# SURVEYING OF SAFE AND WHOLESOME WATER SUPPLY IN THAWIWATTHANA DISTRICT, BANGKOK THAILAND

ChaovayutPhornpimolthape[1],DuangtaKitkaew[2], Apaporn Ruchiraset[3], Lamsak Chavanich[1]

**Abstract**

The aim of this study was to evaluate the quality of Metropolitan Waterworks Authority (MWA) water supply in Thawiwatthana District. Total twenty four samples of tap water were collected during 29 to 30 April 2015 from the households, a community hospital, the schools, the gas stations, a restaurant, a central market, and a temple. Free chlorine residual, pH, and temperature were measured at the sampling points with portable equipment. Turbidity, conductivity, TDS, Fe, and As were analyzed at the Central Laboratory of Faculty of Public Health, Mahidol University. The results showed free chlorine residual were in the range of 0.12–0.82 mg/l whereas Fe and As were in the range of 0.012–0.057 mg/l and 0.001–0.004 mg/l, respectively. Also, pH were in the range of 7.57–8.08, temperature of 29–34 $^{o}$C, TDS of 123.0–220.0 mg/L, conductivity of 180.2–323.6 µS/cm, turbidity of 0.151–0.451 NTU. According to World Chlorine Council recommendation and WHO recommendation, the quality of water supply in Thawiwatthana district from this sampling is safe enough and wholesome for drinking purpose.

**Keyword:** Free chlorine residual, Arsenic, Iron, Drinking water, Distribution network

[1] Faculty of Public Health, Bangkokthonburi University, Thailand

[2]Faculty of Public Health, Mahidol University, Thailand

[3]Faculty of Tropical Medicine, Mahidol University, Thailand

## Introduction

In 1999, Metropolitan WaterworksAuthority (MWA) cooperated with Mahidol University to carry out the inspection of tap water quality in various zones, covering the whole areas of water distribution (Bangkok, Nonthaburi, and Samutprakan Province) under the "Tap Water is Safe for Drinking Project". The report indicates that MWA's tap water quality fully meets the World Health Organization (WHO) drinking water criteria and standard. As the results, MWA announced their tap water is absolutely safe for drinking for whole supply area. Under this project, more than 2,000 places including schools, government offices, hospitals and primary health cares, temples, and food centershave been certificated.

General, water treatment processes are including primary settling, coagulation-flocculation, sedimentation, filtration, and disinfection. Chlorination is the famous disinfection method since it has an enduring disinfection effect. The minimum chlorine residual along distribution network should be in the range of 0.2–0.5 mg/l, mg/l(WHO, 2011).

Thawiwatthana District is located at the outskirt of Bangkok, border to NakornPratom province. Therefore, some certain point of the distribution network a stagnation may be occurred. This will lead to sediment in the pipeline and free chlorine residual will be decreased.

The objective of this study was surveyingthe quality of water supply from MWA distribution network in Thawiwatthana district to ensure that it issafe and wholesome in terms of the measured parameters to be a drinking water.The scope of this study was concern only some of chemical, and physical property (exclude a microbial quality) in term of safe and wholesome.

## Methodology

### Sampling Location

The study area covers Thawiwatthana district and surrounding which is mostly received water from Mahasawat Water Treatment Plant. Total twenty four samples were random collected (Lee, Deininger, & Clark, 1991)at various places, including the

households, a community hospital, the schools, the gas stations, a restaurant, a central market, and a temple during29-30 April, 2015.

Sampling locations is illustrated in Figure 1.

