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Subject: PHILIPPINE STANDARDS FOR DRINKING WATER 1993 UNDER THE PROVISION OF CHAPTER II, SECTION 9 OF PD 856, OTHERWISE KNOWN AS THE CODE ON SANITATION OF THE PHILIPPINES.

To implement the provisions of section 9, otherwise known as the Prescribed Standards and Procedures of Chapter ll of the Code on Sanitation of the Philippines, PD 856, this Philippine National Standards for Drinking Water 1993 hereby revises and updates the 1978 National Standards for Drinking Water.

The Philippine National Standards for Drinking Water 1993 (PNSDW 1993) is designed to guide the Waterworks Officials, Developers and Operators of Water Supply Systems both Government and Private entities, health and sanitation authorities and the general public and all other concerned.

The new standards cover requirements for the acceptable values of the determined parameters in measuring water quality. These parameters include microbiological, physical, chemical and radiological compositions of the water. The standard also delineates values established in conforming with the medical and health implication of the parameters as opposed to values established purely to satisfy aesthetic requirements.

Section 1. DEFINITION OF TERMS

1. **Aesthetic** - aspects of drinking water quality perceived by senses, including odor, taste, color and clarity.

2. **Aerobe** - An organism capable of growing in the presence of oxygen.

3. **Aerobic** - Description of biological or chemical processes that can occur only in presence of oxygen.

4. **Anaerobic** - Life processes or chemical reactions that occur in the absence of oxygen or a condition in which Dissolved Oxygen (DO), is not detectable in the aquatic environment.

5. **Available residual Chlorine -** Generally refers to the part of the chlorine that will with orthotolidine or ampero-metric tests and exhibits significant germicidal activity.

6. **Bottled water -** means water that is placed in a sealed container or package and is offered for sale for human consumption as drinking-water.

7. **Coliform Organism (total coliforms) -** refers to any rod- shaped, non-spore-forming, gram negative bacteria capable of growth in the presence of bile salts, or other surface-active agents with similar growth-inhibiting properties which are cytochrome-oxidase negative and able to ferment lactose at either 35 or 37°C with the production of acid, gas and aldehyde within 24-48 hours.

8. **Composite Sample** - refers to a mixture of grab samples collected at the same sampling points at different times.

9. **Contamination** - A general term referring to the introduction of materials not normally found in water that make the water less desirable or unfit for its intended use.

10. **Disinfection** - Water treatment processes designed to destroy disease - causing micro-organisms. The efficacy of disinfection is often assessd by measuring the coliform group of indicator organism.

11. **Drinking Water** - Water intended for direct human consumption or for use in food preparation. Where high quality waters are scarce, the quality of water used for other domestic purposes does not need to be as high as that of drinking water.

12. **Facultative anaerobic** - Organisms that can use free oxygen or can grow in the absence of atmospheric oxygen

13. **Facultative bacteria** - Bacteria that can adapt themselves to growth and metabolism under aerobic or anaerobic conditions. Many organism of interest in wastewater stabilization are among this group.

14. **Thermotolerant (Fecal) Coliform** - A subgroup of coliform bacteria that has high positive correlation with fecal contamination associated with all warm blooded animals. These organisms can ferment lactose at 44.5°C and produce gas in a multiple tube procedure (EC - Confirmation) or acidity with the Membrane Filter procedure (M-FC Medium).

15. **Gram or Catch Sample** - A sample collected at a particular time and place and can represent only the composition of the source at the time and place.

16. **Grab-negative bacteria** - Bacteria that decolorize and accept that safranin stain which appears pink using the gram-stain technique.

17. **Gross alpha and gross beta radioactivity** - Radio activity emanating from radionuclides belonging to the uranium, thorium and actinium series which are terrestrial in origin. It also includes radionuclides that occur singly and are produced by cosmic rays and are terrestrial in origin.

18. **Integrated Samples -** For certain purposes, the information needed is provided analyzing mixtures of grab samples collected from different points simultaneously,or as nearly as possible.

19. **Large Water Supply System** - more than 5,000 service connection.

20. **Level l (Point source**) - a protected well or a developed spring with an outlet but without a distribution system, generally adaptable for rural areas where the houses are thinly scattered. A level l facility normally serves around 15 to 25 households and its outreach must not be more than 250 meters from the farthest user. The yeild or discharge is generally from 40 to 140 liters per minute.

