*. Surface water sources in many rural areas have been found to be contaminated by human feces and ground water in many urban areas, especially Kathmandu, has been contaminated by seepage from septic tanks and soak pits.

The BGS fact sheet referring to *Adhikari*, 1998, indicated that faecal and total coliform counts are often high in drinking water. According to BGS, some groundwater samples from deep alluvial aquifers and the karstic limestone aquifers of the Kathmandu Valley have detectable coliforms. However, these probably originate from contamination at the wellhead rather than contamination of the aquifer themselves.

The protection of sources and the operation and maintenance of water treatment facilities has thus become a critical issue if the overall health status is not to suffer as a result of microbiological contamination in both surface and ground water sources.

5.2.1.1 Risks of microbiological contamination to human health

As mentioned previously the biological quality of surface water sources in Nepal is extremely poor. A test for Thermo Tolerant (faecal) Coliforms (TTC) is used as a marker for the presence of faecal matter and hence of likely pathogens. The faecal coliform concentration of ponds is also high and many are chemically and bio-chemically contaminated. Examples of diseases which are waterborne (caused by contaminated drinking water) include cholera, typhoid, hepatitis, amoebiasis, and dracunculiasis. The causes of the high levels of contamination/pollution of surface water are often due to hanging latrines and direct sewage discharge (without any treatment etc.) into surface water bodies, close proximity of latrines or drains, shallow tube well depth or method of tube well development, or priming.

Infectious diseases caused by pathogenic bacteria, viruses and parasites are the most common and widespread health risks associated with drinking water. Microbiological contaminants originating from human animal excreta have the capacity rapidly incapacitate large sections of a community, causing illness and death. Many people can be exposed to microbiological contaminants before the danger is highlighted through water quality testing. Unprotected surface water and ground water supplies are all vulnerable to contamination with human and animal excreta. Microbiological contamination is thus an extremely high priority parameter that requires regular and periodic monitoring. It is important not to understand the danger that microbiological contaminants post to health even if high levels of chemical contaminants are also likely to be present.

Every year 10,500 children under 5 years of age lost their lives from waterborne diseases caused by drinking contaminated water. (WaterAid, 2010)

5.2.2 Arsenic contamination

Arsenic is a ubiquitous element found in the atmosphere, soils and rocks, natural waters and organisms. Arsenic occurs naturally in certain rock types, soils, atmosphere and water bodies. It is mobilized and released in the environment through a combination of natural processes such as weathering reactions, biological activity and volcanic emissions as well as through a range of human activities, including mining, industry and agricultural use of arsenical fertilizers and pesticides (ie fertilizers/pesticides containing arsenic compounds). Of the various sources of arsenic in the environment, drinking water probably possesses the greatest threat to human health.

Arsenic concentration in natural waters varies significantly. Groundwater is generally more vulnerable to accumulation of high arsenic concentrations than surface water because of increased opportunity for chemical reactions between water and host rocks and the high ratios of solid to solution compared to surface waters. Both are contaminated by point sources (mining, geothermal, industrial, and surface waters or where river waters have a high component of base flow (groundwater).

Most cases of arsenic contamination in groundwater are naturally- derived, either due to the occurrence of favourable oxidation/reduction and pH conditions in the aquifers or due to inputs from local geothermal sources. Arsenic problems may also be exacerbated in areas affected by mining activity (coal and metals associated with sulphide minerals). Both mining effluent and geothermal waters often have arsenic concentrations in the milligram-per-litre range and can cause major increases in concentrations of surface waters and ground waters. Contamination from industrial sources may also be severe locally, but such cases are comparatively rare.

Although the precise mechanisms of arsenic release in groundwater are not yet fully understood, there appear to be two further criteria necessary for the development of high arsenic concentrations in groundwater from these two environments. Naturally contaminated aquifers recognized so far tend to be:

i) geologically young (ie sediments deposited in the last few thousands years) and;
ii) groundwater characterized by slow flow conditions, either because of low hydraulic gradients, low-lying areas such as flat alluvial basins and the low parts of deltas, or lack of active rainfall and recharge (arid areas, closed basins)

High concentrations of arsenic are found in the groundwater from the shallow and deltaic aquifers. Examples of anaerobic aquifers affected by arsenic include the alluvial and deltaic aquifers of Bangladesh and West Bengal (formed by erosion of the Himalaya in the last few thousand years).

Occurrence in Nepal: Initially no documented report existed, but there is anecdotal evidence for the presence of arsenic in some groundwater from the Terai regions in the south. Before 1999, the concentrations, distribution and scale of the area affected by Arsenic are not known.

When arsenic poisoning news from Bangladesh and West Bengal (India) spread all over the region and when the alluvial sediments deposited by rivers draining from the Himalayas has been identified as potential sources for arsenic in groundwater, then study on the possibilities of arsenic contamination in groundwater in Nepal was initiated.

The deep alluvial aquifers of the Terai are potentially at greatest risk from arsenic contamination as they are anaerobic. Shallow ground water from the Terai is also likely to be at risk when anaerobic conditions occur in the shallow aquifers. Evidence of arsenic contamination in groundwater was found in the southern plains of Nepal, during the preliminary studies conducted by DWSS/WHO, NRCS/JRCS/ENPHO and DWSS/UNICEF in 1999 to early 2000.

By the end of 2002, more than 20, 000 water samples had been tested for arsenic by different concerned agencies working in the water and sanitation sector, out of which 16,000 were tested by AAS-HG and the remainder were tested by field test kits. Out of the total samples tested, 8% have arsenic concentration of more than 50 ppb and 29% showed more than the WHO limit of 10 ppb. The districts of Nawalparasi, Rautahat and Kailali were reported as high risk districts and many other districts are also affected to some extent. The agencies involved in the testing of the water samples for arsenic contamination were: DWSS, UNICEF, NRCS, RWSSSP (FINNIDA), RWSSFDB, NEWAH, PLAN International, DEO/MoE etc.). The Table – 5.5 presented below summarizes the result of arsenic levels at different districts of Nepal from 20,240 water samples.

Similarly, a study carried out by DWSS under Ministry of Physical Planning and Works and ENPHO - a non- governmental organisation and one of WAN's urban partner, has found "excessive concentration" of arsenic in ground water samples taken from shallow tube wells mainly in the districts of Rautahat, Parsa, Nawalparasi, Banke and Bardia.

An estimate of the number of people in Terai, Nepal who may be using water with "high" arsenic concentration from shallow wells is presented in Table – 5.6 below.

Table – 5.5: Arsenic level in different districts of Nepal (2002)

S.N.	District	Arsenic concentration (ppb)					% of Sample above	
		0 - 10	>10 - 50	>50	No. of tests	Max^m As	Proposed Nepal standard (50 ppb)	WHO guideline value 50 ppb
1	Kailali	87	66	34	187	213	18	53
2	Kanchanpur	128	16	9	153	221	6	16
3	Bardiya	386	125	20	531	160	4	27
4	Dang	91	7	1	99	50	1	8
5	Banke	1216	474	31	1721	270	2	29
6	Kapilbastu	2246	235	91	2572	589	4	13
7	Rupandehi	1807	225	46	2078	2620	2	13
8	Nawalparasi	1492	1135	953	3580	829	27	58
9	Chitawan	86	0	0	86		0	0
10	Parsa	1862	206	52	2120	456	2	12
11	Bara	1725	240	46	2011	254	2	14
12	Rauthat	1011	1191	211	2413	324	9	58
13	Saptari	532	82	14	628	98	2	15
14	Dhanusha	157	43	9	209	106	4	25
15	Siraha	195	54	13	262	107	5	26
16	Sarlahi	345	87	13	445	93	3	22
17	Mahottari	79	10	2	91	82	2	13
18	Sunsari	303	67	2	372		1	19
19	Morang	149	22	2	173	70	1	14
20	Jhapa	462	42	1	505	79	0	9
21	Illam		4		4			
	Total	14359	4331	1550	20240	2620	8	29

Source: *DWSS,NRCS/ENPHO,RWSSSP (FINNIDA), PLAN, NEWAH, RWSSFDB, DEO/MOE, 2002*

Table – 5.6: Preliminary Estimate of Extent of Arsenic Problem in Nepal

Based on WHO guideline (10µg/litre or higher)		Based on India and Bangladesh guideline (> 50µg/litre)	
% exposed	population	% exposed	Population
29	3.19 million	5	550,000

Source: *ENPHO/DWSS*

Occurrences of arsenic, along with other potentially toxic trace elements, may also occur where mineralized veins (containing sulfide minerals) occur in the crystalline basement rocks and minor occurrences of black shale. If contamination of water with arsenic has occurred in these areas, the contamination is likely to be localized rather than of regional context.

5.2.2.1 Risks of arsenic to human health

Arsenic has long been recognized as a toxin and carcinogen and thus ingestion of any amount of arsenic posses a potential risk. Long term ingestion of high concentrations of arsenic from drinking water can potentially give rise to a number of health problems, particularly skin disorders, of which the most common is melanosis (hyperpigmentation, depigmentation etc.) ie pigmentation changes (dark/light skin sports), keratosis (warty nodules, usually on palms and feet), and gangrene. Additional symptoms include other more serious dermatological problems (e.g. skin cancer and Bowens's disease), cardiovascular (black foot disease, Reynolds syndrome, hypertension, gangrene), pulmonary and peripheral vascular diseases, neurological, respiratory and hepatic disease as well as diabetes mellitus. Such symptoms have been well documented in areas of known groundwater contamination such as Bangladesh, West Bengal, Taiwan, Northern China, Mexico, Chile

A number of internal cancers have also been linked with arsenic in drinking water, particularly lung, bladder, liver, prostate and kidney cancer (e.g. Smith et al., 1992-1998). Much research is being carried out to assess the risks of such cancers at the levels of the drinking water standards.

Clinical symptoms of arsenic poisoning and their relative prevalence seem to vary between affected regions and there is no clear agreement on the definition of arsenic poisoning.

Some studies have shown a clear relationship between arsenic dose from drinking water and the development of cancer and other diseases. However, the relationship may be complicated by other factors such as nutritional and general health status (hepatitis B may exacerbate the problems) and water chemistry (e.g. aqueous arsenic chemistry, dissolved iron concentration). Debate also remains over whether a threshold of concentration exists below which the element is effectively safe (e.g. Smith et al., 1999)

Latency periods of several years for the development of arsenic related health problems have been noted in several investigations. This is a factor which in part explains why many of the problems in developing countries have only recently emerged despite several years of groundwater use.

Therefore, Arsenic is endemic in groundwater sources from certain areas and causes adverse human health effects after prolonged exposure. There is overwhelming evidence from epidemiological studies that consumption of elevated levels of arsenic through drinking water is causally related to the development of cancer through several sites, particularly skin, bladder and lung. Arsenic is thus a high priority chemical parameter that requires monitoring in water sources deemed to be at risk from contamination.

In this regard, The WHO "Guidelines for drinking-water quality" also calculated the general guideline value based on the concentration associated with an excess lifetime cancer risk of 10-5 which for arsenic and skin cancer was calculated to be 0.17 µg/ litre (0.17 ppb). However, considering the practical quantification limit, WHO established a provisional guideline value for arsenic in drinking-water of 0.01 mg/ litre (10 ppb). The estimated excess lifetime skin cancer risk associated with exposure to this concentration is about 6 per 10,000 populations. The Nepalese standard of 0.05 mg/litre ie 50 ppb (as per NDWQS, 2006) is associated with a higher risk of about 30 per 10,000 populations.

5.2.3 Nitrate

Nitrate is the most widespread agriculture contaminant and is a human health concern since it can cause methemoglobinemia in infants. Some nitrate in ground water is due to naturally occurring sources, but levels of nitrate (NO_3) above 3 ppm typically indicate that pollution is seeping in from latrines, septic tanks, animal wastes, fertilizers, municipal landfills etc. In shallow groundwater, the concentrations of nitrate from agriculture pollutants from domestic and agricultural sources may be high and nitrate concentrations frequently fail WHO guideline values.

High levels of nitrate can develop in ground waters as a result of:

- Run-off from agricultural land using nitrate fertilizers
- Contamination with urine and faeces
- Industrial pollution

In Nepal, few tests have been conducted in groundwater and surface water. ENPHO tested 7 samples from shallow tube wells from 5 eastern Terai districts in 1990. All the test result shows far less concentration of nitrate than the WHO limit of 10 ppm. In February 2002, ENPHO tested 27 samples from Eastern Terai district of Siraha, all the tube wells have concentration of less than 0.1 ppm except two tube wells which had a concentration of 6.11 and 0.38 ppm. However, the concentration in 3 dug wells out of 6 tested -- exceeds the WHO guideline value measuring 10.2, 24.87 and 47 ppm. The test conducted in stone spouts in Kathmandu and Lalitpur district have high nitrate concentration. In most of the spouts, the concentration of nitrate is up to 37 ppm.

5.2.3.1 Risks of nitrate/nitrite to human health

Nitrate is the most widespread agriculture contaminant but presence of nitrate/ nitrite is considered to have minimal effect on the disease burden. Unprotected ground water sources are particularly susceptible to contamination. High nitrate concentration pose a significant health risk to bottle-fed infants as nitrate inhibits the ability of the bold to convey oxygen around the body, leading to a potential fatal condition called "blue-baby syndrome" or methahaemogobinaemia. The long term exposure to Nitrate is, however, a human health concern as it may increase stomach cancer. A recent study suggested that miscarriage might also be linked to high nitrate levels, although scientists have not confirmed this.

The WHO guideline value for nitrate in drinking water of 50mg/litre (equivalent to 10mg/litre nitrate-nitrogen) and 3mg/l for nitrite (short-term exposure) is established solely to prevent Cyanosis (methahaemoglobinaemia) in babies: bottle-fed infants (< 3 months of age).

5.2.4 Fluoride

Fluoride minerals are abundant in certain rock types. Igh concentrations of fluoride can be released into ground waters through dissolution of these fluoride minerals, especially after prolonged contact periods within aquifers.

In Nepal, there are limited studies conducted on fluoride so far. Thus only sporadic data are available for fluoride in Nepal. However, given the climatic conditions (high rainfall), the presence of fluoride at high concentration is unlikely. Concentrations are likely to be below WHO guideline value (1.5 mg/lit) for fluoride in drinking water in both the hill and Terai regions of Nepal.

United Mission to Nepal (UMN) prepared a nationwide fluoride profile of Nepal's drinking water in 2000. It tested 682 water samples collected from all the 5 regions. The test results show great similarity in all parts of the country with the aggregated data demonstrating that 95% of samples have fluoride levels below 0.3 mg/l. More than 70% samples of sites register less than 0.1 mg/lit. At the higher end of the scale, 7 samples enter therapeutic levels (above 0.7 mg/lit) out of them water sample from Janakpur tube well was found to have a highest level of concentration ie 1.07 mg/l. 2 of the 7 samples from Mid Western hot springs (both called Tatopani) found to have a high level fluoride concentration of 3.8 and 2.9 mg/lit. The study also suggested for the introduction of locally produced, affordable fluoridated toothpaste that will benefit the dental health of millions of children and adults.

5.2.4.1 Risks of fluoride to human health

Low concentrations of fluoride are beneficial to dental health (up to 1 mg/lit) and is known to reduce dental decay when added to the diet. In drinking water, in a concentration of 1 mg/lit in a temperate climate, it is known to reduce dental caries by up to 65%. However, high fluoride is a toxin harmful to the public health at elevated concentrations.

Regular exposure to slightly elevated amounts of fluorides during the period of tooth formation, from birth to approximately six years of age, can be associated with dental fluorosis. This is characterized by white areas, and occasionally brown stains, on the teeth. However, excessive intakes of fluoride can result in moderate to severe dental fluorosis, characterized by significant enamel erosion, tooth pain and impairment of chewing ability.

Long-term exposure to levels of fluorides in excess of 200 micrograms per kilogram of body weight per day may be associated with skeletal fluorosis. This is a progressive but not life-threatening condition in which the bones increase in density and gradually become more brittle. In mild cases, symptoms of skeletal fluorosis may include pain and stiffness of the joints. In more severe cases, symptoms may include reduced mobility, skeletal deformities, and an increased risk of bone fractures. It is likely that individuals must consume considerably higher amounts before crippling symptoms will develop.

Fluoride intake can originate from dust inhalation and food sources but drinking water containing high concentrations can also be regarded as a primary source. Fluoride can be classified as a high priority chemical parameter requiring surveillance in areas where it is likely to occur in ground waters at high concentrations.

No fluoride is found reported in Nepalese Groundwater and data regarding fluoride is also not available. However, given the climatic conditions (high rainfall), the presence of fluoride at high concentrations is unlikely. Concentrations are likely to be much below 1 mg/lit., ie less than WHO guideline value for fluoride in drinking water, in both the hill regions and the terai (Groundwater Quality: Nepal, BGS Survey, Natural Environmental Research Council (NERC), 2001). Hence, Fluoride, though this parameter is listed under prinicipal contaminants, is not required for testing while conducting regular Water Quality testing of the water delivered from the newly installed or rehabilitated water points.

5.2.5 Nuisance constituents: aesthetic parameters

WaterAid in Nepal (WAN) recognizes that other chemical (Inorganic) constituents exist which could be described as "Nuisance Constituent: Aesthetic Parameters". These nuisance constituents are not directly harmful to health but may impact on health when exposed to it for a longer period of time. In fact, it directly impacts on aesthetic considerations such as taste, odour and appearance, and cause people to abandon 'safe' sources for traditional 'unsafe' ones. Common Nuisance Constituents: Aesthetic Parameters in the context of Nepal are discussed below:

5.2.5.1 Iron and manganese

These are inorganic constituents and are not directly harmful to health but may impact on health when exposed to it for a longer period of time. In addition, it also impacts on aesthetic considerations and cause people to abandon 'safe' sources for traditional 'unsafe' ones.

