Second Basic Education Improvement Program (2^{nd} BEIP)
Environmental and Social Management Plan

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SUMMARY

ABBREVIATIONS

ATM	Ministry of Labor, Technological Development and Environment
BEIP	Basic Education Improvement Program
2nd BEIP	Second Basic Education Improvement Program
BOB	Bureau for Education in the Interior
BOG	Bureau of Public Health
CARICOM	Caribbean Community
CDFS	Community Development Fund Suriname
CENASU	Centre for In-service Teacher Training
DEV	Electricity Supply Service
DWV	Service Water
EBS	Energy Company of Suriname
ESMP	Environmental and Social Management Plan
FOB	Fund for Development of the Interior
GDP	Gross Domestic Product
GNI	Gross National Income
GNP	Gross National Product
GOS	Government of Suriname
HDI	Human Development Index
ICT	Information and Communication Technology
IDB	Inter-American Development Bank
IFC	International Finance Corporation
IOL	Teacher-Training College
MDG	Millennium Development Goals
MNH	Ministry of Natural Resources
MOECD	Ministry of Education and Community Development
NEAP	National Environmental Action Plan
NIMOS	National Institute for Environment and Development
NMR	National Environmental Council
PAHO	Pan American Health Organisation
PMU	Project Management Unit
SWM	Suriname Water Company
TD	Technical Department
UNDP	United Nations Development Program
WHO	World Health Organisation
WSP	Water Safety Plan

1. INTRODUCTION

In 2004, the Government of Suriname (GoS) undertook an education reform process through the Basic Education Improvement Program (BEIP) financed by IDB (Loan 1521/OC-SU). The objective of the project was the improvement of the quality of primary education by means of providing inputs to schools, improving educational processes, and supporting institutional reforms to increase school autonomy. Among the components, a number of schools were renovated and constructed in order to reduce overcrowding and maintain the stock of schools in good condition.

The Second Basic Education Improvement Program (2nd BEIP) aims to increase the learning outcomes of students in the education system of Suriname from pre-primary through junior secondary education nationally, and improve the internal efficiency and quality of the new basic education system. This operation builds upon the foundation established through BEIP by addressing ongoing education challenges, including expanding coverage and quality of education in the interior and nationally with key emphasis on curriculum revision and innovation in education.

The Program (SU-L1019) is divided into two phases of four years each: phase I will focus on developing the curriculum framework for the entire basic education system and on increasing learning outcomes of students in grades 1 to 8; phase II will focus primarily on improving learning outcomes in the junior secondary grades of the basic education system. One of the components of Phase I focus on increasing access to education through school construction and expansion, as well as construction of teacher housing in the interior.

This Environment and Social Management Plan (ESMP) aims to orient the construction or rehabilitation of schools and teachers housing in the interior, as well as the operation and maintenance of this infrastructure. As the Program also intends to construct a Centre for In-Service Teacher Training (CENASU) and rehabilitated some departments of the Ministry of Education and Community Development (MOECD), directives also apply to these activities in Paramaribo urban area.

As Suriname's legal environmental framework is still not enforced, this ESMP has been prepared based on the best engineering practices applicable to the site conditions in the interior. As all works will be performed by the MOECD, no environmental or construction permits are required.

The MOECD will ensure that this ESMP is implemented and adhered to by the contractors undertaking the project. Thus, this ESMP must be included in the bidding documents for civil works on 2nd BEIP and will be considered as part of contractors' responsibilities on the project implementation.

1.1. Document organization

Section 2 presents an overall description of the 2^{nd} BEIP, objectives, main activities that will be subject to this ESMP, and the institutional arrangement for the infrastructure component implementation.

Section 3 provides information on the legal and institutional framework involved in the implementation of the infrastructure component of 2^{nd} BEIP.

Section 4 presents environmental and social baseline information on the area of influence of the project. As the construction sites are spread out through the country, the area of influence considered was the Interior. In section 4.5 a diagnostic of schools in the interior is presented as well as information on the sites visited.

Section 5 presents the potential environmental and social impacts due to Program's implementation, specifically related to the infrastructure component. The mitigation and prevention measures are presented in Section 6, where the environmental and social directives for both construction and operation phases are detailed.

Section 7 provides the functional organization for the implementation of this ESMP, including roles and responsibilities of key participants; Section 8 presents the supervision and monitoring organization; and finally section 9 presents program documentation.

2. PROJECT DESCRIPTION

2.1. Objectives

The Second Basic Education Improvement Program (2nd BEIP) objective is to increase the learning outcomes of students in the education system of Suriname from pre-primary through junior secondary education nationally, and improve the internal efficiency and quality of the new basic education system.

The infrastructure projects, which include construction of new public schools and expansion of existing ones in the interior of the country, are designed to complement the other initiatives in the program and achieve the following: (i) decrease over-crowdedness in pre-primary and primary public schools; (ii) expand primary schools to include two years of pre-primary; and (iii) increase access to pre-primary, primary and junior secondary schools. The construction of CENASU provides an opportunity to further develop the quality of teaching through continuous teacher training.

