

TECHNICAL PAPER
LESSONS LEARNT FROM THE DEVELOPMENT
OF THE WSP FOR THE SPANISH TOWN
WATER SUPPLY SYSTEM IN JAMAICA



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1.0 Introduction

In October 2005, Jamaica's Spanish Town Water Supply System was selected as the first Water Safety Plan (WSP) Demonstration site by the PAHO/CDC/EPA Partnership. The objective of this Partnership is to work with health and environment sectors in Latin American and the Caribbean, to improve environmental public health practices and the coordination between the health and environment sectors.

The Spanish Town WSP was completed in October 2007 and the main objective of this paper is to present the WSP development process as well as lessons learnt from the experience.

2.0 Background

The Spanish Town Water Supply System (STWSS) consists of the Rio Cobre catchment and intake works, the treatment plant, a number of wells, distribution storage and pipelines to supply consumers with potable water.

The STWSS serves Spanish Town, the capital of St. Catherine which is comprised of commercial, industrial and residential areas and is one of the fastest growing towns in St. Catherine and Jamaica. The 2001 population of Spanish Town based on data from the Statistical Institute of Jamaica (STATIN) is 129,018 which is an increase of 17 % in 10 years above the 1991 population and it is estimated that the 2006 population for Spanish Town is about 140, 000.

The Catchment

The Rio Cobre basin occupies a 1,283 km² (128,300 hectares) area in south-east central Jamaica in the parish of St. Catherine. The basin is sub-divided into two sub-basins, the Upper and Lower Rio Cobre. The two principal aquifers in the basin are limestone and alluvial aquifers. These are the main sources for water supply development for Spanish Town.

The major river draining the Upper Rio Cobre sub-basin is the Rio Cobre which is 52.5 km (31.6 miles) in length flowing south towards the sea (Hunts Bay, Kingston Harbour) with an average flow of 1million m³/d (WRA 1991).

The Rio Cobre River is a source of water for both drinking and irrigation purposes. Water is diverted at the Headworks dam into the National Irrigation Commission's (NIC's) irrigation canal to supply the plains of St. Catherine with irrigation water as well as the National Water Commission's (NWC's) Spanish Town Water Treatment Plant

(STWTP) which has its intake works situated on the canal a few miles downstream of the dam.

The river is contaminated by industrial, agro industrial and sewage effluents as well as storm water runoff containing sediments and pesticide residues. Also the NIC's canal receives contamination from some small legitimate and informal industries and commercial activities as well as residential houses, some of which are unplanned settlements.

The Treatment Plant

The Spanish Town Treatment plant treats water abstracted from the Rio Cobre to potable drinking water standards. The plant is very old and is currently being rehabilitated under a project to upgrade and improve the water supply for the Kingston Metropolitan Area (KMA) which includes Spanish Town.

The existing works consists of the following:

1. Raw water abstraction pumps – transferring water from the Rio Cobre irrigation canal
2. Pre-treatment chlorination – dosed into the raw water transfer main
3. Rectangular settling tank (settling tank no. 1) - with aluminum sulphate (alum) dosing prior to a mixing basin on the tank inlet
4. Circular settling tank (settling tank no. 2)
5. Low Lift Pump Station – transferring water from the settling tanks to the filtration block.
6. Rapid Gravity Filtration
7. Chlorine disinfection
8. High lift pumps to distribution
9. Two treated water basins which are presently unused

Water is abstracted from the Rio Cobre via three pumps at an average rate of 11,365 – 13,183 m³/d (2.5 – 2.9 mgd) up to a maximum rate of 18,200 m³/d (4 mgd) which is the design capacity of the plant.

The Wells

In addition to the surface water source there are ten (10) primary wells that supply water to Spanish Town with a total production of approximately 9 mgd. All well water is chlorinated prior to entering the distribution system. Hazards which may affect well water quality and flows include improper sewage disposal associated with absorption pits upstream of their location, illegal connections and lack of chlorine contact chambers for adequate disinfection before distribution.

Distribution Storage and Pipelines

The distribution system is very old and is plagued with leaks especially in the old town. Additionally, many of the distribution storage tanks have not been used for many years as

the growth of the supply area has caused low pressure on the system preventing these elevated tanks from being filled.

3.0 The KMA Project

There are plans currently underway to rehabilitate the water supply system for the Kingston Metropolitan Area (KMA) which includes the parishes of Kingston, St. Andrew and St. Catherine. This means that the Spanish Town Water Supply system will benefit from improvements under this project which is being funded by the Japan Bank for International Cooperation (JBIC) and implemented by the NWC. Lot 1 of the KMA project which incorporates the rehabilitation of the Spanish Town Water Treatment Plant started in mid February 2007 and is expected to last 18 months. Completion is therefore anticipated in mid August 2008.