Few data exist for these elements in the Nepalese ground waters. Concentrations of iron and manganese are likely to be mostly low in the shallow groundwater where the aquifers are aerated. However, they are higher in the deep anaerobic aquifers of the Terai region and Kathmandu valley. Iron concentrations in the range <0.5 mg/L and manganese in the range <0.1 – 0.7 mg/L have been found in groundwater from the deep aquifers of the Kathmandu valley (Khadka, 1993). The higher concentrations of these elements render the groundwater unusable without prior treatment.

Presence of iron and manganese in the shallow groundwater of the Terai will depend on the degree of aeration of these aquifers. If aerobic, concentrations are expected to be low. Studies showed that iron content in shallow tube wells is mostly high. The analytical report of 1260 samples tested by NRCS/ENPHO/RWSSFDB and DWSS/UNICEF showed that 33% of samples contain very high iron level (more than 5 ppm) and only 20% samples were below WHO guideline value (0.3 ppm).

Similarly, the study conducted by ENPHO (Table – 4.3) showed that all the samples exceeded the WHO guideline value for iron content whereas manganese concentration is nearly around the WHO guideline value.

Risks of iron and manganese: Iron content in water is not related to human health concern but important from the aesthetic point of view. High iron content water is not acceptable to the people for drinking and other domestic purposes like washing, bathing, and food preparation. However, constant high exposure to iron and manganese for longer period of time might lead to carcinogenic effect.

5.2.6 Other aesthetic parameters

a.Chlorine: Free (or residual) chlorine in drinking water is only relevant where supplies are chlorinated, such as piped supplies, or where routine or emergency chlorination has taken place. The presence of free (residual) chlorine is an indication that removal of bacterial contamination is continuing within the supply; where none is found then there is an increased risk to health from microbiological contamination. The WHO recommends a minimum 0.2 to 0.5 mg/litre to ensure and maintain effective chlorination of and safety of drinking water supply. A health-based maximum of 5mg/litre is also given.

b. pH: According to the WHO guidelines, "No health-based guideline value is proposed for pH, although eye irritation and exacerbation of skin disorders have been associated with pH values greater than 11. Although pH usually has no direct impact on consumers, it is one of the most important operational water quality parameters". Whenever water treatment or storage is taking place (arsenic removal, clarification, disinfection, rainwater harvesting), careful attention to the level of pH is necessary and the optimum pH required is generally within the range 6.5–8.5 (as per WHO guideline value) according to the parameter.

c. Ammonia: Ammonia is an indicator of water pollution caused due to human activities and natural decay processed. Sewage contains large amount of ammonia due to bacterial decay of nitrogenous organic wastes. Hence, surface water showing a sudden increase in ammonia content may indicate pollution from sewage, effluent from industries like dairies, tanneries or chemical plants. Ground water often contains some ammonia due to natural reduction of nitrate by bacteria, but sudden change in ammonia may be due to contamination of wastewater through seepage. The WHO guideline value for ammonia is 1.5 mg/lit.

d. Turbidity: Turbidity which is a measure of extent to which light is either absorbed or scattered by suspended materials in water is an indicator of suspended solids present in water. These suspended solids can be in the form of silt, clay, sand, industrial wastes, sewage, organic matter, phytoplankton and other microbial organisms. Turbidity is an important parameter to be considered in drinking water supplies due to aesthetics, filterability and disinfection. The WHO guideline value for turbidity is 5 NTU (Nephelometer Turbidity Unit).

e. Hardness: Hardness is caused basically by calcium and magnesium salts and is expressed in terms of equivalent quantities of calcium carbonate. Depending on other factor such as pH and alkalinity of water with hardness above approximately 200 mg/lit may cause scale deposits in the distribution system and results in excessive soap consumption. Again soft water with hardness less than 100 mg may cause corrosion. Hardness may range from 0 to several hundreds of mg (ppm). Although acceptability levels vary according to consumers' acclimation to hardness, a generally accepted scale is based on taste and household use consideration and with this basis of reference, the WHO recommends a guideline value of hardness.

6 Appropriate water quality standards

WaterAid considers that the standards to be aimed for are those which are believed to deliver drinking-water of acceptable quality in terms of avoidance of health and disease hazards for the consumers. Such water is often referred to as ‘safe’ or ‘clean’ water. ‘Clean’ also implies acceptability of appearance, taste and smell. These are qualitative terms which do not have a common quantitative definition.

In this document ‘standards’ means Water Quality standards appropriate to drinking-water for people, since the standards applied for that purpose will normally be more stringent than standards for most other purposes. This section tries to outline water quality standards which are considered as minimum parameters selected within the broad international and national framework for ensuring the supply of safe quality water. WaterAid Nepal (WAN) and its partners should comply with the proposed standards essentially while delivering WATSAN activities, however should not be taken as a strict rule to be adhered to but should be considered as a benchmark to achieve safe and adequate supply of potable water assuring good health.

The proposed water quality standards have been prepared with reference to WHO guidelines (WHO, 1984 a, b, c) with slight modifications, national policy on water quality standards and WA International’s Organisational Guidelines on Water Quality Testing for WaterAid Country Programmes. One important thing to be kept in mind is to assure the aesthetic value of water within the cultural context otherwise it may encourage consumers to revert to unsafe traditional sources of water putting them at greater health risks even when the facility provided is technically sound. Considering these things in mind, this section tries to set out basic requirements for Physical, Chemical, Aesthetical and Microbial parameters for determining the quality of water. While developing appropriate standards, the following elements in particular, have been considered.

- The established standards should be based upon assessment of drinking water requirements and the states of quality of various water source existing in different parts of the country under various natural and man-made environment settings.
- The limitation posed by the water supply technology, which is sustainable in any given environment•.
- For a monitoring and surveillance programme to be meaningful, it should be enforceable.
- The substances of concern in water should be based on their intrinsic characteristics (such as chemical and microbiological) and other characteristics associated with their uses, functions or physical condition.

6.1 Selection of parameters

The substances of concern in water can be classified according to their intrinsic characteristics (such as chemical and microbiological) and other characteristics associated with their uses, functions or physical condition. Potability of water can only be determined by chemical and bacteriological laboratory tests. Chemical analysis indicates whether water is polluted and contains parameters of concern. Bacteriological tests have been designed which are extremely sensitive and specific in revealing evidence of pollution (Michael, Ried and Chan, 1979). The parameters selected were based on the recommendation made by the workshop. The detail descriptions of selected parameters in each group given below were obtained from various research reports, WHO guideline and on the basis of discussion among the group members focusing on Nepalese condition.

Potability of water can only be determined by chemical and bacteriological laboratory tests. Chemical analysis indicates whether water is polluted and contains parameters of concern. Bacteriological tests have been designed which are extremely sensitive and specific in revealing evidence of pollution (Michael, Reid and Chan, 1979). The parameters selected below are based on the various research reports, WHO guidelines, consultations and discussions with the sector stakeholders and WASH practitioners focusing on Nepalese context, National Drinking Water Quality Standards (NDWQS - 2006), and WQ standards of WA and its organisational guidelines, WQ testing policies of other WA country programmes (CPs) wherever applicable.

The step of standard setting process often could not be straightforward. The parties having a stake in the standard setting process may come from diverse interests representing the local community, political leaders, business community, environmentalists, the scientific and engineering professions, government and bilateral organisations. Their concerns differ as do their values. This is because of the fact that the decision making criteria still has significant components of subjective judgment. The policy decisions in standards setting usually include (WHO, 2002):

- *Determination of acceptable risk:* The bottom line on deciding the standard value of a parameter is the value of acceptable risk. The judgment of what is an acceptable risk is a matter in which society as a whole has a role to play.
- *Determination of public to be protected:* Considering the vulnerable groups ie infants, children, and elderly people in addition to the healthy individuals.

- *Choice of control technology:* Selection of appropriate technologies, which are to be implemented to bring the contaminant, levels down to the standards.
- *Legislation / standards:* Considering existing national legal framework in implementing the standards and monitoring the compliance.
- *Economics:* Considering the cost-benefit analysis.

WHO (2002) has outlined the priorities for setting drinking-water standards as follows:

a. The first priority is to make sure that water is available to consumers, even if the quality is not entirely satisfactory. If there is a consideration to discontinue use of a contaminated water supply, there must be provisions made for instituting an alternative water supply.
b. The second priority is to control the microbiological quality of the water supply. The consequences of contamination with pathogenic bacteria, viruses, protozoa and helminthes are such that their control must always be of paramount importance.
c. Toxic chemicals in drinking water must also be controlled if we have to prevent long-term health effects from exposure to contaminants such as lead, arsenic or certain organic solvents.
d. Finally, in assessing the quality of drinking water, the consumer relies principally on the sense organs. Colour, taste, odour and appearance of the water, although not directly related to health, must be acceptable to the consumer. Some countries have elected to issue recommendations, rather than standards, for these aesthetic parameters.

Similarly, Organisational Guidelines for Water Quality Testing of WaterAid (2008) has outlined the priorities for setting drinking-water standards to be adopted as follows:

- Are capable of verification by the analysis of water samples, but bearing in mind the practical limits of resources (finance and skills) which may be available from WaterAid and/or its partners in the country for testing
- Recognize the limitations imposed by the water supply technology which is sustainable in any given environment. (For example, if hand-dug wells with windlasses are the only technically or economically viable water supply option, microbiological standards may have to be relaxed compared to somewhere where hand pumps are a possibility)
- Consultation with the parties engaged in WASH sector, particularly WQ issues and seeks a consensus. However, this should not be allowed to delay the adoption of a working standard. In practice, such discussion may be limited if a national standard has been adopted already, since there will be official pressure to conform to it. Acceptance by a public health authority would imply that the standard would be defensible against external criticism.
- In developing countries, national standards, where they exist, may be based on the WHO guidelines, but may be modified; a government may quite reasonably and justifiably consider WHO standards to be too onerous and set less stringent national standards.
- At best, less stringent standards will have achieved wide acceptance or, at least, will be aspired to by other practitioners in the field. This makes a good case for WaterAid adopting them, and only in special cases will there be merit in adopting a standard which is not recognised outside WaterAid.

- WaterAid recognises that in situations where people have access to only very low volumes of water daily, significantly increasing the quantity of water available for personal use can be as important in terms of health as improving microbiological quality.

6.2 WaterAid in Nepal recommended drinking water quality standards

This section describes the water quality standards to be followed by WaterAid in Nepal and its partner organisations. The standards were adopted predominantly from Nepal's National Drinking Water Quality Standards (2006) and WHO's 'Guidelines for Drinking Water Quality' (2004) were predominantly referred. That is to say, While selecting the parameters and setting their standards as mentioned, a set of quality standards adopted by a government of Nepal and guided by WHO were referred. The following table provides WAN's Water Quality Standards for Physical, Chemical and Microbiological Parameters.

The Table - 6.1 below provides a reference water quality standard/guideline values for the various parameters set by WHO, Nepal's policy on National Drinking Water Quality Standards and recommended drinking water quality standards of WaterAid in Nepal.

Table – 6.1: Comparative water quality parameters and its guideline/ standard values

Water quality parameters		Units	Nepal's NDWQS*	WHO	WaterAid standards for Nepal	Selection criteria and rationale
Physical parameters	Electrical conductivity	•S /cm	1500			
	TDS	mg/L	1000	1000	**500 (1000)**	Above this, the water may become consumer unacceptable and may cause gastro-intestinal irritation.
	Color	TCU	5 (15)	15	**5 (15)**	Acceptability to users; Colour above 15 TCU can be detected in a glass of water so above this consumer may not accept the appearance
	Turbidity	NTU	5 (10)	5	**≤ 5**	• High levels of turbidity can stimulate bacterial growth and protect micro-organisms from the effects of disinfection. • Above 5, opalescence increases and consumer acceptability decreases; For effective terminal disinfecting, more disinfectant is consumed
	Odor and taste		Non-objectionable	Non-objectionable	**Non-objectionable**	Consumer acceptability

Water quality parameters		Units	Nepal's NDWQS*	WHO	WaterAid standards for Nepal	Selection criteria and rationale
Chemical parameters	pH					
	Total hardness	mg/L	500	-	**300 (500)**	Above this encrustation inside supply lines may occur depending upon other water characteristics such as pH, Alkalinity, Total dissolved solid etc. and may produce adverse effect in domestic uses.
	Nitrate (NO_3)	mg/L	50	50	**50**	Above this value, Methaemoglobinaemia (Blue-Baby Syndrome) take place.
	Iron	mg/L	0.3 (3)	0.3	**0.3 (3)**	Above this imparts taste and colour; effects on domestic uses, water supply structures In absence of alternative sources the value may be extended up to 3
	Manganese	mg/L	0.2			
	Arsenic (As)	mg/L	0.05	0.01	**0.01 (0.05)**	• For new water points, value should be within 0.01 and for old water points, value up to 0.05 is acceptable. • As a precautionary measure any new tube wells installed by WAN should show no arsenic presence when tested with a field test kit at installation • For new tube wells, 0.01 is adopted provided PeCO75 field test kit or lab testing by AAS is used. • Also Refer to WAN's Arsenic Testing Protocols
	Ammonia (NH_3)	mg/L	1.5	1.5	**1.5**	National Water Quality standard also recommended the same value as that of WHO guideline value.
	Chloride	mg/L	250	250		
	Fluoride(F)	mg/L	0.5 (1.5)	1.5		
	Free (Residual) Chlorine	mg/L	0.1-0.2	-	**0.2 (0.5)**	• Excess residual chlorine may produce harmful disinfectant by-products etc. Residual chlorine level may be used in rapid assessment of bacterial quality • To be applicable when water is chlorinated.
	Zinc	mg/L	3	3	**3**	• Impacts a bitter taste at concentration above this value. Value is relevant only for RWH and thus recommended to test before scaling up • The WHO does not have any health based limits. (Refer WHO - Vol:2)

	Water quality parameters	Units	Nepal's NDWQS	WHO	WaterAid standards for Nepal	Selection criteria and rationale
Microbiological (Bacteriological) parameters	Thermo tolerant Faecal Coliform (E.Coli)	MPN/ 100ml	0	nil	0/100 ml. (No Risk) 1-10/100 ml. (Low Risk) 11-100/100 ml. (High Risk) 101-1000 (Very High Risk)	♦ The WHO Guideline Value in the 2nd edition of Guidelines for Drinking Water Quality for thermotolerant coliforms (often referred to as faecal coliforms) is 0cfu/100ml, but Guidelines explicitly state that a relaxation of up to 10 fc/100ml is acceptable in community-managed un-chlorinated supplies. ♦ WEDC has also recommended the limit of 10fc/100ml which is classified as "low risk" to health by WHO. ♦ For most water supply schemes in remote areas of Nepal, chlorination of water supply is not possible due to inaccessible geographical location. In this context, For WAN and its partners, Water quality standards has been fixed according to degree of contamination and urgency for action.
	Total coliform	MPN/ 100ml	0 in 95% samples	nil	0 in 95 % samples	
Note: * NDWQS: National Drinking Water Quality Standards						Not Applicable to WAN

Similarly, the rationale and reasons behind setting the standards for respective parameters are mentioned in adjacent column in the Table 6.2 below. (Refer Annex – 2 for details)

Table – 6.2: Recommended water quality parameters and its standards for WaterAid and its partner organisations in Nepal

SN	Parameters	Required value	Rationale	Remarks
A	Physical parameters			
1	Colour, TCU	5 (15)	Acceptability to users; Colour above 15 TCU can be detected in a glass of water, so above this consumer may not accept the appearance	TCU = True Colour Unit
2	Taste	Unobjectionable	Consumer acceptability	
3	Odour	Unobjectionable	Consumer acceptability	
4 4	Turbidity, NTU	≤ 5 (10)	♦ High levels of turbidity can stimulate bacterial growth and protect micro-organisms from the effects of disinfection. ♦ Above 5, opalescence increases and consumer acceptability decreases; For effective terminal disinfecting, more disinfectant is consumed	NTU = Nephelometer Turbidity Unit
5	Total Dissolved Solids, (mg/l)	500 (1000)	Above this, water may become unacceptable and may cause gastro-intestinal irritation.	

B	Chemical parameters			
1	pH	6.5 to 8.5	Below 6.5 the water tends to be corrosive and above 8.5, it is soapy.	pH value of most natural water falls within this range.
2	Total hardness as $CaCo_3$, mg/l	300 (500)	Above this encrustation inside supply lines may occur depending upon other water characteristics such as pH, Alkalinity, Total dissolved solid etc. and may produce adverse reaction in domestic uses.	In the absence of alternative sources the value may be extended up to 400 mg/l
3	Nitrate, (mg/l)	50 (as NO_3) 3 (as NO_2)	Above this value, Methaemoglobinaemia (Blue-Baby Syndrome) take place.	Some groundwater particularly from Kathmandu is reported to contain nitrate higher than specified value.
4	Residual Free Chlorine, mg/l	0.2 (0.5)	Excess residual chlorine may produce harmful disinfectant by-products etc. Residual chlorine level may be used in rapid assessment of bacterial quality	Applicable when water is chlorinated.
5	Iron, mg/l	0.3 (3)	Above this imparts taste and colour; effects on domestic uses, water supply structures	In absence of alternative sources the value may be extended up to 3
6	[1]Arsenic, mg/l	0.01 (0.05)	• For new water points, value should be within 0.01 and for old water points, value up to 0.05 is acceptable. • As a precautionary measure any new tubewells installed by WAN should show no arsenic presence when tested with a field test kit at installation	For new tubewells, 0.01 is adopted provided PeCO75 field test kit or lab testing by AAS is used. **Also Refer to WAN's Arsenic Testing Protocols**
7	Ammonia, mg/l	1.5	National Water Quality standard also recommended the same value as that of WHO guideline value.	
8	Zinc, mg/l	3	Impacts a bitter taste at concentration above this value. Value is relevant only for RWH and thus recommended to test before scaling uqp	The WHO does not have any health based limits. (Refer WHO - Vol:2)

C	Microbial parameters (Bacterial quality)	The suggested microbial parameters to be included in water quality standard are Faecal Coliform (E-Coli). However, water to be supplied to the consumers should be free from protozoan and helminthic parasites including ova and cysts to ensure safe water quality.		
Organism	**Unit**	**Value (cfu)**	**Remarks**	**Selection criteria**
[2] Thermotolerant Faecal Coliform (TTC), MPN/100ml	Number per 100 ml for all types of water sources such as gravity system, tube well and hand dugwell.	0/100 ml. 1-10/100 ml. 11-100/100 ml. 101-1000 ml	no risk low risk high risk very high risk	The WHO Guideline Value in the 2nd edition of Guidelines for Drinking Water Quality for Thermo Tolerant Coliforms (often referred to as faecal coliforms) is 0cfu/100ml, but Guidelines explicitly state that a relaxation of up to 10 fc/100ml is acceptable in community-managed un-chlorinated supplies. WEDC has also recommended the limit of 10fc/100ml which is classified as "low risk" to health by WHO. For most water supply schemes in remote areas of Nepal, chlorination of water supply is not possible due to inaccessible geographical location. In this context, for WAN and its partners, water quality standards have been fixed according to degree of contamination and urgency for action. Considering this, WAN set microbiological standards as 10TTC/100 ml (acceptable) and 100TTC/100ml (tolerable) considering the evidence that many people in rural Europe drink water containing up to 100 TTC/100 ml without ill effects in health.