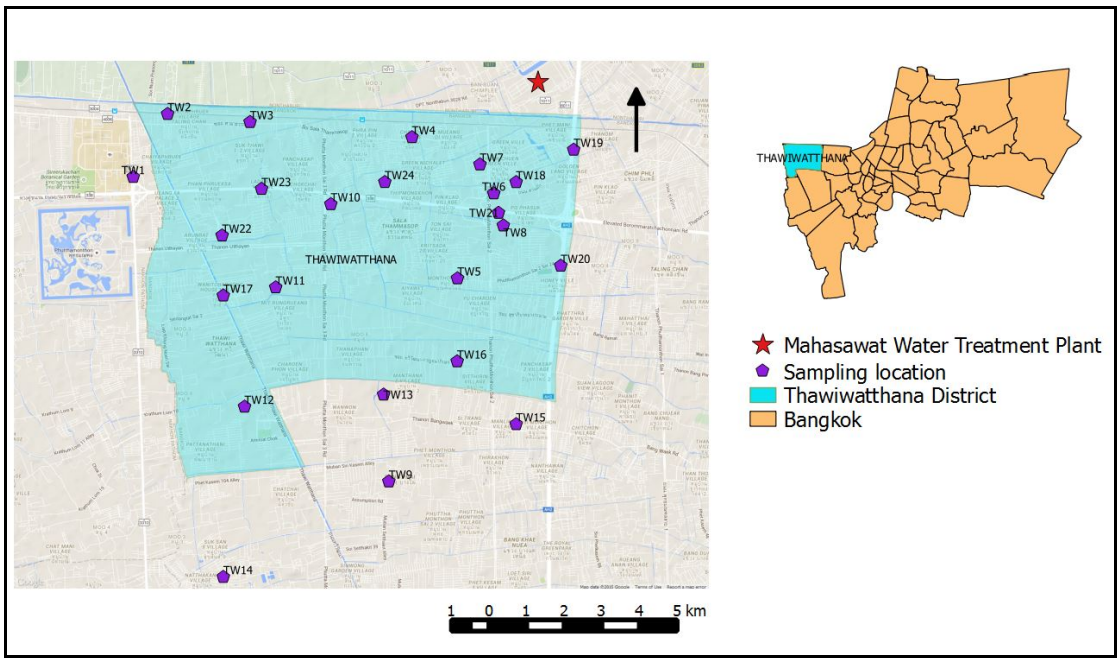


**Figure 1** Sampling location.

**Sampling procedure**

Samples of tap water were collected in clean PPE bottle as following a sampling guidance for unknown contaminants in drinking water recommendation procedure (EPA-817-R-08-003)(US.EPA, 2014).

**Analytical method**

Free chlorine residual, pH, and temperature were measured at the sampling points with portable equipment. Turbidity, conductivity, TDS, Fe, and As were analyzed at the Central Laboratory of Faculty of Public Health, Mahidol University. All of parameters perform following standard method (Eaton & Franson, 2005)as presented in Table 1.

**Table 1**Analytical Method(Eaton &Franson, 2005)

| Parameters | Method |
|---|---|
| Free Chlorine | DPD Colorimetric |
| Turbidity | Nephelometer |
| pH | pH Meter |
| Conductivity | Conductivity Meter |
| TDS | Evaporated at 108°C for 1 hour |
| Fe | Atomic Absorption–Direct Aspiration |
| As | Atomic Absorption–Gaseous Hydride |

## Results and Discussion

### WHO guideline for drinking Water quality

One of the primary goal of WHO and its member states is that "all people, whatever their stage of development and their social and economic condition, have the right to have access to an adequate supply of safe drinking water." The fourth edition of guideline for drinking water was publish in 2011 (WHO, 2011)which purpose to provide the recommendations for managing the risk from hazards that may compromise the safety of drinking-water. The guideline value related in this study was presented inTable 2.

**Table 2** Guideline for drinking water quality (WHO, 2011)

| Parameters | Unit | Value |
|---|---|---|
| Free Chlorine Residual | mg/l | - |
| Turbidity | NTU | 4 |
| pH | - | 6.5-8.5 |
| Electrical Conductivity | µs/cm | - |
| Dissolved Solids | mg/l | 1,000 |
| Fe | mg/l | 0.3 |
| As | mg/l | 0.01 |

Laboratory analysis results of this study are presented in Figure 2. Temperature is the one of important parameter that should be considered in water supply network since it can effect on free chlorine residual concentration. The higher temperature increases vaporization of free chlorine residual, resulting in decreasing of free chlorine residual in water. Especially, samples in this study were mostly collected during the afternoon, which results of temperatures were varied from 32 to 34°C (see Figure 2(a)). This possiblyresulted in free chlorine residual lower thanthe recommended level in some samples of this study. These lower free chlorines residual drew some attention although they were not much

at risk in comparison with the recommended 0.2 mg/l level.