The rehabilitation objective for the Spanish Town Water Treatment Plant (STWTP) is to provide for reliable production of 18,200m³/d (4 mgd) of potable water meeting NWC standards at all times - irrespective of the turbidity of the available raw water.

This is to be accomplished under the KMA project primarily by addressing treatment issues as follows:

- construction of a new reinforced concrete flocculation/sedimentation facility complete with coagulant preparation and dosing facilities – for the use of powdered poly aluminum chloride as the coagulant of choice for high turbidity (up to 150 NTU) – and associated sludge drying beds. The area occupied by the existing Sedimentation Basin #1 will be restructured to form appropriate foundations for these new facilities.
- modification of the existing rapid gravity filter facility to improve backwash arrangements – inclusive of the construction of an elevated backwash tank to replace the existing back wash pumping arrangements – and the refurbishment of the filter machinery generally

In addition, the three raw water pump units and their associated switchgear will be replaced, a new rising main laid to the inlet of the new sedimentation facility and appropriate modifications made to the existing main switchgear to accommodate the electrical requirements of the new works.

The works will allow the retirement of the existing pre-chlorine facility, the intermediate “clarified water” low lift pump facility and Sedimentation Basins.

Under a separate part of the project, the modifications of the overall STWTP installation will include:

- the replacement of the existing high lift pumping plant with intermediate head units to lift production into twin above ground 8000 m³ clear water service reservoirs to be constructed on the site of the old sedimentation basins,

- upgrading chlorination arrangements and revising the main power arrangements (with standby power generation facilities) and
- providing a new final distribution pumping plant (adjacent to the new reservoirs).

Under the project, improvement works will also be carried out on some sections of the distribution system by replacing pipes in areas where their deterioration has severely affected water supply.

4.0 The Process for Developing the WSP

In developing the WSP, a health-based risk management approach to drinking water quality management, as described in Chapter 4 of the 3rd edition of the WHO Guidelines for Drinking-Water Quality (GDWQ/WHO/2004), was used.

The steps followed in the development process included:

- a. An introduction and familiarization of the development of WSPs to key staff and management representatives at stakeholder government institutions.
- b. Formation of a Task Force comprising representatives of the principal agencies involved in the provision of water, protection of the water resources, water quality monitoring and health assessments
- c. Workshop for training purposes for Task Force members and other technical staff.
- d. Selection of a Coordinator to assist the Task Force in developing the WSP
- e. Preparation of the plan
- f. Review of two different stages of a draft plan by the PAHO/CDC/EPA Partnership representatives, members of the Task Force and other outside technical experts
- g. Finalisation of the plan
- h. Presentation of the recommendations of the WSP to senior officials at the Ministry of Housing and Water and the National Water Commission
- i. Presentation of the WSP to other local stakeholders
- j. Presentation of the WSP to other Countries' representatives.

Some problems were experienced near to the beginning of the process between February and July, 2006 due to Presidential elections within the ruling political party during this period. The campaigning together with personnel and other changes within the Ministry of Water after this event caused up to six months delay in the process. Overall the process of developing the WSP for the STWSS had a duration of 23 months from January 2006 to November 2007.

5.0 The Task Force

The Task Force was established with representatives from a number of agencies with a stake in the provision of safe water for Spanish Town. The representatives selected are shown in Table 1.

Table 1 - Members of the Task Force

AGENCY/ORGANISATION MANDATE	POSITION & EXPERTISE OF TASK FORCE MEMBER
<p>Water Resources Authority Manages surface and underground water resources including its use as well as assessment of threats to the quality and quantity of the resources</p>	<p>Senior Environmental Officer - Co-Chair Task Force Geography, Hydrology (Water Resources Management), Water Quality Management: Development of Water Quality Standards and Regulations, Ground & Surface Water Pollution Studies</p>
<p>Environmental Health Unit, Ministry of Health Approves the design of wastewater treatment facilities and monitors their operations Monitors water quality from systems that produce and supply potable water</p>	<p>Water/Wastewater Specialist Co-Chair Task Force, Environmental Health, oversees the Ministry of Health’s water quality monitoring programmes</p>
	<p>Director Environmental Health Practitioner, manages the Ministry of Health environmental health programmes</p>
	<p>Environmental Health Specialist Water and wastewater management</p>
<p>Environmental & Engineering Managers Ltd.</p>	<p>Consultant Coordinator of Task Force; Civil and Environmental Engineering Consultant Environmental Engineer</p>
<p>National Water Commission Potable water service provider</p>	<p>Water Production Manager STWSS Mechanical Engineer specialising in chlorination systems</p>
	<p>Senior Technical Officer – Chemistry, Eastern Laboratory Applied Chemistry, Water Quality</p>
	<p>Senior Project Manager Civil Engineer, specialising in the design, implementation and management of water and wastewater capital projects</p>
	<p>Manager Quality Assurance Analytical Chemistry, Coastal and Marine Environment Pollution Prevention and Watershed Management</p>
	<p>Area Manager, St. Catherine Electrical Engineer and Management; manages NWC water supply systems for St. Catherine</p>
<p>National Environment & Planning Agency Manages the environment, with specific focus in this case on preventing pollution</p>	<p>Actg. Director Legal Standards & Enforcement Division Industrial Chemistry, Environmental Chemistry</p>

