**Non-Revenue Water Reduction**

**Environmental and Social Management Framework**

**Water Supply Modernization Program (SU-L1058)**

**Final Draft Report**

**October 30, 2019**

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**Disclaimer for Disclosure of Environmental and Social Analysis**

The SWM considers this document as a draft version. The SWM reserves the right to revise the document based on further review of the information presented, the proposed project activities, and any public consultation held related to the project

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Prepared for the SWM

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# **Introduction**

The water sector in Suriname is composed primarily of two government-owned drinking water service providers, the Suriname Water Company (SWM), responsible for water supply in the coastal area, and the Department of Water Supply responsible for water supply in the interior. Most of the water supply infrastructure in the rural areas of the coast are in poor conditions. Some of the problems experienced are: i) depleted infrastructure due to age and limited maintenance, with high Non-Revenue Water (NRW) levels, ii) difficulties in servicing large areas with low population density since installation of pipe works for scattered household is uneconomical, iii) absence of a revenue collection mechanism, where water supply is available in rural areas beneficiaries are not being charged, iv) lack of data, v) absence of a water quality program, and vi) limited inspection.

The presented study is based on the 2015 NRW Reduction Strategy developed under the IDB loan for the Water Supply Infrastructure Rehabilitation Program (SU-L1018). Component 1 of this proposed loan Water Supply Modernization Program aims forward the NRW Strategy implementation in the Central Region to minimize losses through the optimized operation of the distribution system and associated institutional support. Specific activities of component 1 will include: i) Strengthening of the NRW unit, ii) installation of meters and service connections, iii) pressure management, and iv) energy efficiency.

From a previous environmental assessment, the Water Supply Modernization Project is considered a Category B project under review procedures of the Government of Suriname (National Institute for Environment and Development - NIMOS) and IDB. The impacts are considered site-specific, limited in number, and mitigation measures are readily available.

This study aims to provide a non-site specific environmental and social management framework for the NRW program. This framework sets out measures that will improve environmental and social sustainability of the activities carried out under the NRW program. This study is **supplementary to the Environmental and Social Analysis study** of the Water Supply Modernization Program.

# **Environmental and Social Risk for NRW Activities**

* 1. Description of Activities

The main aim of the NRW program is to establish DMAs, which

are demarcated areas in which inflowing and outflowing water can be measured and subsequently losses can be calculated. SWM defined DMA’s around the pumping stations, the so-called pumping zones.  Figure 3 gives an overview of the 13 proposed pumping zones for Paramaribo, Wanica and Para (central region).

*DMA Design*

|  |
| --- |
|  |
| Figure 1: Demarcation of DMAs. Source: NRW Unit Operations Department |

DMA/Pumping zones are designed based on a set of criteria, which need to be tested in the field or with network modelling. These criteria are as follows:

* Size of the DMA based on the number of connections (normally between 1000 and 2500)
* Number of valves that should be closed to create an isolated unit. Natural borders are chosen to minimize the number of valves to be installed.
* Number of flow meters for measurement of in- and outflow. The less meters are installed, the lower are the costs.
* Ground level variations result in different pressures in the DMA. Generally, a flat area allows for stable pressure and create a better environment for pressure management than areas with variations in height.
* Topographic characteristics which can act as DMA borders, such as rivers, drainage canals roads etc.

Several activities are carried out for DMA design, which are shown in Table 2.