( ) Values in parenthesis make sure that this policy is in line with National Drinking Water Quality Standards (where the set standards differ from national standards) and thus refers to the acceptable values to when alternative is not available

[1] *National Drinking Water Quality Standards for Arsenic is 0.05 ppm for all tube wells. WAN adopted 0.01 ppm for new installation because there is evidence of seasonality in arsenic concentration and in some cases, the concentration gradually increases. For existing tube wells 0.05 ppm has been adopted.*

[2] *National Drinking Water Quality Standard for faecal Coliform count is ≤ 0 per 100 ml for treated water. In case of large supplies, where sufficient samples are examined, total coliform bacteria must not be present in 95% of samples taken throughout any 12 month period and untreated water supply.*

[o] *For example if hand dug wells are only technically or locally viable water supply option, microbiological standards may have to be relaxed compared to somewhere where hand pumps are a possibility.*

Similarly, the following Table – 6.3 provides the list of organisations consulted while compiling the high risk (principal) contaminants for setting standards for WaterAid in Nepal's Water Quality Standards and Testing Policy.

Table – 6.3: Organisations consulted while compiling High-risk/Principal contaminants

Name of the organisation	Responsibility	Organisation	Remarks
Ministry of Physical Planning and Works (MPPW)	Policy framework	Government	
Ministry of Population and Environment (MoPE)	Regulation	Government	
Department of Water Supply and Sanitation (DWSS)	Setting and enforcing Drinking Water quality policy	Government	
Nepal Water Supply Corporation (NWSC - Recently called as Kathmandu Upatyaka Khanepani Limited – KUKL for KTM Valley only)	Maintaining the water quality standards within the jurisdictions of its Urban water supply network	Autonomous Public body but requiring government subsidy for operating costs	It manages water supply networks in 28 out of 58 Municipalities including Kathmandu. Whereas KUKL manages WS networks of Kathmandu Valley only.
Rural Water Supply and Sanitation Fund Development Board (RWSSFDB)	Supports local NGOs for Water and Sanitation projects.	Quasi government Public body	
Nepal Red Cross society (NRCS)	Implements Water and sanitation Projects	NGO	
Nepal Water for Health (NEWAH)	Helps local NGOs for implementation of water and sanitation projects	NGO	WAN's Implementing partner
Environment and Public Health Organisation (ENPHO)	NGO specialized in Water quality testing	NGO	WAN's Implementing partner
UNICEF	Working with DWSS on water quality and sanitation	UN agency	
UN-HABITAT	Working with government agencies like MPPW/DWSS and DUDBC; MLD and with other sector players in WASH sector of Nepal. Predominantly working in urban water and environmental sanitation under its Water for Asian Cities (WAC) Programme in Nepal	UN agency	
WHO	Working with DWSS on water quality	UN agency	
WaterAid	Supports NEWAH, Lumanti, ENPHO, CIUD, UEMS, NGOFUWS and FEDWASUN and for water and sanitation projects.	INGO	
FINNIDA	Working with District Authority for implementation of Water and sanitation project in Lumbini Zone.	INGO development partner	

7 Frequency of testing, sampling and analysis regime based on risk of contamination

Routine monitoring of water quality is a desirable goal for which to aim and although WaterAid in Nepal may be involved in introducing and supporting the setting up of such procedures, it recognizes that as a transient external agency it cannot undertake to provide support on a long-term basis. It also considers that if long-term monitoring of existing supplies is required, this must be undertaken by indigenous institutions. Therefore, WAN considers that, in general, the support it provides for testing should be limited to testing the suitability of new sources.

There are likely to be exceptions to this principle, such as:

- When WaterAid considers it appropriate to support capacity building of local organisations to carry out regular water quality surveillance. In this case, local organisations should be encouraged to factor in a budget line to support testing in the long-term.
- Where arsenic is present in ground water, testing for arsenic may be required over time until its concentration has been established.
- When WAN considers it appropriate to monitor the effectiveness of their hygiene promotion activities by testing the quality of water at the household level, in storage units and at the point of consumption.
- When WAN periodically looks at the long-term performance of completed projects and the impact projects have on people’s lives, an examination of the quality of water delivered from a sample of older projects should be considered. This data on water quality over time is essential for predicting the sustainability of a water source.

All new sources penetrating an aquifer should be tested as well as those being protected or rehabilitated. A ‘test’ generally involves the taking and analysis of at least three separate samples from the same source on the same day. Digging, drilling and building works introduce microbiological contamination and wells and spring works should routinely be chlorinated before they are brought into service.

It has been noted that water quality tests carried out by some drilling contractors (following borehole construction) may not be reliable. It is advisable to seek independent verification of results by carrying out secondary independent tests on new boreholes.

When a WaterAid considers it appropriate to support the capacity building of local organisations to carry out regular water quality surveillance, a decision on the frequency of testing will need to be taken and recorded in the country programme water quality testing policy.

Factors to consider when determining the frequency of testing

- The level of risk posed by potential contaminants around a source and the level of protection afforded to a source. In the case of microbial contaminants, this risk can be assessed using a sanitary survey. Sources at greater risk of contamination require more frequent monitoring.
- The population served. A town of 100,000 people deserves more quality surveillance than a well serving half a dozen families. Similarly, a higher frequency of monitoring should be afforded to sources supplying schools or hospitals. In high population areas, it can be useful to look at the percentage of a population served by a source. If a source serves more than ten percent of a population it should be subject to more regular risk assessment and quality surveillance
- The greater the risk of contamination and the greater the risk that a large number of people will be affected, the greater the need for a repeat testing regime.

It is important to note that the level of risk may vary with season; dug wells which give good results in the dry season can become grossly contaminated in the wet season due to ingress of shallow ground water through

WaterAid inNepal

the lining. In some cases, rainwater can have a diluting effect in shallow aquifers. Seasonal factors may dictate repeat testing on a different occasion to obtain a representative range of values.

In some places, the patterns of land use can change rapidly, triggered by inward migration or other factors. This will affect decisions not only about the frequency of testing but the future viability of the source, and future trends should always be considered.

7.1 Sampling and frequency of testing

a. Sampling: For in-house water quality monitoring purpose the operator/ service provider shall take samples from different points of the water supply system at frequencies recommended in the Standards. This will ensure the operator/ service provider smooth performance of the system and help him pinning down the source of pollution quickly and rectify it. However, sampling points should be kept as minimum as possible. Because more the sampling points more costly will be the monitoring system. More emphasis should be given to sanitary surveys/inspection.

To keep the cost of surveillance programme low, only distribution pipelines will be chosen for Gravity or mechanical pumping water supply system. One sample point shall be selected for each 5 km of primary, secondary and tertiary distribution pipelines. As far as possible public stand posts shall be preferred as sampling points. Otherwise a private yard connection with very short length of house connection should be the second choice. If both options not available, a sampling point must be tapped on the distribution pipes. In case of rain water harvesting and other form of water collection and distribution systems, sample point shall be immediately below the service reservoir.

Criteria for selection of sampling points

General criteria for sampling are:

- The sample should be representative in terms of temporal and spatial variability
- The sampling points should be uniformly distributed throughout the distribution system taking in account of the population and number of linkages or branches
- The samples should be taken from the Water Sources, Reservoirs or Storages Points and End Users
- One sample point shall be selected for each 5 km of primary, secondary and tertiary distribution pipelines.
- One for individual water points like wells, tube well/hand pump
- For water quality monitoring and surveillance, in addition to the aforementioned points, with due attention to the contamination risk samples should be taken from source, low pressured zones of the distribution pipeline and pipe joints.

The most important tests in water-quality surveillance or quality controls in small communities will be analysis of microbiological quality (E.coli or Total Coliform) and turbidity, and free chlorine residual and pH where chlorination is used.

b. Frequency of testing: Water Quality testing is carried out to determine the suitability of the source and identify degree of treatment required before considering suitable for human consumption.

Frequency of water quality testing differs with the parameters of concern and the risk associated with them. Depending upon the service level of implementation of water supply system and Water Quality Standards defined, testing mechanism and procedures will be followed/adopted as per the standards methods/procedures prescribed by the equipments/testing kits themselves and implemented accordingly on the ground while carrying out the Water Quality Tests in the field.

Simple-to-use community Inspection Forms will be carefully developed in a form of checklists for rapid assessment in and around the intake points, storage tanks, distribution points and in water points as well as pollution prone points in the system.

Minimum number of testing, depending upon the type of system, needs to be standardized for the partner organisations to follow. However, any or a combination of the recommended indicators outlined below should guide the frequency and intervals of

Sanitary Surveys:

1. When developing new sources of water system, water quality testing of the proposed source(s) of water to be used should be tested before and after construction and the entire system should be tested once it gets completed for operational
2. When there are insufficient details to determine the suitability of the source and also to identify the degree of treatment required before raw water can be considered suitable for human consumption.
3. When the existing system is under rehabilitation, then water quality testing should be carried out at least before and after the intervention
4. Should be carried out laboratory analysis of a sample taken from the water system that indicates a hazard to health.
5. When an outbreak of a waterborne disease occurs in or near the area served by the water system.
6. When any significant change in the environment is noted within the immediate vicinity that may affect the water system. Examples include the construction of a new industry on or along the watershed.

7.1.1 Arsenic

Because of arsenic's invisibility, toxicity and carcinogenicy, all tubewells must be tested for its level of contamination. Therefore, Partner organisations should test all tubewells, which were installed in the past, and all new tubewells to be installed. In the case of Kathmandu valley, no contamination has been noticed in shallow tubewells, so no testing is required for already installed tubewells however, for new installations they must be tested. Similarly, the arsenic parameters should be tested only for groundwater and no arsenic testing is required for surface water and harvested rainwater. All the water points tested for arsenic should be within the safe limit of recommended standard value stated in the Table 5.1 and 5.2.

Frequency of testing: Since Arsenic contamination has been detected in certain parts of the country (especially in the Terai belt), it is recommended that each new well in those areas be tested for arsenic at least two times (in 2 different seasons) in a year or as situation demands. Besides new installation of tube wells/hand pumps, 5% of total tube well/hand pump installations in all terai projects are mandatory for Arsenic test in every year. However, arsenic test is not mandatory for the water points or water supply systems within Hilly and Mountainous regions where arsenic contamination has not yet been reported.

In addition, as a safeguard, 10% of wells sited in areas which do not have geological indicators of arsenic's presence should be tested. Regions having geological indicators of a possible arsenic presence are expected to further conduct annual testing of at least 5 % of the wells because of the latency period before arsenic-related health problems emerge and possibilities of arsenic creep in groundwater over time. Should such testing reveal significant changes over time in arsenic concentrations in tube wells over time the testing regime may have to be extended to cover a greater proportion (or all) of the tube wells, depending on the level of change being experienced and after discussions with WAN.

Equipment for testing: Accurate detection of arsenic requires sophisticated equipment like **AAS** (Atomic Absorption Spectrophotometer) in a laboratory.

There also exists arsenic kit ie **Merck Sensitive** (Merckoquant Arsenic Test Strips) or **HACH E2** that can give indication of the presence of arsenic within the sensitivity range of 0.01 – 0.5 mg/l. In the kit, there are test strips which develop characteristic colours corresponding to specific arsenic concentration ranges that fall within the broader sensitivity range. These strips can be used for field-testing to obtain a fair idea about whether the well water is potable so far as arsenic concentration is concerned.

Another test kit that can be use is the **PeCo 75 Arsenator, Wagtech Arsenator**. Training and running costs are unlikely to differ markedly from those of other inorganic field test kits.

In addition to these imported field testing kits, there is one field testing kit developed within the country and its name is **ENPHO Arsenic Field Testing Kit**. For reference, the detail of this **ENPHO Arsenic Field Testing Kit** is attached in the annexes.

In view of the limitations of these field test kits, it is recommended that test results should be validated in reliable reference laboratories recognized by the government and other international agencies.

Methods: The following procedure is proposed when installing any new tubewell in the rural and in the urban programme. Since arsenic has not been detected in surface water, the testing for it is not required in implementing gravity flow schemes.

Pre-feasibility survey: Consideration of the detection of any arsenic contamination in Terai tubewell and deep tubewell is to be made during pre-feasibility survey. The survey team should inquire for any testing carried out by any other sector agencies. They should in particular communicate with the partner NGOs/CBOs/UCs and VDCs. Details of the testing report are to be obtained if possible.

Pre-installation testing: Before installing any tubewell in the shallow aquifer at least three and up to five existing tubewells in the shallow aquifer close by the proposed site should be tested for arsenic using recommended (PeCo 75) arsenic testing kit. The closest tubewell should be tested first. *Alternate to PeCo75 arsenic testing Kit, ENPHO Arsenic Field Test Kit (locally produced test kit) can be used.*

- If even one of these tests shows greater than 0.01 ppm arsenic concentration, DO NOT INSTAL THE NEW TUBEWELL. Choose another location in the village.
- Static water level of all the tested tubewells should also be measured for keeping record.
- If five tubewells are not available test the maximum number of tubewells available within the vicinity.
- If there is not any single tubewell available for the pre-installation testing then the tubewell can be installed.

Since WaterAid is not aware of any record of arsenic in Kathmandu, Nepal, these areas are not to be subject to pre-installation testing but carry out installation testing.

Installation testing: All newly installed tube wells and dug wells must be tested for arsenic with a recommended kit or PeCO75, or in the laboratory by AAS method before the concrete platform is constructed.
If the test is performed by PeCO75 or AAS and indicates less than 10 ppb then the installation of tubewell should be

completed. Where as if the testing is done by other than above two methods, in such case, if test indicates any concentration then the tube well should be temporarily closed until 2 water samples from the tube well can be retested by the implementing agency using PeCO75 or at the recommended laboratory by AAS method.

If arsenic levels are found to be up to 10 ppb then the installation should be carried out and if it's concentration is above 10 ppb then the tube well must be removed and installed elsewhere (where pre-installation tests will again be required).

Re-testing

- Arsenic contamination problems can change and develop over time. All new tubewells in arsenic prone areas must be retested for arsenic after the first 6 months after the initial sampling test so as to have a data for two seasons (ie one for dry and the other for rainy season).
- Sample testing of all tube wells should be undertaken to cover at least 5 - 10% of the tube wells in each 12 month period. Sample testing should include representative samples from each village covered. Should such testing reveal significant changes in arsenic concentrations in tube wells overtime, the testing regime may have to be extended to cover a greater proportion of the tube wells, depending on the level of change is being experienced.
- If a tube well is retested and arsenic is detected then mitigation measures must be undertaken including painting the spout.

Awareness raising: A session on arsenic that includes arsenic contamination, its effect and probable mitigation measures etc need to be incorporated in the training programme (such as NGO coordinator, Health motivator) for the local implementing partners. Partners' staff must launch the awareness programme in the community using IEC materials produced by the National Steering Committee on Arsenic.

Tube well painting: Any tubewell which is contaminated above 10 ppb (0.01 mg/l) for new wells and 50 ppb (0.05 mg/l) for old wells should be painted **white and crossed (X) with black at its spout.** The water from this tubewell should not be used for drinking and cooking purpose.

Before painting the spout should be scrubbed with Iron paper (not sand paper). After cleaning the surface is to be cleaned with a dry cloth. Only good quality of enamel is to be used for painting. Thinner could be used so that the paints lasts longer and dries more quickly. Use two coats of paint. The paint should last at least for two years.

Closure of Tubewells: Existing tubewells are not to be closed down even if they are found to be contaminated above the permissible limit. Paint them white with a cross (X) mark and raise the awareness of the people so that they don't use this water for drinking and cooking purposes. However, arsenic contaminated water can still be used for washing clothes, utensil cleaning, bathing and other household purposes. If all the arsenic contaminated tubewells were closed without providing safe alternative sources, people would be forced to turn to safe sources, or put too much pressure on a small number of safe sources. If a tubewell is found to be heavily affected by arsenic then this should be immediately reported to WAN's partners who should make necessary considerations either to close the tubewell or provide a facility of an arsenic removal plant.

For Details, refer to WaterAid in Nepal's Arsenic testing protocol: Instructions for partner organisation, January 2005).

7.1.2 Microbiological contamination

Surface and ground water are major sources of water for drinking purpose. Springs and streams are surface water sources and deep tube well, shallow tube well and dug wells are ground water sources.

In most rural water supply projects treatment by chlorination is not possible, so, faecal coliform tests are recommended instead of total coliform test. (Total coliform is only relevant in chlorinated water supplies where the detection of ANY surviving bacteria is cause for concern).

Frequency of testing: Use of the sanitary surveillance form on regular basis will help to reduce the risk of water contamination where the water quality testing on regular basis is difficult either due to remote location or lack of resources. Twice in every year, preferably in monsoon and in dry season or before construction and after completion of water projects, all the water points or water supply system constructed are mandatory for microbiological test prior delivering water. Whenever situation demands for microbiological test, it should be carried out in the project areas accordingly. However, to confirm the water quality which is being supplied, every year a sample size of 15 % of water points, critical structures (such as storage tank, distribution chamber, intake etc) and water sources of the projects completed within the preceding 12 months must be tested for assessing the contamination level.