21. **Level ll (Communal Faucet System or Standposts)-**A system composed of a source, a reservoir, a piped distribution network and communal faucets, located at not more than 25 meters from the farthest house. The system is designed to deliver 40-80 liters of water per capita per day to an average of 100 households, with one faucet per 4 to 6 households. Generally suitable for rural and urban areas where houses are clustered densely to justify a simple piped system.

22. **Level lll (Waterworks System or Individual House Connections)** - a system with a source, a reservoir, a piped distribution network and household taps. It is generally suited for densely populated urban areas. This level of facility requires a minimum treatment of disinfection.

23. **MPN (Most Probable Number)** - A statistical method of determining microbial populations. A multiple dilution tube technique is utilized with a standard medium and observations are made for specific individual tube effects. Resultant coding is translated by mathematical probability tables into population numbers.

24. **Non-spore forming -** not capable of producing spores, the defense mechanism of bacteria under favorable growth conditions such as heat, drying, pH change, and disinfectants.

25. **Pollutant** - Dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical waste, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock sand and industrial, municipal, agricultural waste discharge into water.

26. **Potable water** - water suitable (from both health and aesthetic considerations) for drinking and cooking purposes.

27. **Protected well** - it is a borehole well either deep or shallow well which have sanitary protective measures such as concrete apron, grouting, safe distances to toilets and other source of pollution.

28. **Radioactivity** - the spontaneous emission of radiation, generally alpha or beta particles often accompanied by gamma rays, from the nucleus of an unstable isotope.

29. **Raw water** - untreated, undisinfected surface or groundwater.

30. **Residual Clorine** - when sufficient dosage of chlorine is applied to water, micro-organisms of sanitary significance are destroyed and all the oxidizable matter are reacted upon. After all of these reactions have taken place, at the end of a specified contact time, there remains a certain minute quantity of chlorine in the water. This is detected as residual chlorine, Its presence in water is usually an indication, and is therefore an assurance of protection of the bacteriological quality.

31. **Small Water Supply System** - less than 1,000 service connection.

32. **Standard Methods** - Methods of analysis prescribed by a joint action of American Public Health Association, American Waterworks Association, Water Pollution Control Federation or US Environmental Pollution Control Federation or US Environmental Protection Agency. Methods accepted by authority.

33. **Water Quality** - from the user's point of view the term "water quality" is used to define those bacteriological, chemical, physical, biological or radiological characterestics which evaluates the acceptability of the water. The term "quality" must be considered relative to the proposed use of the water.

34. **Water Quality Guideline** - a water guideline in this document is a level for a water constituent which does not result in significant health risk and which ensures aesthetically acceptable water.

35. **Water Supplier** - an entity government or private responsible for source development, water abstraction, treatment and distribution of water.

Section 2. EXAMINATION OF WATER

Regular examination of water will have to be carried out in order to determine its potability.

The results of this examination shall be expressed as follows:

a) **Bacteriological**	
Multiple Tube Fermentation	MPN/100mL; or absence or absence of coliform organisms
Membrane Filter	Colonies / 100mL
MMO-MUG(Auto-analysis Colilert)	presence or absence of coliform organisms
b) **Biological**	Counts /mL
c) **Chemical**	mg/L or unless otherwise stated
d) **Physical**	as appropriate
e) **Radiological**	Becquerel/Liter (Bq/L)

Adequate treatment will have to be made available to deal with changes in the quality of the raw water and to consistently produce a finished product which is reliably safe.

Microbiological testing may be supplemented with the much simpler colorimetric test for free residual chlorine (free residual chlorine of 0.2 - 0.5 mg/L in the distribution system to reduce the risk of microbial regrowth). Absence of the residual chlorine is indicator of the entry of oxidizable matter into the distribution system, or a malfunctioning of the treatment process.