Table 1: Activities required for the DMA design

|  |  |  |  |
| --- | --- | --- | --- |
| **Activity** | **Why?** | **Where?** | **Whom?** |
| 1. Inventory of sub-areas (streets, consumer IDs) | Demarcation of the DMA | VIS system | Sales (user administration and customer service) |
| Desk research | NRW unit [[1]](#footnote-1) |
| 1. Determine location, status and specifications of plugs | Assess what infrastructure needs to replace, amended or newly constructed | Field work | Operations (distribution) |
| 1. Assessment of the number of connections | Assess if the number of connections is feasible for the DMA (between 3000 and 5000 is recommended) | VIS system | Sales (user administration and customer service) |
| 1. Calculation of water needs and usage inclusive NRW | Indication of current NRW percentage | Desk research | NRW unit |
| 1. Assessment of energy use per pump and /or pump station | For calculation of energy index to identify energy efficiency measures | Desk research | NRW unit |
| 1. Assessment of in- and outflow pipes | Determine flow and specifications (material, diameter) of inflow and outflow pipes | Field work | Operations (distribution and production) |
| 1. Installation of pressure valves and flowmeters | Determine locations to install pressure valves and flow meters | Desk research | NRW unit |
| Field work | Operations (distribution) |
| 1. Measurement of pressure in system | Determine water pressure in mains and secondary pipes | Field work | Operations (distribution) |

*NRW Operations*

After the DMA is designed, the SWM staff gathers data for the calculations of NRW with executing the following activities (Table 3).

Table 2: Activities required for the NRW measurement

|  |  |  |  |
| --- | --- | --- | --- |
| **Activity** | **Why?** | **Where?** | **Whom?** |
| Baseline line measurement | | | |
| 1. Gather baseline data | Establish the status of zero measurement on: user data, pipes, production, distribution, pressure | Field work | Meter recording team  Inspection and control |
| Field work | Operations (distribution) |
| 1. Calculate water balance | Understand the big picture of the water system, including the magnitude, sources and costs of NRW | Desk research | NRW unit |
| Resolve visual leakages and AC pipes | | | |
| 1. Identify visual leakages and replace asbestos (AC) piping | Visual leakages are relatively easy to detect | Field work | Operations (distribution) |
| Asbestos is a fibrous mineral known to cause cancer and respiratory diseases | Field work  AC piping is located in Paramaribo, Wanica, Nickerie, Commewijne, Marowijne and Para |
| 1. Measure pressure after replacing AC pipes | Assess if pressure changed after replacing AC pipes | Field work | Operations (distribution) |
|
| 1. Measure metered consumption | Determine metered consumption after resolving leakages and replacing pipes | Field work | Meter recording team |
|
| 1. Calculate losses caused by leakages | Review water balance | Desk research | NRW unit |
| Remove illegal connections | | | |
| 1. Identity theft and illegal connections | Terminate unauthorized consumption | Field work | Operations (distribution) |
| 1. Measure metered consumption | Determine metered consumption after removing illegal connections | Field work | Meter recording team |
|
| 1. Calculate losses caused by illegal connections | Review water balance | Desk research | NRW unit |
| Replace unreadable water meters | | | |
| 1. Replace unreadable and defective meters | Terminate meter inaccuracies | Field work | Operations (distribution) |
| 1. Inspection of home pump installation | Terminate pump installations that are using more water than SWM guidelines | Field work | Operations (distribution) |
| 1. Calculate losses caused by unreadable water meters | Review water balance | Desk research | NRW unit |
| Replace old water meters | | | |
| 1. Inventory of old meters | Terminate meter inaccuracies | Field work | Operations (distribution) |
| 1. Replacement of old meters |
| 1. Random replacement of water meters for accurate test meters | Increase accuracy of meters | Field work | Operations (distribution) |
| 1. Measure metered consumption | Determine metered consumption after replacing old water meters |
| Field work | Meter recording team |
| 1. Calculate losses by old water meters | Review water balance | Desk research | NRW unit |
| Installations without water meters | | | |
| 1. Inventory of water installations without meters | Terminate unmetered water consumption | Field work | Operations (distribution) |
| 1. Installation of meters | Field work | Operations (distribution) |
| 1. Measure metered consumption | Determine metered consumption after connection unmetered installations | Field work | Meter recording team |
| 1. Calculate losses by old water meters | Review water balance | Desk research | NRW unit |
| Calculation of NRW | | | |
| 1. Calculation and analysis of NRW percentage | NRW percentage | Desk research | NRW unit |

*Communication on NRW*

NRW activities should be communicated beforehand to the residents that will be affected in the area of work. For effective NRW communication, apply the protocol for information sharing as described in section 8.3.5 of the ESA report.