AGENCY/ORGANISATION MANDATE	POSITION & EXPERTISE OF TASK FORCE MEMBER
of water resources by monitoring and/or licencing effluent discharges from facilities generating sewage and trade effluent	
National Irrigation Commission Harnesses, conveys and supplies agricultural interests with water	Regional Systems Manager General Agriculture; manages the irrigation services in the eastern region in accordance with policies and objectives of the NIC
National Public Health Lab/Environmental Health Lab, Ministry of Health Conducts tests on water quality samples for the Ministry of Health in fulfilment of surveillance responsibilities	Lab Manager, Environmental Health Laboratory Chemical Engineering, wastewater and other environmental health issues
Pesticides Control Authority Regulates the importation, manufacture and use of pesticides	Registrar Agronomy and Crop Science
St. Catherine, St. Catherine Health Services	Water Quality Control Manager Public Health Inspector; water quality management (water treatment systems, chemical bacteriological and chlorination procedures)
St. Catherine Parish Council Manages and maintains minor water supplies	Superintendent Minor Water Supplies Supervises workers (part time chlorinators) who collect samples to check for residual chlorine in minor water supplies; allocates work for maintenance of pipes associates with minor water supplies
PAHO	Environmental Health Adviser Solid waste management and water and wastewater systems
St. Catherine Health Department	Medical Officer (Health) Public Health Practitioner with responsibility for the health of parish
National Public Health Laboratory	Head of Sanitation Laboratory Medical Technologist responsible for drinking water quality analysis

Two Chairpersons were selected to lead the Task Force which ensured that in the absence of one, the other was available to Chair the meetings. On most occasions the Chairperson from the Water Resources Authority led the meetings while the Chairperson from the Ministry of Health ensured that members were notified of meeting dates and times and arrangements were in place for hosting the meeting.

The multidisciplinary team composition was very important to ensuring that first hand information was available on all the aspects of the water supply system. It was realised at the first meeting of the Task Force that additional members would need to be invited as their expertise would be critical to the development of the WSP. As such, representatives from the National Irrigation Commission (NIC), operators of the irrigation canal from which NWC abstracts water and the Pesticides Control Authority (PCA), the agency that regulates the use of pesticides, were invited to join the Task Force.

6.0 The Coordinator

All Task Force members were full time employees and therefore did not have a lot of time to devote to preparing the WSP. It became necessary to engage a Coordinator for the purpose of obtaining the necessary information from Task Force members in order to prepare the WSP.

The functions of the coordinator included:

- a. Scheduling Task Force meetings and acting as a facilitator
- b. Preparation of the work plan in collaboration with Task Force members
- c. Liaison with the Task Force members to obtain necessary information
- d. Research to obtain relevant data for the WSP
- e. Writing the WSP
- f. Liaison with senior officials in the Ministries of Health and Water regarding the recommendations of the WSP

It was important to identify a Coordinator that had a good understanding of water supply systems and the associated hazards. Someone known within the water, environment, health and sanitation sectors with proven interpersonal skills was found to be an asset. It was also essential that this person be someone who would be readily accepted by the Task Force members in order to promote coordination among the institutions.

Fortunately, the Coordinator was an environmental engineer who had a great deal of experience in the wastewater sector, and therefore did not have a steep learning curve with respect to understanding the methodology of the WSP. Although the Partnership did not require the Coordinator to have a technical background, this did prove to be beneficial to the overall outcome particularly since she would go on to write the drafts of the WSP. This would probably not have been possible had she not had a technical background.