Section 3. STANDARD PARAMETERS AND VALUES FOR DRINKING-WATER QUALITY

Table 3.1 Standard Values for Bacteriological Quality

Source and Mode of Supply	Bacteria	Standard Value (No. / 100mL)
a. All drinking-water supplies under all circumstances (Level l, ll, lll, Bottled water and Emergency Water Supplies)	E. Coli or Thermotolerant (fecal) coliform bacteria	0
b. Treated water entering the distribution system	E. Coli or Thermotolerant (fecal) coliform bacterial Total Coliforms	0 0
c. Treated water in the distribution system	E. Coli or Thermotolerant (fecal) coliform bacteria Total Coliforms	0 Must not be detectable in any 100mL sample. In case of large supplies where sufficient samples are examined, it must not be present in 95% of samples taken throughout any twelve month period

Table 3.2 Standard Value for Biological Organisms

Constituents	Permissible Limit
Total Count/mL	10

Table 3.3 Standard Values for Physical and Chemical Quality: Health Significance

A. Inorganic Constituents

Constituent	Maximum Level (mg/L)
Antimony	0.005
Arsenic	0.01
Barium	0.7
Boron	0.3
Cadmium	0.003
Chromium	0.05
Cyanide	0.07
Flouride	1.0
Lead	0.01
Mercury (total)	0.001
Nitrate as NO_{3-}	50
Nitrate as NO_{2-}	3
Selenium	0.01

B. Organic Constituents (Pesticides)

Constituents	Maximum Level (µg/L)
Aldrin & Dieldrin	0.03
Chlordane	0.2
DDT	2
Endrin	0.2

Heptachlor and Heptachlor epoxide	0.03
Lindane	2
Methoxychlor	20
Petroleum oils & grease	nil
Toxyphane	5
2,4 - D	30
2,4,5 - T	9

Table 3.4 Standard Values for Physical and Chemical Quality : Aesthetic Quality

Constituent or Characteristic	Maximum Level (mg/L)
Taste	Unobjectionable
Odor	Unobjectionable
Color	5 TCU
Turbidity	5 NTU
Aluminum	0.2
Chloride	250
Copper	1
Hardness	300 (as CaCo3) *
Hydrogen Sulfide	0.05
Iron	1
Manganese	0.5
pH	6.5 - 8.5
Sodium	200 *
Sulfate	250
Total Dissolved Solids	500
Zinc	5 *

Table 3.5 Standard Values for Disinfectants and Disinfectant By - Products

Constituents	Maximum Level (mg/L)
a. Disinfectant Chlorine (residual)	0.2 -0.5
b. Disinfectant By-products	

Bromate	0.025
Chlorite	0.2
2,4,6 trichlorophenol	0.2
Formaldehyde	0.9
Phenolic substances	0.001
Bromoform	0.1
Dibromochloromethane	0.1
Bromodichloromethane	0.06
Chloroform	0.2

* ---- Secondary standards : compliance with the standard and analysis are not obligatory

TCU ---- True Color Unit

NTU ---- Nephelometric Turbidity Unit

Table 3.6 Chemicals of No Health Significance at Concentrations Normally Found in Drinking-Water

Asbestos Silver Tin	In consonance with the findings of WHO, the Department of Health does not prescribe any standard values for these compounds since they are not hazardous to human health at concentrations normally found in drinking-water.

Table 3.7 Standard Values for Radiological Constituents

Constituents	Activity Level (Bq/L)
gross alpha activity	0.1
gross beta activity	1

Section 4: MICROBIOLOGICAL REQUIREMENTS:

Water used for drinking must be free from pathogenic organisms responsible for waterborne diseases. These pathogenic organisms include bacteria, viruses, protozoans and helminths.

Elimination of all these pathogenic agents from drinking-water is essential for the protection of public health. Two approaches can be used to reduce the risk of bacterial, viral and parasitic infection to a negligible level: providing drinking-water from a source verified free of fecal contamination or adequately treating fecally contaminated water.

4.1. Bacteriological Requirements

The primary objective of bacterial examination of drinking water is the detection of fecal pollution. Although it is now possible to detect the presence of many pathogens in water, the methods of isolation and detection are often complicated and lengthy. It is therefore impossible and impractical to identify every disease causing organism present in water. The approach is to use normal enteric organisms which are the coliform group especially E. coli as the essential indicator to fecal pollution. These organisms are easy to detect and their presence in a sample indicates that water may be contaminated with organisms that can cause disease.

