WATER SAFETY PLANS FOR WATER TECHNOLOGIES

S. Godfrey
Water and Environmental Sanitation Specialist, UNICEF, India

S. Wate
Environmental Impact Risk Assessment Division, NEERI, India

P. Labhasetwar
NEERI, India

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Summary

Increased anthropogenic pollution combined with over exploitation of limited ground and surface water resources has resulted in the global water sector exploring alternative approaches to ensure the provision of safe water. This has included a fundamental shift in approach outlined by the World Health Organization (WHO) in the 2004 *Guidelines for Drinking Water Quality (GDWQ)- 3rd edition* and 2006 *Guidelines for safe excreta, wastewater and greywater disposal.* The WHO emphasizes a move away from end point testing of water and a move towards a risk assessment and risk management based approach.

Central to the WHO's approach is the establishment of microbiological and chemical health based risk targets. These targets are set as performance limits on which national drinking water and wastewater standards may be established. Based on these targets a

risk management (Water Safety Plan) approach is proposed to ensure that water and wastewater technologies conform to the established targets.

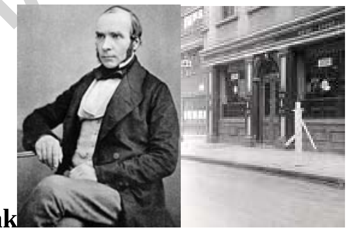
This approach is novel and is fundamentally based on scientific studies from Australasia, Europe and North America. There are limited examples of its application in developing countries. This article provides definitions, methods and processes for the application of Water Safety Plans for various technologies. It provides examples of the application of Water Safety Plans for both small and large scale rural and urban water supplies in developing countries.

1. Introduction

1.1 Global Water Quality History

Historically, the global water sector has focused on the application of compliance of water and wastewater technologies to numerical chemical and microbiological limits. These limits are established based on scientific evidence and include microbiological limits such as 0 *E.coli*/100ml, or <1.5mg/l Fluoride in drinking water and/or <300BOD in wastewater. Many of these parameters were established more than 100 years ago based on scientific evidence generated in Europe during the late 19th Century (see Box 1).

John Snow: Microbiological Water Quality & Health



- **In 1854 John Snow investigated a cholera outbreak**

OUTBREAK:
- 13 pumps supplying water from wells.
- Cholera outbreak
- Ill on night of 31 August and died one or two days later.
- 75 % of population fled
- 89 people who died, only 10 lived closer to another pump.
- 535 inmates of the workhouse in Poland Street were unaffected, even though it was surrounded by fatalities
- **Water coming from the pump was cloudy; people had reported that it smelt bad**

SOLUTION
- The well was nine metres deep, but a sewer only seven metres below ground
- On 7 September, a week after the outbreak began, Snow got the authorities to remove the pump handle. The number of infections and deaths fell rapidly.

Box 1. Historical linkage between water and health

Based on the evidence presented by John Snow, the public health authority of the United Kingdom agreed to establish a limit of 0 pathogenic microorganisms in drinking water. To facilitate the identification of these pathogens in the drinking water, specific indicator bacteria were selected, the most common of which was *E.coli*. Furthermore, in the knowledge that the pathogens originated from the sewers, appropriate bacterial levels were also established for the wastewater in the sewers. Similar scientific evidence was denoted from the mining and industrial sectors to establish appropriate limits for chemicals in drinking water. Mechanized mining in the nineteenth century led to over extraction of natural resources which in turn led to leaching to the contamination of shallow groundwater aquifers with nitrate, iron and fluoride ions. For these, appropriate limits were also established.

1.2 The WHO and Water Quality

The water and wastewater limits established in the late nineteenth century remained the same for almost 100 years. They were documented and disseminated through the World Health Guidelines (WHO) Guidelines for both Drinking Water and Wastewater Quality. In 1958, the WHO published their first *International Standards for Drinking Water*. These were revised in 1965 and 1971. Due to the difficulties of establishing one standard for all countries, the WHO then published the first edition of their *International Guidelines* in the 1980s. This was revised in the 1990s as the second edition with the addition of a third volume which focused on the application of the water quality standards through monitoring and surveillance.

However, in the late 20th Century, global warming, over intensive agricultural practices and mass urbanization resulted in the emergence of new, unidentified, pathogens and chemicals. Public health outbreaks increased in both developed and developing countries due to both the emergence of persistent organic chemical pollutants as well as antibiotic resistant bacteria. Specific outbreaks in Milwaukee – USA, Walkerton – Canada, and Glasgow – Scotland highlighted the fact that reliance on the historical indicator bacteria (*Ecoli*) alone, was not sufficient to protect public health. Additionally, with increased use of pesticides and herbicides in agricultural production, there were further raised concerns in regards to the carcinogenicity of ground and surface water resources.

In light of this, the World Health Organization (WHO), proposed a fundamental change in approach to establishing water quality limits. The approach proposed a move away from end point testing of water quality based on numerical standards, and a move towards health based targets and risk assessment/management. Using the food industries application of the *Hazard Assessment Critical Control Point HACCP)* as their reference point, the WHO proposed the application of HACCP to drinking and wastewater supplies. This approach has become known as *Water Safety Plans (WSPs)* and provides the scientific rationale for the launch of the third edition of the WHO Guidelines in 2004 and 2006.

1.3 Water Safety Plans and Water Technologies

However, despite the development of the WHO "risk based" guidelines, there are currently very few countries in the world who have applied the guidelines. The countries include Australia, New Zealand and more recently the European Union Water Directive and the United State Catchment Management Plans. For many countries, the approach remains difficult to apply. This is specifically true for the emerging economies of South and South East Asia whose primary concern is the provision of sufficient water quantity to meet the increasing industrial and agricultural demand. In countries like India and China, the quality of the water provided may be considered a secondary concern to the provision of sufficient quantity.

Therefore, to resolve the balance between water quantity and water quality, there is a need to develop Water Safety Plans for various water technologies. These include small, as well as large scale water technologies and should range from single household level rainwater harvesting systems to piped urban municipal water supplies. Likewise they should include individual small scale greywater management systems and large scale sewerage wastewater treatment plants.

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Biographical Sketches

Sam Godfrey is a Chartered Water and Environmental Manager (CWEM). With a Ph.D. in groundwater microbiology he combines “cutting edge” scientific knowledge with “grass roots” field work in developing countries. He has worked for the United Nations, Engineering Consultancies, NGO and academic organizations as both a manager and technical advisor on both rural and urban water and sanitation programs and since 2005 he has been working as Project Officer for UNICEF in Central India. His specific responsibilities include the introduction, dissemination and implementation of Water Safety Plans and water reuse in water scarce and fluorosis affected rural communities.

Satish R Wate is the Deputy Director and Head of the Environmental Impact & Risk Assessment

Division of the Indian National Environmental Engineering Research Institute (NEERI). He has an MSc and Ph.D. in biochemistry and is a leading advisor to the Government of India in the area of Environmental Impact Risk Assessment (EIRA). He has worked in more than 10 countries as an international expert and has several international publications.

Pawan Labhasetwar is a senior scientist at the Indian National Environmental Engineering Research Institute (NEERI). From 2005 to 2007 he was on deputation to UNICEF India. His areas of expertise include establishment of monitoring systems, environmental audits, water technology transfer and risk assessment.