The microbiological quality of water sources changes according to season, particularly in monsoon climates. So to establish a microbiological quality profile, at least two tests one in monsoon (wet) and the other in the dry season is required. Thus, the following periodical test is recommended depending on the source of water used in the schemes.

- **Surface water:** During piloting of new gravity flow piped surface water schemes, frequent monitoring of faecal coliform will be necessary. Once reliability of a scheme is established, the water should be tested at least on a six monthly, ie seasonal, basis.
- **Ground water:** Sample of testing tubewells on a seasonal (ie six monthly) basis.
- **Rain water:** During piloting of new rainwater harvesting systems, the water should be routinely tested. Once safe practices are established, the tank water is only required to be tested.

If the test result shows a contamination risk or identifies a problem during a sanitary inspection conducted either by a community or by a partner organisation, then testing should be conducted for that water source.

Samples for test should be collected from all the intake points, reservoirs and tap stands of the selected projects. After the test, the degree of urgency for remedial action will be disseminated and this will depend on the level of contamination which is given below:

- For 1-10 coliform/100 ml, it falls under low risk category and needs remedial action within 6 months.
- For 11-100 coliform/100 ml, risk factor is high and needs attention within one month.
- Finally for above than 100 coliform/100 ml, the risk factor is very high and needs attention within 7 days.

Equipment for testing: The field-testing kit most widely used by WaterAid for microbial testing is Delagua Portable Water Testing Kit developed by Robens Institute and latterly by the Centre for Environmental Health Engineering (CEHE) at Surrey University. It works on the principle of membrane-filtration (MF). The kit incorporates an incubator, and a battery pack for self contained sampling and analysis in remote locations. Similarly Wagtech Potatest is a good alternative to DelAgua Kit.

Yes/Not test strips are also used for rapid assessment/test of microbiological (bacterial) contamination to help inform decision makers on whether further testing will be necessary. These test strips can detect the presence of bacterial from around 3 cfu/ 100 ml upwards only.

In addition to this, ENPHO Water Test Kit was developed by ENPHO and is being used by a number of sector stakeholders and agencies in Nepal for detecting microbial contamination in water. For reference, the detail of this ENPHO Water Test Kit is attached in the annexes.

Sanitary inspection survey for risk assessment *(Refer Chapter – 9 for Detail)*: The frequency of testing should be related to the contamination risk associated with a water source as it is not always feasible to carry out regular testing of every water source. If a contamination risk is present, the source should be repeatedly tested. Sanitary inspection is a very useful risk assessment tool. Routine sanitary inspections should therefore be carried out by partners and community members should be used to identify the level of monitoring assigned to community supplies. Sanitary inspection involves:

- identification of potential sources of contamination
- assessment of the risk posed by these potential sources of contamination

This water quality standard and testing policy recommends that the partners carry out repeat testing of water sources based on a perceived risk that conditions at water points might change. Clearly it is not possible for partners to repeat test, on a regular basis, all remote and inaccessible sources that have ever been installed.

If testing by sampling and analysis presents severe difficulties, either with a field test kit or by laboratory, a sanitary inspection survey should be conducted. If the resulting contamination risk score is low, a water quality test may be omitted. If circumstances improve, the source should be tested when practicable. If there are large numbers of sources with difficult access, testing of a sample proportion (say ten percent) showing a representative range of characteristics should be attempted.

Sample sanitary inspection survey form is included in **Appendix 1**. Sanitary inspections yield scores which enable field workers to deduce the risk that a source may be contaminated. **Refer Chapter – 9 on Sanitary Inspection Survey for detail understanding on conducting it.**

Methods

a. Surface water sources

Feasibility Stage: During feasibility stage the staff from the partner organisation will visit and assess the water source flow regime. For all the water sources, Sanitary Surveillance Forms need to be completed to identify risk factors due to contamination. If the source is likely to be contaminated from upstream human activity or any other reasons, then it must be tested the faecal contamination before selection.

Construction Stage: During the construction phase, all potential risk factors identified during the feasibility stage should be dealt with. These include keeping away surface water run-off from the intake structure, stopping human and animal activity upstream of water source. Similarly, care should also be taken while constructing water supply structures to avoid/prevent contamination. For example, the outward slope of the apron slab of the collection chamber or reservoir tank will prevent the rainwater or other surface water entering into it.

b. Groundwater Sources

Feasibility stage: The location of shallow tube wells and hand-dug wells should be at safe place in terms of contamination possibilities. Sanitary Surveillance Forms should be completed during feasibility stage to properly locate a tube well/hand-dug well by understanding the possible risk factors for tube well contamination from any existing sanitation facilities.

Construction stage: The quality of tube well platform construction and hand dug well apron should be of high quality so that wastewater does not find its way to water body through any cracks. Similarly, the joint between two consecutive lining rings should be watertight to prevent infiltration.

During various construction stages, contamination may be introduced to wells and tube wells. They should be chlorinated before putting into use.

The use of cow dung during tube well boring is common practice in Nepal. WaterAid recommends its partners not to use it. However, in unavoidable circumstances where cow dung is used for such purpose, the super chlorination of tube wells is essential before the well is put into use.

Follow-up visits: The partner staff should train the benefiting communities' representatives to monitor water quality risk factors on regular basis by using the Sanitary Surveillance Form. This will include a bi-annual visit by partner staff to help them to use the form so they develop confidence. Partner staff will also monitor the remedial actions taken following the preceding visit.

7.1.3 Nitrate

Though nitrate is health hazardous, its concentration in shallow wells in the Terai is minimal. There is some indication of high concentration in dug wells in the Terai and stone spouts of Kathmandu valley as tested by ENPHO but they fall within the proposed WaterAid guideline value. Therefore, it is not required to test all the shallow and deep tube wells for Nitrate at the time of installation. However, in case of dug well projects in urban and rural area including Kathmandu valley, each well should be tested for Nitrate.

Frequency of testing: It is suggested that water points be sited away from fields that are subject to agricultural runoffs. However, should it become necessary that if water sources are sited in an area or near an area where there is intensive farming activity, to undergo for nitrate testing mandatory. For new sources, analysis for nitrate should be a pre-requisite under such circumstances. Treated water from surface waters entering the distribution system must also be assayed for nitrate and nitrite. However, it is recommended that nitrate and nitrite testing should be done at least once in every year, one facility in any cluster by random sampling with sampling size of 15% of total water points, critical structures (such as storage tank, distribution chamber, intake etc) and water sources in all the project areas are mandatory for nitrate testing every year.

The following periodical test is recommended depending on the source of water used in the schemes.

- **Surface water:** During piloting of new gravity flow piped surface water schemes, the testing on nitrate should be conducted at the time of commissioning the schemes. Once reliability of a scheme is established, the water should be tested for nitrate on an annual basis.
- **Ground water:** Sample of tube wells tested, and hand dug (ring) wells on a seasonal (ie six monthly) basis.
- If the test result shows a contamination risk or identifies a problem during a Sanitary Inspection conducted either by the community or by a partner organisation, then testing should be conducted for that water source.

Contamination of water supply with nitrate is very difficult and costly to treat. To effectively remove nitrate and nitrite, the following drinking water treatment technologies can be employed: Ion Exchange, Reverse Osmosis, Electro-dialysis. Considering the constraints and glaring limitation of resources, it is advised that alternative drinking water supply be found in cases where there is nitrate/nitrite concentration in excess of the guideline value eg rainwater harvesting.

Equipment for testing: Wagtech Colour Comparator can be used for conducting nitrate test which detected nitrate within the range of 0 – 20 mg/lit. Similarly, Wagtech potatest can also be used for testing the Nitrate Parameter. Similarly, Hach DR 2010 Data-logging spectrophotometer can be used to determine nitrate and nitrite levels present in water. Alternatively, these tests can also be conducted using ENPHO.

Nitrate test kit

Method: The test through ENPHO Nitrate Test Kit is based on colour comparison. Nitrate is treated with phenoldisulphonic acid in alkaline medium to form yellow colour nitro–derivative. The yellow colour obtained is compared with the standard colour chart and its concentration in water is determined.

If the test result shows high concentration of Nitrate then implementing agency must explain to the community about the risk of Nitrate. It must also help by identifying alternative safe water sources. The community should then be advised to use safe water for drinking purpose.

7.1.4 Iron

The knowledge and working experience of partners suggests that there are high concentrations of Iron in shallow and deep aquifers. Sometimes, the concentration of iron is found to be above 10 ppm. The users usually reject such wells for domestic use. Tests for iron can be carried out using either HACH-E2 Test Kit or ENPHO Iron Test Kit.

Frequency of testing: Fortnightly monitoring by the community based on their acceptance as higher iron concentrations are iron becomes objectionable due to its colour and taste. Routine testing therefore is not required but, testing will be required to record the effectiveness of any IRP (Iron Removal Plan) installed.

Method: The following iron testing procedure is proposed when installing any new tube-well in the rural and in the urban programmes.

Installation testing: All newly installed tube wells (shallow and deep) must be tested for iron with a field test kit (ENPHO Iron Test Kit or HACH-EZ Test Kit) before the concrete platform is constructed. If the test result indicates the presence of Iron, action should be taken as mentioned in the Table – 7.1.

7.1.5 Free residual and total chlorine

Surface Water: This only needs to be tested for chlorinated water supplies. At present, WAN partners are not providing chlorinated water supply facilities. However, supplies from urban water points should be tested at the same time.

Groundwater: This needs to be tested only if chlorination of wells is required. Chlorination of wells should not be done routinely, but may be required after a well is contaminated by nearby sanitation (latrine) facilities or by flooding.

Rain water: Not applicable. However, if bleaching to clean a roof catchment has taken place, and then first water flush should be diverted from tank until taste and smell are acceptable.

Equipment for testing: The field-testing kit recommended for chlorine testing is Delagua Portable Water Testing Kit. Alternate to this kit, ENPHO Water Test Kit can also be used.

7.1.6 Turbidity

Frequent visual testing should be done at least weekly during piloting stage. Once the reliability of scheme is established, water should be tested on a seasonal (six monthly) basis along with the test conducted for microbial contamination and during sanitary inspections.

Equipment for Testing: The field-testing kit recommended for turbidity testing is DelAgua Portable Water Testing Kit.

Table – 7.1: Level of Iron in Water and actions required for it

S.N.	Iron (ppm)	Actions required
1	0 – 3	Complete the installation of tube well
2	3 - 7	Discuss with communities and acquire their acceptance before constructing a platform. In this case, communities/users may be offered an iron removal plant
3	> 7	Reinstall the tube well in another location rejecting the tested one OR install iron removal plant in the tested tube well

7.1.7 pH

Once the reliability of scheme is established, water should be tested on a seasonal (six monthly) basis along with the test conducted for microbial contamination. The test for pH is mandatory if water is disinfected through chlorination. Routine testing, therefore, is not required if chlorination is not done. If it is the case of rainwater system, then pH test should be carried out on a quarterly basis for first year and then on seasonal basis once reliability is established.

7.1.8 Colour, odour and taste

Fortnightly monitoring by the community using visual observation and their acceptance level should be done. Acceptance levels should be recorded by WAN partners during sanitary inspections.

In view of the current state of water supply schemes the frequency for conducting a Water Quality Testing is suggested in the Table 7.2.

Table 7.2: Frequency of water quality parameters to be tested in a Water Supply System

<table>
<tr><th rowspan="2">Parameters to be tested</th><th colspan="2">By partner organisation</th><th>Remarks</th></tr>
<tr><th colspan="2">Frequency (Once initially, thereafter):</th><th>Source and mode of supply</th></tr>
<tr><td>Arsenic</td><td>Two times (in 2 diff seasons) in a year or As situation Demands</td><td>• 5% of total hand pump installations in all Terai Projects are mandatory required for Arsenic Testing in every year
• Not necessary for Water Projects within Kathmandu Valley and Hilly and Mountainous Regions</td><td rowspan="2"><u>Ground Water</u>
• Open wells for community supply
• Covered dug wells and shallow tube-wells with hand-pumps
• Deep tubewells with hand-pumps
• Wells and piped supplies
• Springs and piped supplies</td></tr>
<tr><td>Microbial</td><td>Twice in a year or As situation Demands</td><td>• Once in every monsoon and the other in every dry season
• 15% of the total water points, critical structures (such as storage tank, distribution chamber, intake etc) and water source
• If found exceeds the standards, further testing is required after adopting mitigation measures to ensure delivered water is safe.</td></tr>
<tr><td>Nitrate</td><td>Once in a year or As situation Demands</td><td>• 5% of total water points, water sources and storage/reservoir tanks installed in all the Project areas are mandatory required for Nitrate Testing in every year
• Those sources or water points which are in an area or near area where there is intensive farming and open sewer drains</td><td rowspan="2"><u>Surface Water</u>
• Streams and Piped Water Supplies
• Projects serving < 1000
• Projects serving 1,000 to 3,500 population
• Projects serving > 3,500 population
• In case of existing water supply systems, if no reliable data is available, existing pipelines fed from surface sources should be tested at source and delivery points including critical structures (such as storage tank, distribution chamber, intake etc) prior to extending or modifying the existing system</td></tr>
<tr><td>Iron</td><td>Once in a year. or As situation Demands</td><td>• But wherever treatment plant is installed like IRP, routine testing is required annually</td></tr>
</table>

Parameters to be tested	By partner organisation		Remarks
	Frequency (Once initially, thereafter):		Source and mode of supply
Chlorine (Free Residual Chlorine)	Twice in a year or As situation Demands	• Once in every monsoon and the other in every dry season • 15% of the total water points, critical structures (such as storage tank, distribution chamber, intake etc) and water source should be tested	Every test should be carried out at an interval of at least 1 month duration continuously in water supply system having chlorination facilities
Turbidity	Twice in a year or As situation Demands	• Once in every monsoon and the other in every dry season • 15% of the total water points, critical structures (such as storage tank, distribution chamber, intake etc) and water source	Monthly observation by Users' Committees (UCs)
pH	Once in a year or As situation Demands	Only if chlorination is done	Quarterly for first one year if it is rainwater harvesting system

Note: While working for new water source, immediate WQ test is required to be performed before developing that source and immediately after completion of the construction of work prior to put the system in operation. Then after WQ test should be performed as per the frequency mentioned above.

Source and mode of Supply	Minimum frequency of sampling and analysis		Remarks
	Microbiological parameters	Physical /Chemical parameters	
Open wells for community supply	**Sanitary protection measures:** Microbial testing as mentioned above	Twice in a year or as situation Demands	Pollution is usually expected to occur
Covered dug wells and shallow tube wells with or without hand pumps	**Sanitary protection measures:** Microbial testing as mentioned above	Twice in a year or as situation Demands	Situations requiring testing: • Change in environmental conditions • Outbreak of waterborne diseases • Increases in incidence of water borne diseases
Deep tube wells with hand pumps	**Sanitary protection measures:** Microbial testing as mentioned above	Once in a year or as situation Demands	
Protected Springs	**Sanitary protection measures:** Microbial testing as mentioned above	Once in a year or as situation Demands • Periodically for residual chlorine if water is contaminated and has been disinfected	
Rainwater Harvesting Systems	**Sanitary protection measures:** Microbial testing as mentioned above	• Twice in a year or as situation Demands • Periodically for residual chlorine if water is contaminated and has been disinfected	

Sampling, Test/Analyses Frequency in distribution pipelines of piped water supply system: The minimum frequency of sampling and analysis in the distribution pipelines for piped water supply system could be referred as mentioned in the Table – 7.3:

Table – 7.3: Minimum frequency of sampling piped water supply system

Population	Number of samples
For < 2,500	1 sample during WQ testing for entire system
For 2,500 – 5,000	2 samples during WQ testing for entire system
For 5,000 – 100,000	3 samples plus extra sample per 5,000 additional population
For > 100,000	1 sample per 10,000 population plus 10 additional samples

8 Information, record keeping, reporting and dissemination of results

8.1 Background

Information, record keeping, reporting and its dissemination to concerned stakeholders including community people is required to be inbuilt under water quality testing, surveillance and monitoring programme. Mere compilation of sanitary survey, water quality analysis and preparation of database would not help to improve water quality situation. Proper interpretation of data and timely flow of information and reporting to concerned party is required for effective system. Information management is very important, whereby roles and responsibilities of stakeholders and manpower involved would be transparent and judge worthy and corrective measures can be introduced. This would also help to establish good water practices. This chapter discusses on information, record keeping, reporting and dissemination procedure.

8.2 Reporting and communicating

An essential element in a successful surveillance programme is the reporting of results to key stakeholders. It is important to establish appropriate systems of reporting to all relevant stakeholders including community people and other related agencies. Proper reporting and feedback will enable the development of remedial strategies. The ability of the surveillance programme to support the interventions to improve water supply are highly dependent on the ability of the surveillance bodies to analyze and present information in a meaningful way to different target audiences. The target audiences for surveillance information will typically include:

- Public health officials at local and national levels
- Water suppliers
- Local administrations
- Communities and water users
- National/regional authorities for development planning and investment

This information would be helpful in preparing water safety plan for water supply systems.

8.3 Interaction with community and consumers

Community participation is a necessary component, particularly for community supplies. As primary beneficiaries of improved water supplies, community members have a right to take part in decision-making about their own future. The community represents a resource that can be drawn upon for local knowledge and experience. They are the people who are likely to first notice problems in the water supply and therefore can provide an indication when immediate remedial action is required. Communication strategy should include:

- Procedures for promptly advising of any significant incidents to the water supplier as well as the public health protection agency and, in the event of significant public health risk;
- Summary information to be made available to consumers, for example through annual reports, mass media and meetings or the internet; and
- Establishment of mechanisms to receive and actively address community complaints in a timely fashion.