4.2 Sampling and Analysis for Bacteriological Quality

In order to determine whether the water supplied is safe or acceptable for human consumption, (i.e. free from pathogenic or disease causing organisms) samples should be collected from the water supply system for the bacteriological examination of the water(i,e. total coliforms, thermotolerant (fecal) coliform bacteria and E. coli). The samples should be representative of the whole water supply system [i,e. samples from the water source,before and after treatment if any, and from a reasonable number of points (see Table 4.1) in the distribution system]. For disinfected water, free residual chlorine should be measured during sampling.

4.2.1 Frequency of Sampling

The minimum number of samples to be collected and examined periodically must be based on the mode and source of water supply (see Table 4.1). The procedure, identification and location of sampling are indicated in Table 4.2. However, frequency of sampling should also take into account the past frequency of records yielding unsatisfactory results, the quality of raw water treated, the number of raw water sources, the adequacy of treatment and capacity of the treatment plant, risks of contamination at the source and in the distribution system, the size and complexity of the distribution system, the risk of an epidemic and the practice of disinfection.

Table 4.1 Minimum Frequency of Sampling for Drinking-Water Suppy Systems

Source and Mode Of Supply	Population Served	Minimum Frequency of Sampling
a. Level I	90 - 150	Once in every three (3) months

b. Level II	600	Once in every two (2) months
c. Level III	Less than 5,000 5,000 - 100,000 more than 100,000	1 sample monthly 1 sample per 5,000 population monthly 20 sample plus 1 sample per 10,000 population monthly
d. Bottled Drinking Water	---	Once every two Months
e. Emergency Supplies of Drinking Water.	---	Before delivery to users

4.2.2 Methods of Sampling

The sample should be representative of the water under examination. Contmintion during collection and before examination shall be avoided.

Step-by-step details of collecting water samples (from different sources) for microbiological analysis are given in the PNSDW 1993 manual.

Table 4.2 Methods of Sampling for Drinking-Water Supply System

Source and mode of Supply	Procedure of Sampling	Location of Sampling Points	Sample volume
Level I	Pump water to waste for two(2) minutes to remove water in the water column. Then flame the mouth of pump before taking sample (optional)	Sample is taken directly at the mouth of the pump	The volume of the sample should not be less than 100mL.
Level II	Allow water to waste for at least	Sample is taken from the farthest	The volume of the samples should not

	one (1) minute. Flame the tap before sample is taken (optional)	standpipe and at the entering point of the distribution system.	be less than 100 mL.
Level III	Remove any filters (rubber or plastic) and allow water to run to waste for at least one (1) minute. Flame the tap before the sample is taken (optional)	Sample is taken from the source of the distribution system and taps at strategic sampling point within the distribution network.	The volume of the sample should not be less than 100mL.
BOTTLED DRINKING-WATER	Same procedure as above for samples taken from the source	Sample is taken from manufacturer's stock and outlets	The volume of the sample should not be less than 100 mL.
EMERGENCY SUPPY OF DRINKING-WATER		Sample is taken at storage containers and mobile tankers before being served to end users.	The volume of the sample should not be less than 100mL.

Identification of Samples -- samples must be accompanied by a complete and accurate identification and descriptive data.

4.2.3 Examining Laboratories

Examination of samples shall be performed by the following laboratories:

a. Department of Health Laboratory

b. Laboratories of Water Supplies

c. Laboratories Accredited by the Department of Health

4.2.4 Preservation and Storage of Samples

The bacteriological analysis of water samples collected should be initiated promptly after collection to avoid unpredictable changes.

If samples cannot be processed within six (6) hours after collection, the use of ice coolers for storage of water samples during transport to the laboratory is recommended. The time elapsed between collection and processing should in no case exceed 24 hours. The time and temperature of storage of all samples should be considered in the interpretation of data.

When delay is likely in bringing samples to the laboratory, the sample can be filtered through a membrane filter at the site of collection. The membrane after filtration is placed in a petri dish using an appropriate medium. This will keep the bacteria viable, and will arrest visible growth for up to 72 hours.