## **4.2 Environmental and Social Risks for NRW activities**

### 4.2.1 General Risk Assessment Framework

A high level of NRW will have a severe and direct impact on the ability of SWM to satisfy customer demand and therefore has a negative impact on customers. High physical losses often lead to intermittent supply, either because of limited raw water availability or because of water rationing (especially during extended dry season), which may be needed to reduce supply hours (and therefore hours of water leakage) per day. Intermittent supply poses a significant health risk, as contaminated groundwater, or even sewerage, can enter the leaking pipes during supply interruptions and very low-pressure periods. Avoiding this significant public health risk should be reason enough to reduce leakage to enable continuous supply. High leakages also increase flow rates in the pipe network, which can cause unnecessarily high-pressure losses that affect customers and often lead to supply interruptions during peak demand hours.

As NRW activities involves lots of field work, some potential risks exists due to lack of fundamental documents, such as Emergency Response Plan, EHS (Environmental, Health and Safety) Plan, and Waste Management Plan. These plans are formally documenting procedures to be implemented to manage potentially hazardous situations, should emergencies and accidents occur. Standard Operating Procedures for the execution of all activities need to be included in the future EHS Plan, especially those activities with certain level of risk for workers. Due to the replacement as well as the placement of pipes, meters, valves, etc. a proper waste management plan need to be prepared for the collection, transport and disposal removed pipes, meters, packaging materials, and so on.

### 4.2.2 Environmental and Social Risks

NRW activities are linked to SWM procedures and work instructions which are broadly implemented in the company.  All procedures instructions on network maintenance and repair require SWM staff to comply with the following codes:

* Disinfection of pipes and fittings (O WB S W-005). This work instruction was unavailable at the time of this study.
* Personal hygiene (O WB S W-11). This work instruction was unavailable at the time of this study.
* Safety book. Recommendations to improve SWM’s Occupational Health and Safety (OHS) guidelines are outlined in the ESIA study in section 7.2.

Besides these general guidelines on network repair, some specific procedures and instructions are used, and these are assessed on their environmental and social risk in Table 4.