The right of consumers to information on health-related parameters of the water supplied to them for domestic purposes is fundamental. However, in many communities, the simple right of access to information will not ensure that individuals are aware of the quality of the water supplied to them. The partners responsible for monitoring should therefore develop strategies for disseminating and explaining the significance of results obtained by mobilizing the users committees or appropriate community organisations which can provide an effective channel for feedback of information to users. Furthermore, by using local organisations like users committees (UCs) or other community based organisations (CBOs), it is often easier to initiate a process of discussion and decision-making within the community concerning water quality. The most important element in working with local organisations is to ensure that the organisation selected can access the whole community and have the ability on the ground to initiate discussion around the results of Water Quality Assessment / Surveillance.

In summary,

1. Implementing organisations, with whom WAN partners with, must keep the records of all the tests performed for arsenic, microbial contamination, nitrate and iron in a standard format. All the water sources, whether surface water, rainwater or ground water, should have clear references to ensure that they can be accurately identified for future testing/follow up.
2. A standard register should also be kept in every partner's office showing all the results of the tests conducted for all the water sources. This will show the systematic record of tests with all details (such as identification number, date, location etc). An electronic copy of the records of the tests must be submitted to WaterAid in Nepal (WAN) by each partner in the formats mentioned in the formats (Format 1 and 2) mentioned in Page 23 along with their Progress Reports and they have to report the records f the tests in the formats mentioned in the annexes along

with their six monthly/annual progress reports and wherever applicable.

3. Partners should make sure that all the test results of arsenic, microbial contamination, nitrate and iron are reported and communicated to communities and partners who are involved.
4. To ensure that the results are interpreted in context, wherever possible test results for improved sources should be presented alongside test results for existing unimproved sources so that judgments about levels of improvements achieved can be made.

9 Sanitary Inspection Survey (SIS)*

9.1 Background

The traditional approach to water quality management has relied only on the testing drinking water at the water points and sources and is normally called as “end product testing”. Water quality analysis although very useful may be limited in itself because it is usually based on spot samples. Even if spot samples are taken both in rainy and dry periods they still may not give a complete picture. This is the reason for which regular sanitary inspections are recommended to serve as a complementary measure for confirmation. That is why, WHO (2004) stated that this traditional end product testing approach has a problem of too little results and too late for preventive actions. Too little because so few samples are taken compared to the water produced. The implication here is that the results may not be indicative of the true quality of water. Too late because by the time a contamination event is identified through end product testing, large numbers of people may have been affected.

The most effective means of consistently ensuring the safety of a drinking-water supply is through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer

Sanitary Inspection Survey (SIS) is a continuous and vigilant public health assessment and overview of the safety and acceptability of drinking-water supplies. Each component of the drinking-water system, ie source, treatment, storage, and distribution - must function without risk of failure Water is vulnerable to contamination at all stages in the process of supply, hence the need for constant vigilance is essential.

---

* *This chapter is added to the format prescribed by WA-UK.*

A sanitary inspection survey (SIS) is an on-site review of the water source, facilities, equipment, operation, maintenance, and monitoring compliance of a public water system for the purpose of evaluating the adequacy of the drinking water system, its source, treatment, and distribution, operation and maintenance for producing and distributing a reliable and safe supply of drinking water. It is in fact an on-site inspection and evaluation of all the conditions, devices and practices in the water supply system, which poses or may pose a danger to the health and well being of the water consumer.

9.2 Significance of Sanitary Inspection Survey (SIS)

SIS, therefore, provides us with a useful way of identifying the likely causes of contamination when it is found. It should institute the provision of technical advice on how defects can be removed and quality can be improved. Efforts should focus primarily on encouragement and stimulation of individuals and community groups to make their own improvements and then to provide information on proven techniques.

A sanitary survey provides a comprehensive and accurate record of components of small water systems assesses the operating conditions and adequacy of the water system and determines if past recommendations have been implemented effectively. During an sanitary survey/ inspection, operation and maintenance practices, records and communication flows are reviewed. It is a very useful tool because it can give first hand information and it can do so in 'real time'.

It should be emphasized that, when a sanitary survey/inspection shows that a water source or its mode of distribution and storage is liable to pollution; it should be condemned irrespective of the results of chemical or bacteriological examination or a single sample, which can provide information only on the conditions prevailing at the moment of sampling.

9.3 Sanitary Inspection Survey (SIS) components

The sanitary survey will address, at a minimum, the following elements:

- Sources
- Treatment
- Distribution system
- Water storage or reservoir
- Pumps, pump facilities, and controls
- Monitoring, reporting, and data verification
- System management and operation

9.4 Points to be considered in a sanitary inspection survey

- The sanitary inspection can point out the obvious points of risk of information contamination while single water sampling may not be representative for the real situation of water quality. However, sanitary inspection alone also may not generate an accurate picture of likely water quality at source either. Therefore, combination of both ie sanitary inspection and water testing results is highly recommended for the evaluation of water facilities.
- Sanitary Inspection form should include at least a checklist of the components of the water supply from source to distribution

and incorporate all the potential points where hazards may be introduced. It should also not be restricted only to factors and problems associated to water quality but also take into account for other service indicators, e.g. Coverage, cost, continuity and quantity. **(For details of Sanitary Inspection Survey (SIS) Information Assessment Form, please refer to the Annex - 6 and 7).**

- Frequency of Sampling should be higher for Microbiological parameters.

9.5 Risk assessment in Sanitary Inspection Survey (SIS)

It is recognized that it is not always feasible to carry out regular testing of every water source. The Frequency of testing should be related to the contamination risk associated with a water source. If a contamination risk is present, the source should be repeat tested. Sanitary inspection is thus a very useful risk assessment tool. Routine sanitary inspections, carried out by partners and community members should be used to identify level of monitoring assigned to community facilities.

a. Sanitary Inspection Survey (SIS) involves:

- identification of potential sources of contamination
- assessment of the risk posed by these potential sources of contamination

A sample sanitary inspection form is included in the annex – 6 and 7. Sanitary inspections yield scores which enable field workers to deduce the risk that a source may be contaminated. A popular sanitary inspection survey scoring system is presented below.

Table – 9.1: SIS scoring system (Refer Annexes for associated inspection form)

Sanitary Risk Score	Assessment of Risk
9-10	Very high-risk
6-7-8	High-risk
3-4-5	Some risk
0-1-2	Low risk

Sources identified as high-risk should be assigned a higher testing frequency until the problem is resolved. A sample inspection sanitary form is included in annexes. Sanitary inspections yield scores which enable field workers to deduce the risk that a source may be contaminated.

b. Assessing the risk in Sanitary Inspection Survey:

Total Sanitary Risk Score (SRS) =

$$\frac{\text{(Total Number of “YES” in the Observations Made)}}{\text{Total Number of Observations Made during SIS}} * 10$$

Note: *The SRS should always be less than 10.*

9.6 Sanitary Inspection Survey (SIS) activities

As in the case of analytical procedures, it is not mandatory that the DWQS produce extremely detailed information or conditions related to sanitary survey/inspection. Sanitary survey/inspection should consider the selection and visit of the most important points in a water system such as reservoirs, treatment systems, low pressure points, stand pipes, special connections etc.

In developing countries like Nepal, depending upon the availability of personnel, equipment, resources and higher operational costs, the extent of these types of survey/frequencies will be dictated as the availability of resources/ facilities permits. It is thus important that WAN will work towards having realistic but not health compromising frequencies of sanitary inspections. The activities proposed for a Sanitary Inspection Survey (SIS) is presented in the Table 9.2.

Sources identified as high-risk should be assigned a higher testing frequency until the problem is resolved. A sample inspection sanitary form is included in annexes. Sanitary inspections yield scores which enable field workers to deduce the risk that a source may be contaminated. Refer Annex - 6 and Annex – 7 respectively for SIS and SI Risk Scoring system.

9.7 Frequency of Sanitary Inspection Survey (SIS) of water supply system

Frequency of SIS differs with the parameters of concern and the risk associated with them. Depending upon the level of implementation of survey/inspection programme, interventions needed to rectify them need to be implemented. Simple-to-use community Survey and Sanitary Inspection Survey (SIS) Forms must be carefully developed. This may be in a form of checklists for rapid assessment.

The common survey/inspection sites/ activities (wherever applicable) are usually in and around the intake points and control points/pollution prone points in the supply system.

Minimum number of sanitary survey/ inspections, depending upon the type of system, need to be standardized for the partner organisations to follow. However, any or a combination of the recommended indicators outlined below should guide the frequency and intervals of Sanitary Surveys:

1. When developing new sources of water and where there is insufficient details to determine the suitability of the source and

Table 9.2: Sanitary Inspection Survey (SIS) activities

For source water	In supply system
Fencing of the intake points (applicable to spring source, impounded area of the spring, dug wells, etc.)	Collection/sedimentation/distribution chambers: inspection may be made on their physical and working conditions, frequency of de-sludging/ cleaning etc.
Diversion of surface runoff from agricultural and cultivated areas, domestic/industrial areas	Treatment process (gravel filtration, slow sand filtration, activated carbon, aeration, coagulation etc.): inspection may be made on their process efficiencies, frequency of cleaning/ back washing etc.
Prevention of unsanitary use of upland river stretch such as defecation and waste dumping along banks	Disinfecting process: Inspection may be made on pre disinfecting, terminal disinfecting points, control of pH, residual chlorine, effectiveness of disinfecting etc.
Appropriate measures to prevent landslides and mud water falling into stream channels, particularly during rainy season (weak zone upstream of the intake)	Distribution Network: Inspection may be made on pipeline conditions, leakage, fittings, cross connections, syphonage, sanitation near to tap-stand.

Table 9.3: Frequency of Sanitary Inspection Survey (SIS)

Source and mode of supply	Minimum number of sanitary inspections per year	
	Community workers	Partner organisation (Once initially, thereafter)
Ground water		
Open wells for community supply	3	At least once in a year) or As situation demands
Covered dug wells and shallow tube-wells with hand-pumps	2	
Deep tube wells with hand-pumps	2	
Wells and piped supplies	1	Once every 3 yrs, or as situation demands
Springs and piped supplies	1	Once every 3 yrs, or as situation demands
Surface water		
Streams and Piped Water Supplies	2	Once every 3 yrs, or as situation demands
A. Simply piped supplies:		
Projects serving < 3,500 population	2	Once every 3 yrs, or as situation demands
B. Filtered and/or chlorinated piped supplies:		
Projects serving < 3,500 population	2	Once every 3 yrs, or as situation demands

also the degree of treatment required before raw water can be considered suitable for human consumption.

2. When laboratory analysis of a sample taken from the water system indicate a hazard to health. Under such circumstances a survey should begin immediately to identify sources(s) of contamination.
3. When an outbreak of a waterborne disease occurs in or near the area served by the water system.
4. When interpreting bacteriological, chemical and physical analyses of water samples.
5. When any significant change in the environment is noted within the immediate vicinity that may affect the water system. Examples include the construction of a new industry on or along the watershed.

In view of the current state of water supply schemes the frequency for conducting a sanitary inspection is suggested in the Table 9.3.

9.8 Limitations of SIS in terms of available resources[2]

To address the SIS limitation in terms of available resources which might be Financial, Human as well as Material (e.g. equipment) etc., only distribution pipelines will be chosen for Gravity or

2 *Resources here means Financial, Human and Material (Equipment)*

mechanical pumping water supply system. One sample point shall be selected for each 5 km of primary, secondary and tertiary distribution pipelines. As far as possible public stand posts shall be preferred as sampling points. Otherwise a private yard connection with very short length of house connection should be the second choice. If both options not available, a sampling point must be tapped on the distribution pipes. In case of rain water harvesting and other form of water collection and distribution systems, sample point shall be immediately below the service reservoir.

9.9 Alternative sources

Treatment of water on community managed water supplies should always be considered as a last resort and, if water quality testing shows a potential source to be a problem, the first action should always be to look for an alternative safe source that will not require treatment.

10 Resources

An assessment must be made of the resources which will be required for the task; these will include physical, human and financial resources. The provisions of WaterAid's policy on health and safety will apply to persons working on water quality testing, both in the field and in the laboratory, and may affect the resources required.

The under-listed are options from which resources may be made available for testing activities:

- WaterAid in Nepal
- Communities
- Local partners

The possibility of mutually beneficial cooperation with other water or health agencies should also be explored. Information on the equipment that is likely to be required for the tests of various contaminants in the field is given in the relevant sections below.

10.1 Human resources

WaterAid should develop capacities and skills of the partners' staff to undertake this policy to translate on the ground. Similarly, WaterAid staff in Nepal need to have sufficient skills and capacity so that they could support partner organisations to put this policy in place and implement it on the ground accordingly. In this regard, training and orientation as well as refresher trainings and exposures need to be provided to build up the capacities and skills as well as confidence in conducting WQ test and also to learn and understand from external perspectives to know how others are taking the process ahead. In addition to this, WA in London is also required to support Nepal office building capacity so that CP will be able to support its partner organisations and community people accordingly to step further in this initiative.

Therefore, resources will be required for training; training is not a one-off activity and should be assessed as an on-going procedure. A water quality cadre should be developed at WAN level to work with the partner; at the partner level to work with communities; and local cadres at community level to work with the community users and consumers, and other interested parties.

In this regard, we need to train both WAN colleagues and partners' focal person in developing their skills in handling and operating WQ testing kits as mentioned below particularly, Delagua, WAGTECH, PeCO75 field test kit, Merck Sensitive or HACH - E2, ENPGO's WQ testing kits etc. so that they could conduct WQ test confidently and train the local community cadres and partners accordingly to continue this process for the longer term. Training on portable water quality testing kits/ equipment can however be arranged either through the experts within the country or through the manufacturer.

Community awareness and understanding is also a key issue in this regard. WAN and its partners will develop a stronger role in promoting Water, Sanitation and Hygiene Promotion programme in this process. WAN will provide water quality training including training on arsenic issues and refresher training to its partners. Water quality issues relating to the "soft-ware" components such as awareness building and use of the WAN's water quality as well as arsenic testing protocols will be mainstreamed into Water Sanitation and Hygiene Promotion/ Education programmes.

WHO Guidelines recommends that field personnel responsible for liaison with communities and partners, on-site water quality testing, sanitary inspections and data reporting should be sent on a comprehensive two-week training course. In this context, the supports from WA in London will be inevitable.

10.2 Physical resources

WAN requires its partners to specifically include for water quality testing, monitoring and mitigation in their budget submissions. In this regard, It is WaterAid's responsibility to provide reliable Water Quality Field Testing Kits like, WQ testing kits as mentioned below particularly, Delagua, WAGTECH, Merck Sensitive or HACH - E2, Locally produced kits like ENPHO's WQ testing kits etc.

10.3 Financial resources

The field test kits/ equipments as mentioned above are also required by the partners for undertaking the WQ tests in the field. WAN should provide financial resources to the partners to procure the relevant and necessary water quality test kits (recognized and reliable one). In addition to the cost of field test kits, the additional cost of

Table – 10.1: Water quality field testing kits and their tentative cost

S.N.	Field testing kit	Accessories	Use
1	DelAgua Kit (www.rcpeh.com)	Incubator, battery pack for self contained sampling and analysis in remote locations	Microbiological Test
2	Wagtech Potatest		• Good alternative to DelAgua Kit • Can Test inorganic parameters like nitrates, fluorides etc.
3	Wagtech Digital Arsenator		• Arsenic Test • Can be used to cross verify and validate results collected using a visual colour detection kit
4	Wagetch Visual Colour Detection Kits (VDCK) and cheaper version is Arsenic Safety Kit (ASK)		Arsenic Test
5	Wagtech Colour Comparator		Nitrate Test (detecting Nitrate (within the range of 0 – 20 mg/lit)
6	Merckoquant Arsenic Test Strips (www.slaughter.co.uk)	Come in boxes of 100 strips	Useful for rapid assessment / test of arsenic contamination
7	Yes/No Test Strips		• Useful for rapid assessment / test of Microbiological (bacterial) contamination • Can help inform decision makers on whether further testing will be necessary • Can detect the presence of bacterial from around 3 coliforms per 100 ml upwards
8	ENPHO's WQ Field Test Kit		• pH – color comparison using hydrogen ions (pH reagents) • Ammonia - color comparison using ammonia reagent s • Iron - color comparison using iron reagent s • Hardness - color comparison using hardness reagents • Nitrate – color comparison using nitrate reagents • Phosphorous - color comparison using phosphorous reagents • Chloride - color comparison using chloride reagents • FRC - color comparison using FRC reagents • Coliform P/A Kit - color comparison using Presence/Absence (P/A) vials
9	ENPHO's Arsenic Field Test Kit	Can test for 50 samples *(dilution is required if water sample contains arsenic higher than 20 ppb)*	Arsenic Test

Note: Training on portable water quality testing kits/equipment can however be arranged either through the experts within the country or through the manufacturer.

transport, training and field-workers' expenses should also be considered under the requirement of the financial resources. This requires huge sum of money which ultimately either be allocated in the partners' project plan or need to be provided by WA. However, the partners are at present using ENPHO's WQ testing kits (locally developed kits) which are now under the process of validation and verification.

Apart from this, continuous resources need to be allocated by partner organisations to ensure that WQ tests are constantly being carried out in the water points installed either through new construction or through rehabilitation to ensure they are delivering safe water. The tests might be required continuously to build upon the evidence of safe water from the installed water points. Having WaterAid's WQ protocol for Nepal is in place, partners were allocating the resources themselves either within the same project or through their monitoring and follow up projects. The resources are required not only for conducting the tests but also necessary for conducting regular and periodic monitoring of water supply as well as building the skills and capacities of the local cadres to keep continue this initiatives for the longer period of time.

In addition to the testing activities WAN and its partners will have to develop their resources to provide alternative options for communities. At present, WAN and its partners, particularly NEWAH on one hand is carrying out limited arsenic mitigation activities such as painting the affected tube wells red, and conducting specific education and awareness activities. Whereas ENPHO on the other, (though not through WAN) is providing technical services to other sector stakeholders/ agencies of the country for detecting arsenic contamination (either through self developed field testing kits or through its well set up laboratory), mitigation measures through KAF (Kanchan Arsenic Filter) and BSF(Bio-Sand Filter).