4.2.5 Methods for the Detection and Estimation of Coliform Organisms.

a. Standard Methods

The standard laboratory methods to be used in the estimation of organisms indicative of pollution are stated in the succeeding discussions. The procedures can be found in the PNSDW 1993 manual. The details can be obtained from the Standard Methods for the Examination of Water and Wastewater, 1989 17th Edition.

------ **Membrane Filter**

The membrane filter technique gives a direct count of total coliforms and fecal coliforms present in a given sample.

------ **Multiple Tube Fermentation**

The multiple-tube fermentation technique is used to enumerate positive presumptive, confirmed and completed tests. This technique gives a Most Probable Number (MPN) of coliforms present in a given sample. Determination of MPN based on the test results is explained in detail in PNSDW 1993 manual.

b. Alternative Methods

The following methods can be used for rapid detection of coliform organisms.

---- PHC Test

This is a simple, inexpensive and rapid screening test for the detection of coliform organisms. However, this is not a substitute for standard testing of water. The details for the preparation of PHC Test Media, can be found in PNSDW 1993 manual.

---- MMONPG-MUG (Auto-analysis Colilert) Test
Minimal medium ONPG (0-nirophenyl ß-d Galactopyranoside) and MUG (4 - methylumbellifery 1 ß-d glucoronide)

This test is designed to identify both total coliforms and E. coli in a single container in 28 hours or less by inoculating the predispensed reagent with water sample and incubating it.

Section 5. EVALUATION FOR BACTERIOLOGICAL QUALITY

The bacteriological quality of drinking water supply shall be judged from the presence or absence of E. coli or thermotolerant (fecal) coliform bacteria as shown in Table 3.1 , Standard Value for Bacteriological Quality.

5.1 The detailed explanation of minimum requirements as to bacteriological quality of drinking-water from Levels I, II, III, Bottled Water & Emergency Supplies can be found in PNSDW 1993 manual.

5.2 Unsatisfactory Bacteriological findings

When coliform colonies in a single standard sample exceed the above values, daily samples from the same sampling point shall be collected and examined until the results obtained from at least two (2) consecutive samples show the questionable water has already achieved satisfactory quality. Daily samples collected following unsatisfactory water samples shall not be included in the total number of samples examined. Neither shall such samples be used as a basis for prohibiting the use of the supply, provided that:

a. Thermotolerant (fecal) coliform bacteria are absent.
b. Immediate and active efforts are made to locate the cause of pollution.
c. Immediate action is taken to eliminate the cause.
d. Samples taken following such remedial action are satisfactory.

The above shall be deemed the minimum bacteriological requirements for a drinking-water supply. Supplies which are intended to be maintained in conditions better than these minimum standards are desirable, but not mandatory. These supplies shall consistently contain no organisms capable of fermenting lactose broth with the production of acid and gas.

It is common to examine samples submitted by private individual, owners of private water supplies from deep and shallow wells, for bacteriological quality. In this situation it is essential that the multiple fermentation technique be done and the E. coli tests utilized to confirm thermotolerant (fecal) coliform bacteria.

Section 6. BIOLOGICAL REQUIREMENTS

The biological examinations of water or, as it is sometimes called, the mircroscopical examination, provides a useful tool for the control of raw water quality and treatment processes. It includes a qualitative analysis as well as a quantitative estimation of the types of organisms present, generally designated as "plankton".

Biological examinations of water shall be resorted to only if it is desired to:

a. Determine the cause of objectionable tastes and odors in water;

b. Aid in the interpretation of various chemical analysis;

c. Identify a specific water when it is mixed with another or different composition;

d. Determine the causes of clogging of distribution pipes and filters or other treatment units; or

e. Detect rapidly the organic pollution of water contamination with toxic substances, and cross-connections of distribution system with contaminated waters.

Details on the BIOLOGICAL METHOD USED FOR ASSESSING WATER QUALITY INCLUDE THE COLLECTION, COUNTING AND IDENTIFICATIION OF AQUATIC ORGANISMS can be found in PNSDW 1993 manual.

Section 7. PHYSICAL AND CHEMICAL REQUIREMENTS

Whereas frequent bacteriological examination is required to ascertain water potability, chemical examinations are done less frequently and are utilized to detect and estimate the chemical substances that might affect health as well as the acceptability of water for domestic use. Tables 3.3 to 3.6 show the maximum permissible