7.0 Development of the Plan

Prior to the Coordinator coming on board, the PAHO/CDC/EPA Partnership visited Jamaica and met with PAHO/Jamaica and the Ministry of Health/Environmental Health Unit to discuss how to move forward. Subsequently, the Partnership held a technical workshop in July 2006 to raise awareness of the WSP process among a key set of

representatives from the Jamaica government institutions responsible for providing and ensuring the safety of the drinking water for Spanish Town. They also toured the STWSS and met with health officials in an effort to explore possibly measuring the health effects of doing a WSP. During this time, the Partnership, the PAHO Jamaica office and the Ministry of Health decided that it would be necessary to designate a local coordinator who could ensure that the development of the WSP move forward and stay on course.

Once hired, the first task the Coordinator had to undertake was a visit to the installations comprising the STWSS. This visit was facilitated by the service provider, the NWC and the surveillance agency, the Ministry of Health, Environmental Health Unit. In order to be an effective facilitator for the Task Force meetings, it was important for the Coordinator to have a thorough understanding of the water supply system to elicit relevant information from the Task Force members.

The second task was the preparation of a workplan to guide the process of developing the WSP. The workplan was useful in estimating the duration of the overall project; identifying the tasks to be done, the responsible persons and the target dates for completion. The workplan was designed with a tight schedule to maintain the focus of the members. It was noticed that as meetings became less frequent towards the end of the process, it was more difficult to get the attention of the Task Force members.

The work plan had to be revised a few times as dates for delivery of information or completing tasks had to be rescheduled and a few new activities not originally envisaged had to be added.

The definition of the study area was extremely important as many of the members had different ideas of what this should be. After many discussions it was agreed that the study area would comprise:

- a. The catchment – upper and lower Rio Cobre Basin
- b. The treatment plant
- c. The primary wells
- d. The service area falling within the area called Spanish Town as defined by the Statistical Institute of Jamaica (The Spanish Town Water Supply system actually supplies areas outside of Spanish Town, and the supply area can expand and contract based on the demand, system pressure and water availability)

Each agency represented on the Task Force had to provide information for the WSP. There were challenges in obtaining information within the agreed time due to competing job priorities. The quality of the information was generally good. However quantitative data was lacking for the amount of pollution (pollutant loading) from industrial and agro industrial effluent discharges to the Rio Cobre River.

Working meetings were held with members of the Task Force where the Coordinator acted as a facilitator. Over a series of meetings, the hazards were identified and analysed

and the risks characterised for all the components of the water supply system from catchment through to the consumer. The risks were prioritized, critical control points identified and control measures were determined for all risks along with responsible agencies and a time addressing deficiencies.

8.0 Reference Material

Since this was the first WSP developed for the Latin-American and the Caribbean Region, and the concept was still fairly new internationally, there were only a few WSPs that could be used as reference documents.

In developing the WSP for the STWSS, examples of existing plans for Melbourne, Australia and Kampala, Uganda were reviewed in addition to technical papers from the Ministry of Health in New Zealand.

Melbourne Water is located in Victoria, Australia and was the first bulk water supplier in Australia to implement and achieve HACCP certification in 1998. Kampala, the capital city of Uganda in East Africa, was the first water supplier in Africa to develop a Water Safety Plan in 2002. This was achieved with technical assistance from the Water, Engineering and Development Centre (WEDC) UK and funding from the Department for International Development (DFID) UK through their Knowledge and Research programme. The Kampala piped water supply is managed by the National Water and Sewerage Corporation (NWSC) with distribution operation let by management contract to Ondeo Services Uganda Limited (OSUL).

In addition to these examples, the Water Safety Plan Manual, May 2006 by Annette Davison, Dan Deere, Melita Stevens, Guy Howard and Jamie Bartram was a very useful guidance document.

9.0 Geographic Information System (GIS)

While there was the capability to utilize the NWC GIS system to map the hazards and critical control points identified within the STWSS, this was not fully explored. Only one GIS map was generated showing the hazards, primarily informal housing and commercial settlements, along the NIC canal between the Headworks dam and the NWC intake works. It was recognised however that the GIS could be a useful tool in mapping all the hazards and critical control points within the STWSS with the added potential to overlay other related information to examine the interrelationships between water safety and issues such as:

- areas experiencing sanitation related illnesses (e.g., gastroenteritis)
- areas classified as poor
- informal settlements
- illegal connections
- water wells census

- excreta disposal
- sewage treatment plants
- garbage collection
- health centres
- flooded areas
- industrial and commercial sewage effluent discharges

10.0 The Health Assessment Component

This section of the plan was done by the CDC in collaboration with the St. Catherine Health Department. The objective was to assess the quality of water reaching the consumer and how water was stored and utilized after being delivered to the consumer by the service provider. This is a critical aspect of the WSP as disruptions in supply or quality issues can cause persons to engage in water storage and handling practices that can lead to health problems. This component was not integrated into the WSP for the STWSS as it was conducted as a separate exercise. Integration of the health assessment aspect into the WSP could have led to better examination of water storage issues at the point of the consumer as this was not covered in the WSP. Persons involved in the health assessment component did not participate in Task Force meetings.