Periodic monitoring of water supply is another important area which is necessary to ensure that the water being supplied is safe for drinking. So it is essential for partner organisations to have a routine monitoring programme. This activity should be undertaken by partner organisations within their own financial resources budgeted in their respective project plans.

However, WaterAid Nepal should also provide financial resources for:

1. Procuring WQ Testing Kits and reagents required for the kits
2. Conducting Training and building capacities of the staff both at the level of WAN and at partners in this WQ discourse; and subsequently in the communities where we work.
3. Testing the suitability of new sources (if required and asked by partners for support).
4. Testing of arsenic over a time period until its concentration has been established.
5. When the country programme periodically looks at the long term performance of completed projects by an examination of the quality of water derived from a sample of older projects.
6. Supporting the initiations for undertaking water treatment works to overcome the cause of contamination and pollution in the water supply system (be it community supply like gravity flow or individual water points)

A water quality testing programme cannot be developed without diverting resources from competing demands. Therefore, there is likely to be a compromise between what ideally should be done and what is practically achievable. The quality of drinking-water sources cannot be put at risk so the outcome may be that a balance has to be struck between the development programme of new installations and what can be sampled and tested. Whatever solution is chosen, it should be periodically reviewed and updated in the light of changing needs and experience. It is important to make a start.

10.4 Others

Realizing that drinking water quality is becoming a major public health concern of the people residing in both rural and urban settings and water quality testing is another problem in Nepal, WaterAid has thus developed its WQ Protocol to be used at least by its partner organisations in Nepal. Since most of the water testing laboratories are concerned in Kathmandu, they are not accessible to and affordable by all. Testing of water in a laboratory by using Atomic Absorption Spectrophotometers (AAS) is also expensive, and using imported testing kits such as PeCO75 field test kit, Merck Sensitive or HACH - E2, etc for arsenic; WAGTECH, Delagua etc. though considered to be the preferred kit for field workers by WA-UK is also not affordable in the context of Nepal. The quality of water should be tested as soon as possible after sampling or needs to be preserved, conditioned per Standard Methods making the testing process more complicated for field workers.

One of WaterAid's urban partner ENPHO, a research based scientific organisation, owns a recognized water quality testing lab and has developed a simple cost effective water testing kit to be used for important water quality parameters. Water quality testing kits developed by ENPHO are put into use by other sector stakeholders and agencies of the country but not yet by WaterAid. Realizing the characteristics of these kits (such as: easily available, cost effective, easy to handle, can be tested by any person after simple training, easy to tackle problems etc.), WaterAid plans to promote them by allowing its Partner Organisations to carry out water quality tests of the parameters mentioned above. These locally developed WQ test kits by ENPHO are being used by WaterAid's partners are at present and are now under the process of validation and verification. This local test kits definitely require further improvement and was verified (validated) by Nepal Bureau of Standards and Metrology (NBSM), under Ministry of Industry (MoI), Government of Nepal with some recommendations for further improvement. A strategy on introducing the training required and how to make best use of the available equipment in ENPHO will be developed in due course in consultation with ENPHO.

11 Follow- up arrangements

11.1 Water quality monitoring

Based on the use of WAN's WQ protocol by its implementing partners, it is experienced that the Water quality testing has been providing crucial information for decision making on the suitability of a water source for human consumption. Considering the need of diverting the resources from competing demands for undertaking WQ testing and its regular follow up as well as monitoring programme, WAN adopted a balancing monitoring approach for the assurance as 'no significant health risk arises from the use of drinking water in WAN supported projects' with a compromise between what ideally should be done and what is practically achievable.

The basic purpose of this WQ monitoring is to achieve the following aims and objectives:

- To be accountable to the beneficiaries concerning to water quality (WRT to WAN's WQ testing policy or NDWQS of Nepal) and mitigation measures adopted.
- To identify the risk level of key contaminants or, risk associated with their occurrence.
- To predict sustainability of the water sources tailored with preventative and corrective actions.
- To capacitate partner staff and community activists on WQ monitoring areas.

System and approaches

- Ground water is the major source in Terai. Therefore, testing of impurities like arsenic, iron, turbidity, pH and faecal coli form tests should be the minimum compliance to ensure the safe water quality.
- Major sources of water in hilly areas are well, snow, spring and stream. Therefore, testing of impurities like turbidity, Chlorine, pH, lime and faecal coli form should be the minimum compliance to ensure the safe water quality.
- All the high risk contaminants parameters mentioned in the WAN's WQ

testing policy (Section 5.2) need to be tested as per the frequency mentioned in Chapter – 7.

- Sanitary Inspection Survey (SIS) will be initiated to start with prior moving towards Water safety plans (WSP) for risk assessment and management. Water safety plans should then gradually be taken as an integral part of monitoring system in explicitly risk-based projects and.
- WQ undergoes frequent changes due to many factors therefore, long term monitoring of existing supplies is required. As a beginning, testing parameters like pH and turbidity should be integrated with community based MandE systems.
- Drinking water quality will be determined based on WQ standards of WAN (Chapter 6) to make sure that people are consuming water within safe permissible standards. In case the set standards are breached, alternative arrangements need to be made along with the point of use treatment options at household level or any other water treatment options.

11.2 Points to be considered while developing plan of action in the event when standards are failed to meet by the test results

a. **Microbiological test results:** If the test results of given source or water points fails the standards recommended by this WQ testing policy, then the problem should be discussed with the communities and partners who are involved. Considerations should be given to:

- Identify the potential cause of contamination conducting a sanitary inspection survey (SIS) to locate the sources of contamination

For this to happen,

WAN Will:	Implementing Partners Will:
• Carry out independent verification WQ test results reported by partners adopting appropriate methodology. • Maintain a WQ records and analyze information on periodic basis to fulfil the purpose of WQ monitoring (as mentioned above section). Learning extracts will be shared with WA and local stakeholders through publication or annual reports. • Identify mutually beneficial cooperation like water and health agencies for effective and extensive WQ monitoring initiative. Appropriate WQ monitoring mechanism will also be integrated with the hygiene promotion policies of WAN and partners. • Further develop, if required on a need basis, uniform reporting mechanism with segregated information in terms of pre-implementation, implementation and post implementation periods.	• Have adopted WAN's water quality testing standards and monitoring framework. • Maintain WQ records well maintained and report to WAN on quarterly basis in the specified formats (format 1 and 2 as mentioned in Chapter – 4). • Implementing partners will submit detailed WQ test information with necessary recommendation for the future follow up mandatorily during submission of project completion reports

- Assess the risk posed by these potential sources of contamination
- Implementing protective measures to prevent further source contamination
- Raising awareness about the importance of water safety and source protection
- Increased awareness on hygiene for improving poor hygiene practices and neighborhood sanitation practices
- Promote household water treatment options normally called as Point of Use (PoU) treatment options
- Raw water treatment by adopting different treatment methods

(Note: treatment measures may depend on other raw water qualities; chlorination will not be effective if turbidity exceeds 5 NTU or pH values are higher than 8, indicating a possible need to also test for these parameters.)

Particular problems will arise if:

- Alternative measures are not viable, or
- The results are border line and alternative solutions are less cost-effective or have other drawbacks.

If this is the case, consultations should be held with communities, partners and other interested parties to determine the best course of action; this might be a decision that the source represents sufficient improvement on those already in use. However, decisions should be made locally on a case-by-case basis and act accordingly to overcome the problem. As suggested above, all test results should be presented against a context of results from existing unimproved sources.

b. Physio-chemical test results:
Consideration should be given to communicating all results of tests for inorganic contaminants to:

- communities
- partners
- other agencies carrying out water supply work in the region
- medical/health authorities
- any other organisation or academic or research institution interested in the incidence of inorganic constituents or if required to do so by legislation

Poor or borderline results should be discussed with communities, partners and other interested parties and their implications should be explained. In the case of poor results, options for action include:

- treatment, including blending
- a search for alternative sources, or simply
- consideration of whether or not the proposed source represents a sufficient improvement over existing sources

These options should be considered in the light of the normal criteria for assessing whether or not a solution is an acceptable one, namely, value for money, health benefits and risks, sustainability, cultural and community views, comparison with previous sources and with levels of water supply service, distance and quantity of water available. If there is no agreement as to what would constitute an acceptable solution, WAN and its implementing partners must consider what action they believe would be in the best interests of the community and must record their views.

It is useful to build up a picture of water quality test results over time. This can help with predicting the sustainability of a source in the long-term, giving insight into the demand levels that a source can sustain without degradation of quality through over abstraction.

Should other parties wish to proceed with the use of a source that WAN considers inadvisable because of the possible risk to health, consideration should carefully made whether WAN and its partners should withdraw support or agree to continue support. In either case, WAN and its partners need to record views about the health risks in writing to the other parties. Should other parties not wish to proceed with a source on health risk grounds, alternative solutions will have to be sought.

However, in any cases, if the water quality standards are failed to maintain, it should be disseminated and documented. In addition, the plan of action needs to be developed to mitigate the cause of contamination be it microbiological or physio-chemical parameters. Partners have to act immediately to implement the plan of action together with the communities for whom they work to make sure that the water delivered from the water points and water stored in the respective households are safe. May be here comes the importance of Sanitary Inspection Survey (SIS). This can be done along with the Rapid Convenient Survey (RCS) which WAN's implementing partners initiated to carry out to understand the hygiene behaviour practices within the community and to understand the efficacy of partners hygiene education programme within the communities where they work.

11.3 Regular revising and updating the WAN's Water Quality Testing policy

The preparation of this WQ policy document has been made to serve as a guide for programme staff, partner organisations and other stakeholders for preparing the provision, supervision, maintenance and routine use of water and sanitation facilities. Although this document is an outcome of a comprehensive review of the relevant documents in Nepal, and consultations with the water experts of Nepal, it is suggested that other relevant publications on water quality and public health endeavours could be used as a supplementary reference guide to this document.

Where there are doubts and difficulties encountered during the interpretation of this document and whenever the policy seems to raise conflicts with other publications, it will be necessary to confer with the appropriate authority in the country to facilitate the process of making the right decision and revising this document accordingly.

As epidemiological evaluation changes, toxicological information increases, and laboratory know-how on contaminant identification and removal improves, it will be necessary to adopt the standard to the changing environment. Therefore, WAN will endeavour to keep abreast of new developments in the sector and will update the policy notes as the situation demands.

There will be a periodic evaluation of this water quality documents and thus it is recommended that it is revised and updated every five years or as and when appropriate. Revisions will consider the changed condition and circumstances over the preceding years; incorporate new knowledge, evidence, technology and resources; and confer uniformity with other published documents related to water quality issues.

The usefulness of procedures and water quality standards is inherently dependant on follow up and remedial measures in the case of standards being breached. This will consist of immediate remedial measures for protecting health, and longer-term preventative action for preventing recurrence. WAN and its partners should make a detailed sanitary inspection of the water facility, and suggests remedies for any shortcomings found and shall endeavour to record the longer term actions which will feed into lesson learned for future improved options.

Major parameters which pose health risk will be assessed. In the event of any non-compliance to any provision in this document, the partner shall be considered to have departed from the conditions of the Memorandum of Understanding entered into with WAN and shall justify the circumstances leading to the non-compliance.

WaterAid partners are striving to support communities in the supply of safe drinking water and WaterAid team will continue to support this effort. In the unlikely case of WaterAid partners, disregard for community health, this would require re-assessment of future WaterAid financial support to its partner organisations.

An increased focus on influencing through advocacy will mean that follow up activities will also involve WaterAid and Partner Organisations in engaging with the GoN where they have a responsibility to ensure safe water supplies by materializing the National Drinking Water Quality Standards (NDWQS).

12 References

British Geological Survey – Ground water Quality: Nepal, 2002

British Geological Survey – Water Quality fact sheet for Arsenic

GWRDB (2001) ***Assessment of Ground water Pollution in Kathmandu Valley***, Ground Water Resources Development Board, Kathmandu.

IDI (2002), ***Final Report of Workshop on Nepal Drinking Water Quality Standards***, WHO

Khatiwada N R, Manandhar D, Shrestha H D and Pradhan U M, (2003) ***Establishing Drinking Water Quality Standards in Nepal: Asian WATERQUAL***, Oct 20-22, 2003, Bangkok, Thailand

Khatiwada N R, Manandhar D, Shrestha H D and Pradhan U M, (2002) ***Setting Drinking Water Quality Standards in Nepal: Workshop on Nepal Drinking Water Quality Standard***, July 29, Kathmandu, Nepal

Lohani B N and Evans J. W., (1993) ***Appropriate Environmental Standards for Developing Countries, Environmental Systems Information Center (ENSIC), Asian Institute of Technology***, Bangkok, Thailand

NASC and ENPHO, (2003), ***The State of Arsenic in Nepal***

National Drinking Water Quality Standards, 2006

National Water Plan, 2005

Nepal Net (2002), ***Contamination of Drinking Water in Nepal***

Nepal's Drinking Water – A nationwide Fluoride Profile – Oral Health Programme, United Mission to Nepal.

NESS (2000), ***Establishing National Drinking Water Standards and Programs for Water Quality Monitoring and Surveillance under WHO Country Program NEP PHE 001, 2000/01.***

WaterAid (2008), ***Organisational Guidelines for Water Quality Testing,***

RWSSFDB (2002) ***Water Quality Testing for Batch III and Batch IV schemes***, Rural Water Supply and Sanitation Fund Development Board, Kathmandu

Shrestha, R. R.(2002), ***Rural Water Supply and Water Quality Status in Nepal.***

State of the Environment Nepal, 2001

UMN, (2000), ***Nepal's Drinking Water: A Nationwide Flouride Profile***, Oral Health Programme, UMN, Kathmandu, Nepal

WaterAid International Department Guidelines for Water Quality Testing and the development of country policies on water quality standards and testing, 2001

Water Quality Testing Protocol, WaterAid Bangladesh, WaterAid Ghana

WHO (1999) ***Guidelines for drinking-water quality, Vol. 2 Health Criteria and other supporting information***, second edition, World Health Organisation, Geneva.

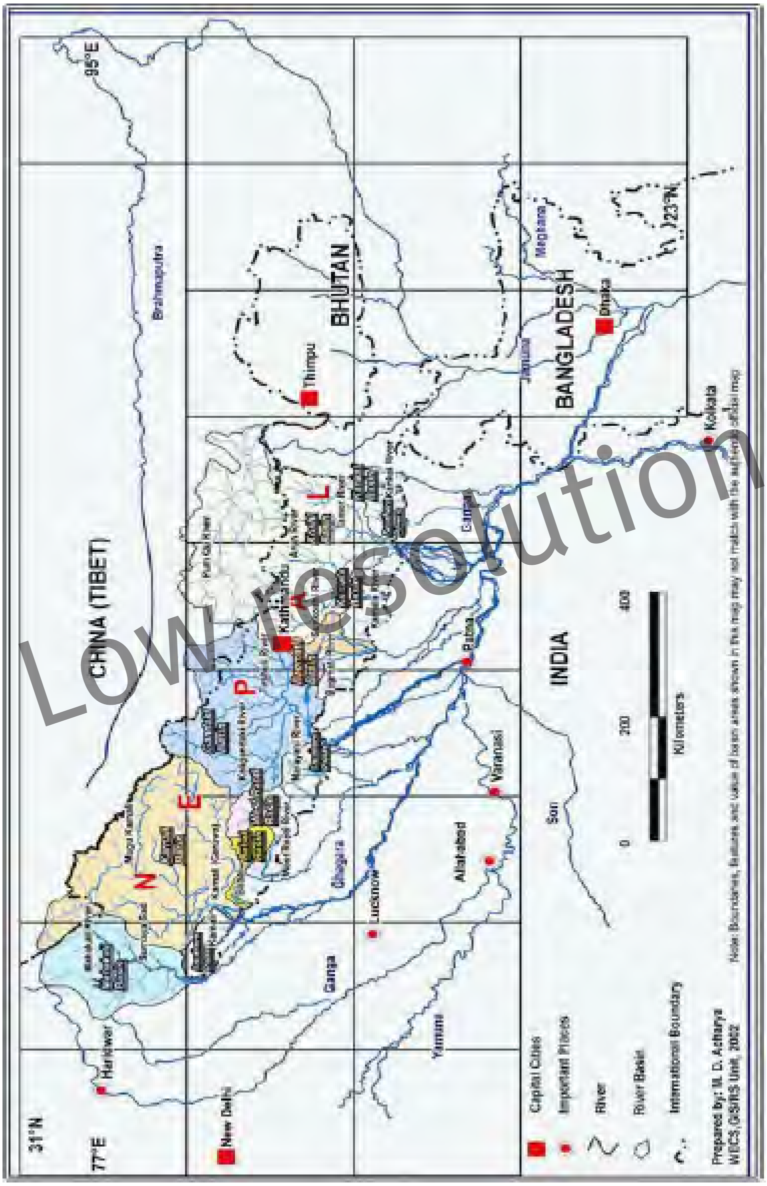
WHO (1999) ***Guidelines for drinking-water quality, Vol. 3 Surveillance and control of community supplies***, second edition, World Health Organisation, Geneva.

WHO (1999, 2004) ***Guidelines for drinking-water quality, Vol. 1 Recommendations***, second and third editions, World Health Organisation, Geneva.