Table 3: Environmental and social risks associated with NRW activities

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Activities** | **SWM Procedure** | **SWM Work instruction** | **Gaps and constraints** | **Environmental/**  **social risk** |
|
|  | **Design** | | | | |
| D.1 | Determine location, status and specifications of valves (plugs) | D OH S P-001 Maintenance of main pipes | D OH C W-003 Maintenance of valves (plugs) | Lacks instructions on:  -Traffic safety | -Change in traffic situation due to work can cause accidents |
| D.2 | Assessment of in- and outflow pipes (flow, pipe specifications) | Not available |  |  |  |
| D.3 | Installation of pressure valves and flowmeters | Not available |  |  |  |
| D.4 | Measurement of pressure in system | D OH S P-001 Maintenance of main pipes | D OH S W-006 Pressure monitoring | Lacks instructions on:  -Traffic safety | -Change in traffic situation due to work can cause accidents |
|  | **Operations** | | | | |
| O.1 | Identify visual leakages | D OA S P-001 Maintenance of service pipes | D OA S W-001 Resolve leakage at the service pipe | Lacks instructions on:  -Chemical contamination due to entering of other water  -Microbial contamination: waterborne pathogen intrusion  -Standing water  -Traffic safety  -Outdoor works/sun exposure | Risk of intrusion of chemicals e.g. pesticides, debris, petroleum  -Risk of pathogen intrusionwith leakage repair (low flows)  -Standing water can lead to an increase of vector-borne diseases  -Change in traffic situation due to work can cause accidents  -Too much sunlight may cause health issue for workers |
| O.2 | Replace asbestos (AC) piping | D OH S P-001 Maintenance of main pipes | Not available | Lacks instructions on:  -Registration of activity at the Government (Labour inspection)  - Request for expert supervision (from Government)  -Handling of asbestos  -Containment, removal and transport of asbestos  -Post-handling health monitoring of workers  -Post-handling of equipment used in activity  -Traffic safety  -Disposal of removed asbestos pipes | -Risk of having no expert supervision when working with AC pipes  -Risk of release of and exposure to toxic chemicals  -Risk of development of lung- and other illnesses in workers  -Risk of asbestos residue in equipment  -Risk of asbestos residue at worksite and waste management site  -Change in traffic situation due to work can cause accidents  -Risk of contaminating surface/ground water and soil when asbestos is disposed incorrectly |
| O.3 | Measure pressure after replacing AC pipes | D OH S P-001 Maintenance of main pipes | D OH S W-006 Pressure monitoring | See D.1 | See D.1 |
| O.4 | Measure metered consumption | Not available |  |  |  |
| O.5 | Identify theft and illegal connections | Not available |  |  |  |
| O.6 | Replace unreadable and defective meters | VP-04 Replacement of unreadable meters | D OM SW-001 (Re)placement of water meter | Lacks instructions on:  -In case leakages occur. It only focuses on detection of leakages  -Disposal of removed meters | See O.1 and  -Contamination of surface/groundwater and soil |
|  | D OM S W-002 Overhaul water meter | Lacks instructions on:  -Safe handling of hazardous chemicals (phosphoric acid, paint, soap)  -Safe storage and transport of hazardous chemicals | -Risk of exposure to hazardous chemicals with storage, handling and transport |
|  | D OM SW-003/004 Calibrate water meter |  |  |
| O.7 | Inspection of home pump installation |  |  | Lacks instruction on:  -Collection, transportation and disposal of removed meters | -Contamination risk of surface/groundwater and soil |
| O.8 | Inventory and replacement of old meters | See O.6 | See O.6 | See O.6 | See O.6 |
| O.9 | Random replacement of water meters for accurate test meters | Not available |  |  |  |
| O.10 | Inventory of water installations without meters | No specific instruction available, detection occurs with general surveillance of distribution team |  |  |  |
| O.11 | Installation of meters | See O.6 | See O.6 | See O.6 | See O.6 |

# **Environmental and Social Management Framework**

In this section, management measures are summarized intended to avoid, reduce potential negative environmental and social impacts and optimize measures to generate, maximize and/or enhance potential benefits of implementation the NRW program in SWM.

The ESMF is not-site specific and provides general measures with the purpose to:

* Encouraging and achieving the highest environmental and social performance and response from all employees and contractors
* Ensuring that management efforts are proactive and focused to prevent impacts from occurring
* Supplementing the proactive approach with reactive measures to minimize the severity or significance of any impacts that cannot be prevented at source.

This ESMF has a **general focus**. It serves as a tool to guide SWM to revise or develop procedures and work instructions to guide management and staff to manage and monitor environmental and social impacts.

Costs for this plan are included in the ESMF associated with the Environmental and Social Assessment study. For the cost proposal, the assumption is made that SWM will carry the costs of : i) preparing manuals and ii) developing or revising procedures for work execution.