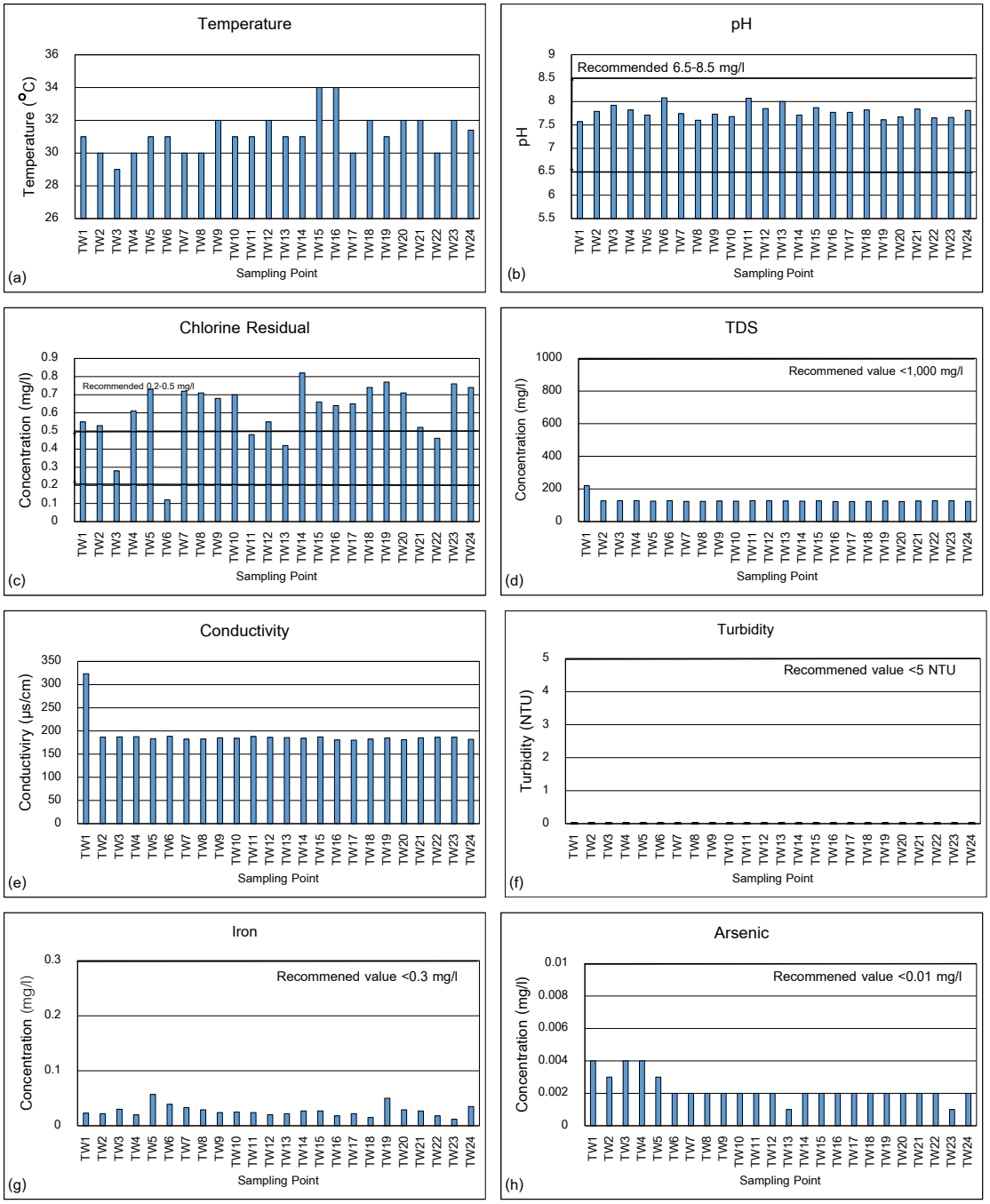


**Figure 2** Concentrations of (a) Temperature, (b) pH, (c), Chlorine Residual, (d) TDS, (e) Conductivity, (f) Turbidity, (g) Iron, and (h) Arsenic in this study

In case of some certain points of the distribution network become stagnant, this lowering of free chlorine residual may lead to more sediment in pipelines and lower disinfection capability.

pH in water supply should be in the range of 6.5-8.5(WHO, 2011). Never the less, chlorination prefer pH less than 8. However, lower pH water (approximately pH 7 or less) is more likely to be corrosive. In this survey, pH in samples were ranging from 7.57-8.08 (Figure 2(b)) which was in the range of the WHO guideline value for drinking water(WHO, 2011).