WHO (2002) ***Establishing National Drinking-Water Standards, WHO Seminar Pack for Drinking Water Quality***, available at http://www.who.int/water_sanitation_health/Training_mat/GDWAtrtoc.htm

Annexes

ANNEX – 1:
River Network of Nepal



ANNEX – 2:
Comparative water quality parameters and its guideline/standard values

	Camparative Chart of Water Quality Parameters and Its Guideline / Concentration Limits (Standards)													
Water Quality Parameters		Units	Country Standards					Nepal's NDWQS	WHO	WAN Standard	Selection Criteria	WA CP Standrads		
			India	China	Srilanka	Bangla desh	Thailand					WAG	WAI	WAB
Physical Para meters	Electrical conduc tivity	mS / cm		400	750 (3500)			1500						
	TDS	mg/L		1000		1000		1000	1000	500 (1000)	Above this, the water may become consumer unacceptable and may cause gastro-intestinal irritation.	1000		
	Color	TCU	10 (50)	⇠15	30	15	5 (15)	5 (15)	15	5 (15)	Acceptability to users; Colour above 15 TCU can be detected in a glass of water so above this consumer may not accept the appearance	15ntu		-
	Turbidity	NTU	⇠ 5	⇠3	2 (8)	10	5 (20)	5 (10)	5	≤ 5	High levels of turbidity can stimulate bacterial growth and protect micro-organisms from the effects of disinfection. Above 5, opalescence increases and consumer acceptability decreases; For effective terminal disinfecting, more disinfectant is consumed		⇠ 5	10
	Odour and taste		nil	none	none	Not objection able	none	non objection able	Non-objection able	Un objection alable	Consumer acceptability		nil	-
Chemical Para meters	pH	-	6.5-8.5	6.5-8.5	6.5-9.0	6.5-8.5	6.5-8.5	6.5-8.5		6.5 - 8.5	Below 6.5 the water tends to be corrosive and above 8.5, it is soapy.	6.5-8.5		
	Total hardness	mg/L	300 (600)	250	250 (600)	200-500		500	-	300 (500)	Above this encrustation inside supply lines may occur depending upon other water characteristics such as pH, Alkalinity, Total dissolved solid etc. and may produce adverse effect in domestic uses.	500	-	-
	Nitrate (NO_3)	mg/L	100	88	45	50	45	50	50	50	Above this value, Methaemoglobinaemia (Blue-Baby Syndrome) take place.	50	50	50
	Iron	mg/L	0.3	0.3	0.3 (1)	0.3 - 1	0.5 (1)	0.3 (3)	0.3	0.3 (3)	Above this imparts taste and colour; effects on domestic uses, water supply structures In absence of alternative sources the value may be extended up to 3	0.3	0.3	1
	Manganese	mg/L				0.1	0.5	0.2				0.1		0.5

	Arsenic (As)	mg/L	0.01	0.05	0.05	0.05	0.05	0.05	0.01	0.01 (0.05)	For new water points, value should be within 0.01 and for old water points, value up to 0.05 is acceptable. As a precautionary measure any new tubewells installed by WAN should show no arsenic presence when tested with a field test kit at installation F	0.01	0.01	0.05
	Ammonia (NH_3)	mg/L		0.5	0.06	0.5		1.5	1.5	1.5	National Water Quality standard also recommended the same value as that of WHO guideline value.	1.5		
	Chloride	mg/L	250 (1000)	250	200 (1200)	150-600	250 (600)	250	250			250		600-1000
	Fluoride(F)	mg/L	0.6-1.2 (1.5)	1	0.6 (1.5)	0.1	0.05	0.5 (1.5)	1.5			1.5	1.5	
	Free (Residual) Chlorine	mg/L	0.2	0.3	0.2	0.2		0.1-0.2	-	0.2 (0.5)	Excess residual chlorine may produce harmful disinfectant by-products etc. Residual chlorine level may be used in rapid assessment of bacterial quality To be applicable when water is chlorinated.			0.2-5
	Zinc	mg/L	5	1	5 (15)	5	5 (15)	3	3	3	Impacts a bitter taste at concentration above this value. Value is relevant only for RWH and thus recommended to test before scaling up The WHO does not have any health based limits. (Refer WHO - Vol:2)	3		5
Micro biological (Bacterio logical) Para meters	Thermo tolerant Faecal Coliform (E.Coli)	MPN/ 100ml	nil		nil		none	0	nil	0/100 ml. (No Risk) 1-10/100 ml. (Low Risk) 11-100/100 ml. (High Risk) 101-1000 (Very High Risk)	The WHO Guideline Value in the 2nd edition of Guidelines for Drinking Water Quality for thermotolerant coliforms (often referred to as faecal coliforms) is ocfu/100ml, but Guidelines explicitly state that a relaxation of up to 10 fc/100ml is acceptable in		0	0 - 10
	Total coliform	MPN/ 100ml	0		nil	0	2.2	0 in 95% samples	nil	0 in 95 % samples				
Note: NDWQS: National Drinking Water Quality Standards of Nepal													
	Not Applicable to WAN												

Note: NDWQS: National Drinking Water Quality Standards of Nepal
Not Applicable to WAN

ANNEX – 3:
Sanitary Inspection Survey (SIS) information assessment

Following are some of the formats that can be used during sanitary inspection or sanitary survey of source and supply system. Formats that are included in the WHO Guidelines can be used with necessary modifications as per Nepalese context using hazard scoring.

1. General Information:

Description	Content
A. Rural areas	
Health centre, village	Code No, Address
Water authority / Community representative	Name Signature
Date of visit	
Type of facility	Dug well /Tube Well / Spring / Surface
Land use practices	Irrigation, Mining, Deforestation
Water sample	Sample No.
Family / Population served	
Hygiene education	Water source, Water treatment, Water use, Food handling, Excreta disposal
Continuity	Daily and seasonal
Complaints received if any	
B. Urban areas	
Date of survey	
Surveyor identification	Name, Signature, Agency
Name of supply	State, District, Treatment plant, Address
Geological setting	Rocks, Minerals, Faults, Folds
Climate	Humid, Semi-arid, Arid
Land use pattern	Irrigation, Mining, Deforestation, Ground water pumping
Toxic constituents that may be increased due to existing or new industries	As, Mo, Hg, Ni, Ba, NO_3, Fe,
Survey of	Source / Intake / Treatment plant / Distribution
Person in charge	Name
Coverage	Area served Population served
Treatment plant capacity	Design actual
Water works	Flow diagram
Cost	Amount paid by individual family
Security provision	Fence Security guard
Complaints received if any	

2. Source water surveys: *(A= APPLICABLE NA = NOT APPLICABLE)*

Information for Assessment	Dug Well	Tube Well	Tanker Trucks	Spring	Surface Source
Latrine within 10 m. distance / Uphill Latrine, Waste dump	A	A	NA	A	A
Other source of pollution (animal excreta, rubbish, chemical disposal) within10m.distance	A	A	NA	A	A
Possible Constituents in water	A	A	A	A	A
Stagnant / Ponding of water within 2m. Distance	A	A	NA	NA	NA
Parapet around	A	A	NA	A	NA
Walls inadequately sealed	A	A	NA	NA	NA
Chances of contamination of rope and bucket	A	NA	NA	NA	NA
Concrete floor less than 1m. width	A	A	NA	NA	NA
Fencing	A	A		A	NA
Tanker ever used for transporting other liquids			A		NA
Filler hole / delivery nozzle sanitary condition of Tanker	NA	NA	A	NA	NA
Masonry Protection , Air Vent, Overflow Pipe	NA	NA	NA	A	NA
Diversion of surface run off from agricultural and cultivated areas, domestic /industrial areas	A	A	NA	A	A
Appropriate measures to prevent landslides and mud water falling to stream channels, particularly during rainy season (weak zone upstream of the intake)	NA	NA	NA	NA	A
Filter required / not required	NA	NA	NA	NA	A
Minimum head of water	NA	NA	NA	NA	A
Leakage	NA	NA	A	NA	NA

3. Supply system (Water treatment plant) surveys

Information for Assessment	
A. Collection / Intake Unit	
Collection/ Intake	Source type Intake adequacy with respect to: location structure maintenance, pollution sources in the vicinity Weak zone upstream of the intake
B. Treatment process units:	
Screening	Type Working Condition Frequency of Cleaning Problems Incurred if any

Information for Assessment	
Aeration	Type Contact Period Problems Incurred if any
Coagulation and Flocculation	Type Coagulant types Optimum Dose Mixing time Problems Incurred if any
Sedimentation	Type Frequency of desludging Method of sludge disposal Appearance of clarified water Efficiency of process Problems Incurred if any
Filtration	Type Filtration rate Depth of gravel and Sand Air and Water Scour rate and duration for Backwashing Disposal of wash water Efficiency of process Problems Incurred if any
C. Disinfection Process Unit	
Disinfecting process	Dose and chemical used for Fluoridation Dose and chemical used for Chlorination Dosing facility for Disinfectant Reserve stock of Disinfectant and storage conditions Interruption in Chlorination and causes Problems Incurred if any
D. Distribution Tank Unit	
Distribution Tank / Clear Water Tank	Capacity Concentration of free residual chlorine pH Turbidity Colour E.coli Leakage Pumping Facility Problems Incurred if any
E. Distribution Network	
Distribution Network	Pipeline conditions Leakage Fitting, cross connection, syphonage Air Vents, Pressure Break Box Sanitation around tap-stand Problems Incurred if any

ANNEX – 4:
Water point monitoring form

Implementing partner:

Project Name: Location/District:

Type of Project: Hill/Tarai Municipality/VDC:

Rural/Urban Community:

Ground Water: Spring/Stream

Surface Water: Dug Well (DW)/ Tube Well (TW)

Date:

			Surface water source			Ground water source				Water facilities							
Water point ID	Type of source	Water facilities	Type of source	Discharge measurement		Type of source	Depth from ground level		Discharge measure ment**	System installed			Name of care taker	Private/ commu nity	No of users	Remarks
	SW/ GW	Tapstand/ TW/ DW/RWH	Spring/ Stream	Mean	Date	DW/TW /HP	Static water level	Base of well*	Mean	Type	Year	By***				

* : *Desirable Value as set by the standards for the parameters to be tested as mentioned in WAN's WQ Testing Policy*

** : *Values in parenthesis make sure that WAN's WQ Testing Policy is in line with NDWQS (where the standards set in WAN's WQ Testing Policy differ from national standards) and thus Refers to the Acceptable Value Limit to when alternative is not available*

*** : *Value adopted from NDWQS as WAN's WQ Testing Policy does not have standard value for these parameters*

NDWQS: Nation Drinking Water Quality Standards

ANNEX – 5: Water quality monitoring and testing form

FORM - 1

Implementing partner:

Project name:

Type of project: Rural/Urban; Hill/Tarai

Location/District:

Municipality/VDC:

Community:

Reporting Month/Year:

Date:

Tested water points	Water point ID	Location			Water facilities	Date of install ation	Name of care taker	Private/ community	No. of users
		District	Muni/VDC - Ward #	Community					
Surface water source:									
Intake:									
a. Spring intake									
b. Stream intake									
Collection chamber									
Distribution chamber									
Reservoir /Storage tank									
Private tap stand									
Community (Public) stand post									
Other system components									
Treatment units:									
a. Sedimentation tank									
b. Filtration unit									
c. Chlorination Unit									

Tested water points	Water point ID	Location			Water facilities	Date of install ation	Name of care taker	Private/ community	No. of users
		District	Muni/VDC - Ward #	Community					
Ground water source:									
Dug well (Community):									
a. Without hand pump									
b. With hand pump									
Tube Well:									
a. Private									
a. Community (Public)									
Pumping system with OH tank:									
a. Overhead reservoir tank									
b. Private tap stand									
c. Community (Public) stand post									
d. Treatment (Chlorination) unit									
e. Other system components									
Stone spouts									
Kuwa									
Note:									

ANNEX – 5: Water quality monitoring and testing form

FORM - 2

Implementing partner:

Project name:

Type of project: Rural/Urban — Hill/Tarai

Location/District:

Municipality/VDC:

Community:

Reporting Month/Year:

Date:

Tested water points	Water point ID	Coliform (cfu/100 ml)				Nitrate (mg/L)	Ammonia (mg/L)	Arsenic (mg/L)	Chloride (mg/L)	Iron (mg /L)	Manganese (mg /L)	Turbidity (NTU)	pH	Hardness (mg/L of $CaCO_3$)	Date of WQ test	SI dcore	Remarks
		No risk	Low risk	High risk	Very high risk												
		0	1 - 10	11 - 100	101 - 1000	50*	1.5	0.01 (0.05)	250***	0.3 (3)	0.2***	≤ 5	6.5 - 8.5	300 (500)**			
Surface water source:																	
Intake:																	
a. Spring intake																	
b. Stream intake																	
Collection chamber																	
Distribution chamber																	
Reservoir /Storage tank																	
Private tap stand																	
Community (Public) stand post																	
Other System components																	
Treatment units:																	
a. Sedimentation tank																	
b. Filtration unit																	

Tested water points	Water point ID	Coliform (cfu/100 ml)				Nitrate (mg/L)	Ammonia (mg/L)	Arsenic (mg/L)	Chloride (mg/L)	Iron (mg /L)	Manga nese (mg /L)	Turbi dity (NTU)	pH	Hardness (mg/L of $CaCO_3$)	Date of WQ test	SI dcore	Re marks
		No risk	Low risk	High risk	Very high risk												
		0	1 - 10	11 - 100	101 - 1000	50*	1.5	0.01 (0.05)	250***	0.3 (3)	0.2***	≤ 5	6.5 - 8.5	300 (500)**			
c. Chlorination unit																	
Ground water source:																	
Dug well (Community):																	
a. Without hand pump																	
b. With hand pump																	
Tube well:																	
a. Private																	
a. Community (Public)																	
Pumping system with OH tank:																	
a. Overhead reservoir tank																	
b. Private tap stand																	
c. Community (Public) stand post																	
d. Treatment (Chlorination) Unit																	
e. Other System components																	
Stone spouts																	
Kuwa																	

Note:

**   : Desirable Value as set by the standards for the parameters to be tested as mentioned in WAN's WQ Testing Policy*

***   : Values in parenthesis make sure that WAN's WQ Testing Policy is in line with NDWQS (where the standards set in WAN's WQ Testing Policy differ from national standards) and thus Refers to the Acceptable Value Limit to when alternative is not available*

**** : Value adopted from NDWQS as WAN's WQ Testing Policy does not have standard value for these parameters*

NDWQS: Nation Drinking Water Quality Standards

ANNEX – 6:
Sanitary Inspection Survey (SIS) form

Annex – 6(a): Form No. 1

Implementing partner:

Name of project:

Type of project: Hill/Tarai
Rural/Urban

Location/District:	Location/District:
Municipality/VDC:	Municipality/VDC:
SW: Spring/Stream:	Community:
GW: Dug Well/ Tube well:	Date:

Note: One (1) Point is given for each "YES" answer. Add up the total number of "YES" answers to get the risk (Sanitary Inspection) score		Dug well		Shallow tube well	Rain water harvesting	Remarks
		Without hand pump	With hand pump			
	Specific dDiagnostic information for assessment					
A. Dug well with hand pump						
1	Is there a latrine within 30 ft of the dug well/tube well?					
2	Is there nearest source of faecal pollution (if any)?					
3	Are there any other sources of pollution within 30 ft of the well?					
4	Is the drainage faulty allowing ponding within 6 ft of the well?					
5	Is the drainage channel cracked, broken or in need of cleaning?					
6	Is the concrete platform less than 3 ft in width or radius?					
7	Does spilt water collect in the platform area?					
8	Is the platform cracked, damaged or unsanitary?					
9	Is the hand pump loose at the point of attachment to the platform?					
10	Is the concrete seal/lip to the base of the hand pump damaged or missing?					
	Sanitary Inspection (SI) scoring system					

Note: One (1) Point is given for each "YES" answer. Add up the total number of "YES" answers to get the risk (Sanitary Inspection) score		Dug well		Shallow tube well	Rain water harvesting	Remarks
		Without hand pump	With hand pump			
	Specific dDiagnostic information for assessment					
	No. of "YES" in the observations made					
	Total Risk Score (Sanitary Inspection Risks Score)					
	Risk Score: 9 - 10 = Very High: 7 - 8 = High; 4 - 6 = Medium; 0 - 3 = Low					
B. Tube well with hand pump						
1	Is there a latrine within 30 ft of the tube well?					
2	Is human excreta on the ground within 20 ft of the tube well?					
3	Are there any other sources of pollution within 30 ft of the tube well?					
4	Is the drainage faulty allowing ponding within 6 ft of the well?					
5	Is the drainage channel cracked, broken or in need of cleaning?					
6	Is the concrete platform less than 3 ft in width or radius?					
7	Does spilt water collect in the platform area?					
8	Is the platform cracked, damaged or unsanitary?					
9	Is the hand pump loose at the point of attachment to the platform?					
10	Is the concrete seal/lip to the base of the hand pump damaged or missing?					
	Sanitary Inspection (SI) scoring system					
	No. of "YES" in the observations made					
	Total Risk Score (Sanitary Inspection Risks Score)					
	Risk Score: 9 - 10 = Very High: 7 - 8 = High; 4 - 6 = Medium; 0 - 3 = Low					
C. Rainwater harvesting system						
1	Are there visible signs of contamination (debris, dirt, dust) on the roof catchment?					
2	Is there a build up to of debris, dirt or durst in the gutter?					
3	Is the "first flush" pipe and valve damaged or leaking?					
4	Is the drainage system for "first flush"/overflow water damaged or blocked?					
5	Is water collected directly from the tank					

Note: One (1) Point is given for each "YES" answer. Add up the total number of "YES" answers to get the risk (Sanitary Inspection) score		Dug well		Shallow tube well	Rain water harvesting	Remarks
		Without hand pump	With hand pump			
	Specific dDiagnostic information for assessment					
6	Is human excreta on the ground within 30 ft of the tank or water collection point?					
7	Is there any source of pollution within 30 ft of the tank?					
8	Are the vents and covers to the collection tank damaged or open?					
9	Is the rainwater tank cracked, damaged or leaking?					
10	Is the tank visibly dirty inside?					
In case the tank is underground:						
11	Is the hand pump located directly above the reservoir tank?					
12	is the hand pump loose at the point of attachment to the platform?					
13	Is the concrete seal/lip to the base of the hand pump damaged or missing?					
	Sanitary Inspection (SI) Scoring System					
	a. Above ground system:					
	No. of "YES" in the observations made					
	Total Risk Score (Sanitary Inspection Risks Score)					
	Risk Score: 9 - 10 = Very High: 7 - 8 = High; 4 - 6 = Medium; 0 - 3 = Low					
	b. Under (Below) ground system:					
	No. of "YES" in the observations made					
	Total Risk Score (Sanitary Inspection Risks Score)					
	Risk Score: 9 - 10 = Very High: 7 - 8 = High; 4 - 6 = Medium; 0 - 3 = Low					

$$\text{Total Sanitary Risk Score (SRS)} = \frac{\text{(Total number of "YES" in the observations made)} * 10}{\text{Total number of observations made during SIS}}$$

Note: The SRS should always be less than 10.