11.0 Liaison with other stakeholders

There were other stakeholders that were not involved directly in the development of the WSP that could have made a contribution to its development. These include:

- a. Representatives of agro-industrial and industrial entities discharging waste into the Rio Cobre River
- b. The National Solid Waste Management Authority which manages solid waste collection and disposal and has the mandate to provide guidance and training to communities (that do not and cannot receive curbside collection by truck) on alternative ways to manage solid waste
- c. Ministry of Agriculture – Squatter Management Unit
- d. Developers of housing developments
- e. Community Representatives

12.0 Liaison with Senior Officials

Towards the end of the process of developing the WSP a number of attempts were made to meet with senior officials at the Ministry of Health, Ministry of Water and the National Water Commission. This proved to be quite difficult to achieve and in the end only a brief meeting was held with officials of the NWC and the Ministry of Water and Housing to discuss the recommendations of the WSP. A contributing factor to the difficulties experienced was the resignation of a senior official who was involved at the start of the process but whose successor was unfamiliar with the project.

It should be noted that the workplan did not include for regular meetings with these officials throughout the WSP development process which could have avoided the problems experienced in this case.

13.0 Implementation of the WSP

It was clear that the Task Force saw its function as only the development of the WSP and that it did not extend to the monitoring of the implementation of the WSP. Since it is recognised that the implementation of the WSP is the most critical part of the initiative, the mechanism for monitoring the implementation needs to be clearly defined.

For this plan it was suggested that overall monitoring of the plan reside with the Water Quality Subcommittee of the Central Health Committee. However the actual mechanism for monitoring the implementation has still not been determined.

14.0 Lessons Learnt

A number of lessons were learnt from the experience of developing the WSP for the Spanish Town Water Supply System. Improvements that could have been made to the process are outlined below.

- a. Convene a Steering Committee comprising senior officials of the Ministry of Health and Environment, the Ministry of Water and Housing and the service provider, in this case the NWC. Meetings should be scheduled at strategic points throughout the development of the WSP and these meetings should be included in the workplan. This would avoid the problem of trying to engage the senior officials at the end of the process when it is likely to be difficult and would ensure that they are fully aware of and “buy-into” the WSP.
- b. Ensure that all relevant agencies are represented on the Task Force and add to the membership as it becomes necessary and ensure commitment from these organizations, particularly the water utility for the subsequent implementation of the WSP.
- c. Integrate the health assessment component into the development of the WSP as this establishes a baseline that can be used to assess the effectiveness of the WSP during its implementation. Ideally the persons conducting the health assessment should attend Task Force meetings regularly.

While these “lessons learnt” are likely to extend the duration of the development of the WSP, it is expected that they will bring valuable improvement to the implementation of the plans.

15.0 Recommendations

There are also some recommendations which could be included in the process to improve its effectiveness.

- a. Where possible, identify a Coordinator for the Task Force with technical skills and expertise in the water, environmental, health or sanitation fields.
- b. It may be useful to expose the Coordinator to a brief training course on the development of WSPs depending on the experience and expertise of the person.
- c. It may be useful to prepare a short WSP course for training purposes and to reproduce more WSP tools such “Practical Manuals” and share more experiences
- d. Early in the process identify the person or entity that will oversee the implementation of the WSP as well as the entity that will monitor the progress and report out to the relevant institutions. This activity should be included in the workplan
- e. Utilise a GIS where available to map the hazards and critical control points associated with the water supply system. Include also vulnerable areas such as “red zones” where there is a high incidence of illegal connections or low level or absence of residual chlorine and health data such as areas where gastrointestinal illnesses are prevalent
- f. Develop mechanisms to include other stakeholders in the development of the WSP which does not necessarily require them to become members of the Task Force. This could include special meetings with these groups to get their perspective on the hazards and risks associated with the water supply system. Include the strategies for engaging the other stakeholders in the workplan.

Based on the experiences with developing the WSP for the STWSS, the process flow shown at Figure 1 is proposed for the development of other WSPs.

16.0 Conclusion

It is hoped that others developing WSPs locally in Jamaica and within the Latin American and Caribbean Region may benefit from the information provided in this paper on the experiences and lessons learnt while developing the WSP for the STWSS in Jamaica.

Figure 1 - Proposed WSP Development Process Flow