Table 4: Recommendations for Mitigating Environmental and Social Risks

|  |  |  |  |  | **Monitoring and Performance Evaluation** | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **No** | **Management Aspect** | **Risk** | **Recommendations** | **Responsible Person** | **Performance Indicators** | **Monitoring Methods** | **Monitoring Frequency** |
|  | | | | | | | |
| **Design** | | | | | | | |
| D.1 | Determine location, status and specifications of valves (plugs) | Traffic Accidents | Create procedures and work instructions on road safety including demarcation of area, signage, traffic regulation (include in NRW manual, see G.1) | NRW unit | Procedures and work instructions | NRW manual | Quarterly |
| Coordinate with local authorities to improve signage, visibility and overall safety of roads | Operations (distribution) | Number of road accidents | Road safety | Monthly |
| Have first aid services on site in case of injuries (ensure that at least one person is on site with first aid training) | Number of first-aid injuries | Health report | Monthly |
| Have information (location, telephone) of the nearest emergency room in case of accidents |
| Coordinate with neighbors about interfering in activities (parking etc.) |  |  |  |
| Inform street/neighborhood with pamphlet about activities beforehand | Information dept | Pamphlets | Communication report | Monthly |
|  | | | | | | | |
| D.2 | Assessment of in- and outflow pipes (flow, pipe specifications) | Traffic Accidents | See D.1 |  |  |  |  |
|  | | | | | | | |
| D.3 | Installation of pressure valves and flowmeters | Traffic Accidents | See D.1 |  |  |  |  |
|  | | | | | | | |
| D.4 | Measurement of pressure in system | Traffic Accidents | See D.1 | | | | |
| **Operations** | | | | | | | |
| O.1 | Identify visual leakages | Chemical contamination of water | Revise/develop procedures and work instructions including disinfecting of materials during storage, handling, transport | Operations (distribution)/HSEQ | Number of works executed according to written instructions. | Operations report, Field compliance audits | Monthly |
| Revise/develop procedures and work instructions on water quality testing to ensure detection of chemical hazards | Operations (distribution)/HSEQ/Laboratory |
| Microbial contamination of water | See Chemical contamination of water | | | | |
| Standing water/vector borne diseases | Revise/develop procedures and work instructions to include provisions on preventing standing water after works | Operations (distribution)/HSEQ | Number of works executed according to written instructions. | Operations report, Field compliance audits | Monthly |
| Traffic Accidents | See D.1 | | | | |
|  | | | | | | | |
| O.2 | Replace asbestos (AC) piping | Asbestos toxicity | Revise/develop procedures on safe handling of asbestos including:  -Registration of activity at the Government (Labour inspection)  - Request for expert supervision (from Government)  -Handling of asbestos  -Containment, removal and transport and disposal of asbestos  -Post-handling health monitoring of workers  -Post-handling of equipment used in activity | Operations (distribution)/HSEQ | Number of works executed according to written instructions. | Operations report, Field compliance audits | Monthly |
| Traffic Accidents | See D.1 | | | | |
|  | | | | | | | |
| O.3 | Measure pressure after replacing AC pipes | Traffic Accidents | See D.1 | | | | |
|  | | | | | | | |
| O.4 | Measure metered consumption | No information available at time of study |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| O.5 | Identify theft and illegal connections | No information available at time of study |  |  |  |  |  |
|  |  |  |  | | | | |
| O.6 | Replace unreadable and defective meters | Chemical contamination of water | See O.1 | | | | |
|
| Microbial contamination of water | See O.1 | | | | |
| Standing water/vector borne diseases | See O.1 | | | | |
| Chemical contamination of meters | Revise/develop procedures and work instructions including disinfecting and cleaning of meters from any chemicals during storage, handling, transport | Operations (distribution)/HSEQ | Number of works executed according to written instructions. | Operations report, Field compliance audits | Monthly |
| O.7 | Inspection of home pump installation |  |  | | | | |
|  |  |  |  |  |  |  |  |
| O.8 | Inventory and replacement of old meters | Chemical contamination of water | See O.1 | | | | |
|
| Microbial contamination of water | See O.1 | | | | |
| Standing water/vector borne diseases | See O.1 | | | | |
| Chemical contamination of meters | See O.1 | | | | |
|  |  |  |  |  |  |  |  |
| O.9 | Random replacement of water meters for accurate test meters | No information available at time of study |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| O.10 | Inventory of water installations without meters | No information available at time of study |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| O.11 | Installation of meters | Chemical contamination of water | See O.1 | | | | |
|
| Microbial contamination of water | See O.1 | | | | |
| Standing water/vector borne diseases | See O.1 | | | | |
| Chemical contamination of meters | See O.1 | | | | |

1. SWM organizational chart includes an NRW unit under the Director. Another NRW unit for the Central area is under the Operation Department. All references to NRW unit in this document apply to the latter. [↑](#footnote-ref-1)