Annex – 6(b-1): Form No. 2

Implementing partner:

Name of project:

Type of project: Hill/Tarai
Rural/Urban

Location/District: Location/District:

Municipality/VDC: Municipality/VDC:

SW: Spring/Stream: Community:

GW: Dug Well/ Tube well: Date:

Note: One (1) point is given for each "YES" answer. Add up the total number of "YES" answers to get the risk (Sanitary Inspection) score		Surface water source: Gravity flow piped system			Ground water source: Pumping with OH (Gravity) piped system	
		Intake	Collection chamber	Distribution chamber	GW extraction point	Pumping unit
	Specific diagnostic information for assessment					
D. Source: Intake, collection and distribution chamber						
1	Is the source unprotected?					
2	Is the intake structure cover damaged or open?					
3	Is the backfill area behind the catchment will eroded?					
4	Is the masonry protecting the source cracked or damaged?					
5	Does spilt water flood the collection area?					
5	Is the fence absent / missing around the source?					
6	Can animals come within 30 ft of the source?					
7	Is there a latrine uphill and within 30 ft of the source?					
8	Is human excreta on the ground within 30 ft of the source?					
9	Are there other sources of pollution uphill of the source?					
10	Is the diversion ditch around the source absent or blocked?					

Note: One (1) point is given for each "YES" answer. Add up the total number of "YES" answers to get the risk (Sanitary Inspection) score		Surface water source:			Ground water source:	
		Gravity flow piped system			Pumping with OH (Gravity) piped system	
		Intake	Collection chamber	Distribution chamber	GW extraction point	Pumping unit
	Specific diagnostic information for assessment					
	Sanitary Inspection (SI) scoring system					
	No. of "YES" in the observations made					
	Total risk score (Sanitary inspection risks score)					
	Risk score: 9 - 10 = Very High: 7 - 8 = High; 4 - 6 = Medium; 0 - 3 = Low					
E. Source: Ground water extraction point, pumping system						
1	Is the pumping unit at the point of extraction of groundwater source unprotected?					
2	Is the pumping unit/system structure cover damaged or open?					
3	Does the pump produce any abnormal sound/noise when pumping system operates?					
4	Has there been discontinuity of pump operation for more than last 7 days?					
5	Has there been discontinuity of electricity for more than 24 hrs in the last 7 days?					
5	Is the piping systems within the pumping units leaked, damaged or cracked?					
6	Is the masonry protecting the pumping units and system cracked or damaged?					
7	Does spilt water flood the collection area?					
8	Is the fence absent / missing around the source?					
9	Can animals come within 30 ft of the source?					

Note: One (1) point is given for each "YES" answer. Add up the total number of "YES" answers to get the risk (Sanitary Inspection) score		Surface water source:			Ground water source:	
		Gravity flow piped system			Pumping with OH (Gravity) piped system	
		Intake	Collection chamber	Distribution chamber	GW extraction point	Pumping unit
	Specific diagnostic information for assessment					
10	Is there a latrine or sewer line or human excreta or any sources of pollution/contamination within 30 ft of any water point?					
11	Is the diversion ditch around the source absent or blocked?					
	Sanitary Inspection (SI) Scoring System					
	No. of "YES" in the observations made					
	Total Risk Score (Sanitary Inspection Risks Score)					
	Risk Score: 9 - 10 = Very High: 7 - 8 = High; 4 - 6 = Medium; 0 - 3 = Low					
F. Piped water systems						
1	Does the pipe between the source and treatment units (e.g. sedimentation, bio-sand filter tank etc.) leak?					
2	Is any of the components of the treatment unit cracked, damaged, leaking or malfunctioning?					
3	Are the covers on the tank damaged or open?					
4	Is the reservoir tank cracked, damaged or leaking?					
5	Are the vents and covers on the reservoir tank damaged or open?					
6	Does the pipe between any components of the treatment units (e.g. sedimentation, filter, etc.) and reservoir tanks leak?					
7	Is there a latrine or sewer line or human excreta or any source of pollution / contamination within 30 ft of any water point?					
8	Are the supply pipes to the exposed?					
9	Do the supply pipes remain supported while crossing a stream?					

Note: One (1) point is given for each "YES" answer. Add up the total number of "YES" answers to get the risk (Sanitary Inspection) score		Surface water source:			Ground water source:	
		Gravity flow piped system			Pumping with OH (Gravity) piped system	
		Intake	Collection chamber	Distribution chamber	GW extraction point	Pumping unit
	Specific diagnostic information for assessment					
10	Does water collect in any of the junction or valve chambers?					
11	Do any control valves or any accessories leak?					
	Sanitary Inspection (SI) Scoring System					
	No. of "YES" in the observations made					
	Total Risk Score (Sanitary Inspection Risks Score)					
	Risk Score: 9 - 10 = Very High: 7 - 8 = High; 4 - 6 = Medium; 0 - 3 = Low					
G. Water points: (Stand post / Tap stand)						
1	Do any water points leak?					
2	Does surface water collect around any water point?					
3	Is the area around any of the water points eroded?					
4	Is human excreta on the ground within 30 ft of any water point?					
5	Is there a latrine or sewer line within 30 ft of any water point?					
6	Is there a stagnant water body or ditch within 30 ft. of any water point?					
7	Is the drainage channel cracked, broken or in need of cleaning?					
8	Are the supply pipes to the tap stands exposed?					
9	Do the supply pipes to the tap stand leak?					
10	Has there been discontinuity of more than 24 hrs in the last 10 days?					
Water points with reservoir system						
11	Is the reservoir cracked, damaged or leaking?					
12	Does the top of the reservoir extended less than 1 ft above ground level?					

Note: One (1) point is given for each "YES" answer. Add up the total number of "YES" answers to get the risk (Sanitary Inspection) score		Surface water source:			Ground water source:	
		Gravity flow piped system			Pumping with OH (Gravity) piped system	
		Intake	Collection chamber	Distribution chamber	GW extraction point	Pumping unit
	Specific diagnostic information for assessment					
13	Are the reservoir vents and inspection covers damaged or missing?					
14	Is the inspection cover set less than 2 inches above the surface of the reservoir?					
15	Does spilt water collect inside the reservoir platform area?					
Water points with metering system						
16	Is the main supply pipe to the reservoir damaged or leaking?					
17	Is the joint of the meter to the supply pipe damaged or leaking?					
18	Does the top of the meter pit extended less than 1 ft above ground level					
19	Is the meter pit remains dirty or filled up with water inside?					
	Sanitary Inspection (SI) scoring system					
	a. Without both Reservoir and Water Meter System:					
	No. of "YES" in the observations made					
	Total Risk Score (Sanitary Inspection Risks Score)					
	Risk Score: 9 - 10 = Very High: 7 - 8 = High; 4 - 6 = Medium; 0 - 3 = Low					
	b. With reservoir system only:					
	No. of "YES" in the observations made					
	Total Risk Score (Sanitary Inspection Risks Score)					
	Risk Score: 9 - 10 = Very High: 7 - 8 = High; 4 - 6 = Medium; 0 - 3 = Low					
	c. With water meter system only:					

	Note: One (1) point is given for each "YES" answer. Add up the total number of "YES" answers to get the risk (Sanitary Inspection) score	Surface water source:			Ground water source:	
		Gravity flow piped system			Pumping with OH (Gravity) piped system	
		Intake	Collection chamber	Distribution chamber	GW extraction point	Pumping unit
	Specific diagnostic information for assessment					
	No. of "YES" in the observations made					
	Total risk score (Sanitary inspection risks score)					
	Risk score: 9 - 10 = Very High: 7 - 8 = High; 4 - 6 = Medium; 0 - 3 = Low					
	d. With both reservoir and water meter system:					
	No. of "YES" in the observations made					
	Total risk score (Sanitary inspection risks score)					
	Risk score: 9 - 10 = Very High: 7 - 8 = High; 4 - 6 = Medium; 0 - 3 = Low					

$$\text{Total Sanitary Risk Score (SRS)} = \frac{\text{(Total number of "YES" in the observations made)} * 10}{\text{Total number of observations made during SIS}}$$

Note: The SRS should always be less than 10.

Annex – 6(b-2): Form No. 3

Implementing partner:

Name of project:

Type of project: Hill/Tarai
Rural/Urban

Location/District: Location/District:

Municipality/VDC: Municipality/VDC:

SW: Spring/Stream: Community:

GW: Dug Well/ Tube well: Date:

Note: One (1) point is given for each "YES" answer. Add up the total number of "YES" answers to get the risk (Sanitary inspection) score		Piped distribution system:					Remarks
		Storage/Reservoir tank		Treatment unit	Piped water system	Water points (Tap stand/ Stand post)	
		Above ground tank	Overhead tank				
Specific diagnostic information for assessment							
D. Source: Intake, collection and distribution chamber							
1	Is the source unprotected?						
2	Is the intake structure cover damaged or open?						
3	Is the backfill area behind the catchment will eroded?						
4	Is the masonry protecting the source cracked or damaged?						
5	Does spilt water flood the collection area?						
5	Is the fence absent / missing around the source?						
6	Can animals come within 30 ft of the source?						
7	Is there a latrine uphill and within 30 ft of the source?						
8	Is human excreta on the ground within 30 ft of the source?						
9	Are there other sources of pollution uphill of the source?						
10	Is the diversion ditch around the source absent or blocked?						

Note: One (1) point is given for each "YES" answer. Add up the total number of "YES" answers to get the risk (Sanitary inspection) score		Piped distribution system:					Remarks
		Storage/Reservoir tank		Treatment unit	Piped water system	Water points (Tap stand/ Stand post)	
		Above ground tank	Overhead tank				
	Sanitary Inspection (SI) scoring system						
	Total Risk (SIS) Score (No of Yes) out of 10						
	Risk (SIS) Score: 9 - 10 = Very High: 7 - 8 = High; 4 - 6 = Medium; 0 - 3 = Low						
E. Source: Ground water extraction point, pumping system							
1	Is the pumping unit at the point of extraction of groundwater source unprotected?						
2	Is the pumping unit/system structure cover damaged or open?						
3	Does the pump produce any abnormal sound/noise when pumping system operates?						
4	Has there been discontinuity of pump operation for more than last 7 days?						
5	Has there been discontinuity of electricity for more than 24 hrs in the last 7 days?						
5	Is the piping systems within the pumping units leaked, damaged or cracked?						
6	Is the masonry protecting the pumping units and system cracked or damaged?						
7	Does spilt water flood the collection area?						
8	Is the fence absent / missing around the source?						
9	Can animals come within 30 ft of the source?						
10	Is there a latrine or sewer line or human excreta or any sources of pollution/contamination within 30 ft of any water point?						
11	Is the diversion ditch around the source absent or blocked?						

Note: One (1) point is given for each "YES" answer. Add up the total number of "YES" answers to get the risk (Sanitary inspection) score		Piped distribution system:					Remarks
		Storage/Reservoir tank		Treatment unit	Piped water system	Water points (Tap stand/ Stand post)	
		Above ground tank	Overhead tank				
	Sanitary Inspection (SI) scoring system						
	Total Risk (SIS) Score (No of Yes) out of 11						
	Risk (SIS) Score: 10 - 11 = Very High: 7 - 9 = High; 4 - 6 = Medium; 0 - 3 = Low						
F. Piped water systems							
1	Does the pipe between the source and treatment units (e.g. sedimentation, bio-sand filter tank etc.) leak?						
2	Is any of the components of the treatment unit cracked, damaged, leaking or malfunctioning?						
3	Are the covers on the tank damaged or open?						
4	Is the reservoir tank cracked, damaged or leaking?						
5	Are the vents and covers on the reservoir tank damaged or open?						
6	Does the pipe between any components of the treatment units (e.g. sedimentation, filter, etc.) and reservoir tanks leak?						
7	Is there a latrine or sewer line or human excreta or any source of pollution / contamination within 30 ft of any water point?						
8	Are the supply pipes to the exposed?						
9	Do the supply pipes remain supported while crossing a stream?						
10	Does water collect in any of the junction or valve chambers?						
11	Do any control valves or any accessories leak?						
	Sanitary Inspection (SI) scoring system						
	Total Risk (SIS) Score (No of Yes) out of 11						

Note: One (1) point is given for each "YES" answer. Add up the total number of "YES" answers to get the risk (Sanitary inspection) score		Piped distribution system:					Remarks
		Storage/Reservoir tank		Treatment unit	Piped water system	Water points (Tap stand/ Stand post)	
		Above ground tank	Overhead tank				
G. Water points: (Stand post / Tap stand)							
1	Do any water points leak?						
2	Does surface water collect around any water point?						
3	Is the area around any of the water points eroded?						
4	Is human excreta on the ground within 30 ft of any water point?						
5	Is there a latrine or sewer line within 30 ft of any water point?						
6	Is there a stagnant water body or ditch within 30 ft. of any water point?						
7	Is the drainage channel cracked, broken or in need of cleaning?						
8	Are the supply pipes to the tap stands exposed?						
9	Do the supply pipes to the tap stand leak?						
10	Has there been discontinuity of more than 24 hrs in the last 10 days?						
Water Points with reservoir system							
11	Is the reservoir cracked, damaged or leaking?						
12	Does the top of the reservoir extended less than 1 ft above ground level?						
13	Are the reservoir vents and inspection covers damaged or missing?						
14	Is the inspection cover set less than 2 inches above the surface of the reservoir?						
15	Does spilt water collect inside the reservoir platform area?						
Water points with metering system							
16	Is the main supply pipe to the reservoir damaged or leaking?						

Note: One (1) point is given for each "YES" answer. Add up the total number of "YES" answers to get the risk (Sanitary inspection) score		Piped distribution system:					Remarks
		Storage/Reservoir tank		Treatment unit	Piped water system	Water points (Tap stand/ Stand post)	
		Above ground tank	Overhead tank				
17	Is the joint of the meter to the supply pipe damaged or leaking?						
18	Does the top of the meter pit extended less than 1 ft above ground level						
19	Is the meter pit remains dirty or filled up with water inside?						
Sanitary Inspection (SI) scoring system							
	a. Without both reservoir and water meter system:						
	Total Risk (SIS) Score (No of Yes) out of 10						
	Risk (SIS) Score: 9 - 10 = Very High: 7 - 8 = High; 4 - 6 = Medium; 0 - 3 = Low						
	b. With reservoir system only:						
	Total Risk (SIS) Score (No of Yes) out of 15						
	Risk (SIS) Score: 13 - 15 = Very High: 9 - 12 = High; 5 - 8 = Medium; 0 - 4 = Low						
	c. With water meter system only:						
	Total Risk (SIS) Score (No of Yes) out of 14						
	Risk (SIS) Score: 12 - 14 = Very High: 9 - 11 = High; 5 - 8 = Medium; 0 - 4 = Low						
	d. With both reservoir and water meter system:						
	Total Risk (SIS) Score (No of Yes) out of 19						
	Risk (SIS) Score: 16 - 19 = Very High: 11 - 15 = High; 6 - 10 = Medium; 0 - 5 = Low						

Annex – 6(c): Form No. 4

Implementing partner:

Name of project: Location/District:

Type of project: Hill/Tarai Rural/Urban Municipality/VDC:

Community:

SW: Spring/Stream: GW: Dug Well/ Tube well:

Date:

H	Additional Questions	
1	Functionality	
	a. Functional	
	b. Partial functional	
	c. Non-functional	
2	Use	
	a. Drinking Purpose	
	b. Cooking Purpose	
	c. Other Purpose	
3	Maintenance	
	a. Platform Condition	
	- Good	
	- Broken	
	- None	
	b. Drainage Condition	
	- Good	
	- Broken	
	- None	
	c. Is Water Point Repaired	
	- Yes	
	- No	
	- None	
	If Yes, How many months ago?	
	- 3 Months	
	- 6 Months	
	- Specify, What type of repair is done?	

ANNEX – 7: Summary of risk (Sanitary Inspection Survey) scoring

TOTAL RISK (SANITARY INSPECTION) SCORING SYSTEM		Dug well		Shallow tube well	Rain water harves ting	Surface water source:			Ground Water source:		Piped distribution system:					Remarks
		Without hand pump	With hand pump			Gravity flow piped system			Pumping with OH (Gravity) piped system		Storage/ Reservoir tank		Treat- -ment unit	Piped water system	Water points (Tap stand/ Stand post)	
SN	Specific diagnostic information for assessment					Intake	Collect ion chamber	Distribu tion chamber	GW extraction point	Pumping unit	Above ground tank	Over head tank				
A	Dug well with Hand pump															
B	Tube well with Hand pump															
c	Rainwater Harvesting System															
	a. Above Ground System:															
	b. Under (Below) Ground System:															
D	Source: Intake, collection and Distribution Chamber															

E	Source: Ground Water Extraction Point, Pumping System															
F	Piped Water Systems															
G	Water Points: (Stand post / Tap stand)															
	a. Without both Reservoir and Water Meter System:															
	b. With Reservoir System Only:															
	c. With Water Meter System Only:															
	d. With both Reservoir and Water Meter System:															

30 YEARS 1981-2011

WaterAid

WaterAid transforms lives by improving access to safe water, hygiene and sanitation in the world's poorest communities. We work with partners and influence dicision-makers to maximise our impact.

For more information, please contact:
WaterAid in Nepal
Kupondole, Lalitpur, Nepal
GPO Box: 20214, Kathmandu, Nepal
Telephone: + 977 1 5552764/ 5552765/ 5011625
Fax: + 977 1 5547420
Email: wateraidnepal@wateraid.org

www.nepal.wateraid.org