Free chlorine residual in all samples were in the range of 0.12–0.82 mg/l (Figure 2(c)), which mostly were higher than WHO recommendation range (0.2–0.5 mg/l)(WHO, 2011).

TDS comprise inorganic salts and small amounts of organic matter that are dissolved in water such as cations magnesium, calcium, sodium and potassium and the anions carbonate, bicarbonate. Guideline values for TDS in drinking water recommended by WHO was less than 1,000 mg/l(WHO, 2011). Although possible health effects associated with the ingestion of TDS in drinking-water are not reported but the presence ofhigh TDS level may also be offensive to consumer, remaining to unnecessary scalingin water pipes. From Figure 2(d), the concentration of TDS were ranged from 123-220 mg/l which quite lower WHO guideline value. Conductivity is correlated with TDS concentration, high TDS value resulting in high conductivity also. As presented in Figure 2(e), conductivity values were in a range of 180.2-323.6 µs/cm.

To ensure effectiveness of disinfection along distribution network, turbidity should be less than 1 NTU. Large, well-run water treatment plant should be control of turbidity less than 0.5 NTU before disinfection step and more preferable to less than 0.2 NTU or less (WHO, 2011). In this study, turbidity values were in the range of 0.151–0.451 NTU (as shown in Figure 2(f)) that less than WHO's guideline value of 5 NTU(WHO, 2011).

The concentrations iron (Fe) found were in a range of 0.012–0.057 mg/l, respectively (Figure 2g)). Taste is not usually noticeable at iron concentrations below 0.3 mg/l, although turbidity and color may develop in piped systems at levels above 0.05–0.1 mg/l(WHO, 2011).

Arsenic (As)in drinking water may causes of several disease, such as cancer in different organ, harm the nervous system, skin problem and also cause birth defects and reproductive problem(Pontius, Brown, & Chen, 1994). In this survey, Arsenic concentration were found in the range of 0.001–0.004 mg/l (Figure 2(h)) which was tenfold lower than WHO guideline value of 0.01 mg/l(WHO, 2011).

Therefore, water supply in Thawiwatthana District is safe and wholesome enough for drinking purpose.

## Recommendations

Recommendations based on the results of the study for further studies are as follows:

1) This study was carried out once in April 2015 (summer season) that could not be representatives for all year round condition. More samplings for seasonal variation are therefore recommended for further study.

2) From the results, the highest free residual chlorine of 0.82 and the lowest of 0.12 mg/l were obtained in this sampling. According to World Chlorine Council recommendation for free chlorine residual that should be not less than 0.5 mg/l after 30 minutes of contact time at pH<8.0 and WHO's guideline value for drinking water in the range of 0.2 – 0.5 mg/l, hence the best way to achieve more uniform and optimum free chlorine residual and less risk of disinfection by-product (DBP) formation (Wang, Mao, Tang, Yang, & Xie, 2015)should be more installation of chlorination booster.

## References

Eaton, A. D., & Franson, M. A. H. (2005). *Standard Methods for the Examination of Water & Wastewater*: American Public Health Association.

Lee, B. H., Deininger, R. A., & Clark, R. M. (1991). Locating Monitoring Stations in Water Distribution Systems. *Journal of American Water Works Association, 83*(7), 60-66. doi: 10.2307/41293293

Pontius, F. W., Brown, K. G., & Chen, C. J. (1994). Health implications of arsenic in drinking water. *Journal of the American Water Works Association, 86*(9), 52-63.

US.EPA. (2014). *Sampling Guidance for Unknown Contaminants in Drinking Water*. (EPA-817-R-08-003). Washington, DC: Retrieved from http://www.epa.gov/watersecurity/pubs/guide_watersecurity_samplingforunknown.pdf.

Wang, X., Mao, Y., Tang, S., Yang, H., & Xie, Y. (2015). Disinfection byproducts in drinking water and regulatory compliance: A critical review. *Frontiers of Environmental Science & Engineering, 9*(1), 3-15. doi: 10.1007/s11783-014-0734-1

WHO. (2011). *Guidelines for Drinking Water Quality (4th ed)*. Geneva.