2.2. Basic Education Improvement Program

In 2004, the GoS initiated the execution of an education reform process through the implementation of the Basic Education Improvement Program (BEIP) financed by the Inter-American Development Bank (IDB). The Program aimed to improve the quality and internal efficiency of basic education by means of updating the educational contents and processes, providing inputs to schools, and supporting institutional reforms to strengthen the MOECD and build-up management capacities at the school level. The major reform in the program was to develop a new Basic Education System mandatory to all school-age children between the ages of 6 and 14 and consisting of six years primary and four years junior secondary education for a total of 10 years of formal schooling.

To achieve its purpose, the Program included four components: (i) support the establishment of a revised basic education cycle and quality improvement; (ii) renovation of school and MOECD infrastructure; (iii) strengthening of management capacities at the school level; and (iv) Modernization and strengthening of the MOECD and the school system.

The purpose of Component II – Renovation and rehabilitation of school infrastructure in basic education was to improve the condition of school infrastructure in Suriname, by renovating and rehabilitating selected primary and junior secondary schools and certain MOECD units that were in need of repairs. The school renovation and construction aimed to reduce overcrowding and maintain the stock of schools in good condition. The Technical Department (TD) of the Ministry of Education, with the support of the Project Management Unit (PMU) executed and concluded the renovation and rehabilitation of 55 schools and 3 MOECD departments.

In continuity to the BEIP, completed in 2012, the 2nd BEIP was approved by the Inter-American Development Bank in June 2012 (SU-L1019). The Program includes expanding coverage and quality of education in the interior and nationally with key emphasis on curriculum revision and innovation in education.

In this regard, the GoS and IDB have designed an eight year multi-phased loan that consists of two phases of four years each (Phase I: year 1-4; Phase II: year 5–8). Phase I will focus on developing the curriculum framework for the entire basic education system and on increasing learning outcomes of students in grades 1 to 8. Phase II will focus primarily on improving learning outcomes in the junior secondary grades of the basic education system. The multi-phase approach is being taken as the activities must be implemented sequentially, to allow for the progressive reform of the basic education system. This approach provides the time needed for an appropriate and sequentially transition to this new basic education system.

The strategic objective of the program is to create a new basic education system with initial focus on the first eight years from pre-primary through primary. Doing so will give all students the time required to develop the foundation in core skills such as reading and comprehension, writing, and mathematics and essential life skills. All levels will follow a seamless transition to facilitate students' ability to build upon each prior year's learning and skills development, giving them the foundations required for success in their future endeavors, whether they choose vocational/technical or academic routes. While all students will receive the same general education, the new first phase of the basic education system will have the flexibility to allow students to focus on their interests through elective subjects, as well as provide adequate support to low performing students. Education approaches can also be modified as required to meet the needs of children in urban, rural, and interior areas of the country. This type of education system can increase the competitiveness of the Suriname education system and contribute to the integration with Caribbean Community (CARICOM).

Taking into consideration the GoS' priority on Information and Communication Technologies (ICT) in education, and the formation of Presidential Task Force for Education Innovation, the program will also explore and support the use of alternative ICT strategies to improving quality of the knowledge base in education. The inclusion of ICT in education is justified based on the effects of technology on job functions and the related changes in the skills demanded by the labor market. ICT provides an avenue for innovative learning and enhances the management of information within education systems.

As result, Phase I of this program will focus on four components: (i) improving student learning outcomes in basic education in grades 4 to 8, with an emphasis in Dutch and mathematics, and in teaching approaches; (ii) Information and Communication Technology ICT in education and implementing pilots to test different strategies for utilizing ICT; (iii) increasing access to education through school construction and expansion, and construction of teacher housing in the interior; and (iv) improving management of the education system at the MOECD and school levels.

Component III includes infrastructure projects that comprehend the construction or rehabilitation of schools in the interior of the country, as well as the construction of the Centre for In-service Teacher Training (CENASU), and the renovation of some departments of the Ministry of Education and Community Development, in Paramaribo.

The infrastructure projects, specifically the construction/rehabilitation of schools in the interior of the country, are designed to complement the other initiatives in the program and achieve the following: (i) decrease over-crowdedness in pre-primary and primary public schools; (ii) expand primary schools to include two years of pre-primary; and (iii) increase access to pre-primary, primary and junior secondary schools.

Under this component the program will finance: (i) construction of schools (including furniture, equipment, multimedia centre, sports facility, teacher housing, and supervision) in the interior; (ii) the operations/management of the multimedia centers in these schools for the first two years, after which the MOECD will take over financial responsibility; (iii) a diagnostic on school construction and expansion in the interior; and (iv) construction, rehabilitation and refurbishment of MOECD departments, including equipment for staff as a non-monetary incentive.

2.3. Infrastructure Component

There are 325 primary schools in Suriname, 289 of which include pre-primary, and 124 junior secondary schools. Ninety-two of the primary schools (including 56 denominational and 36 government schools) and six of the junior secondary schools are located in the interior, where 10 percent of the population resides.

Approximately 54 percent of the primary and secondary schools are public and the remaining schools are denominational, run by religious organizations, mainly Roman Catholic (RKBO) or Moravian (EBGS). These schools operate with government subsidies in the form of: payment for teacher salaries based on the government salary scale; curriculum materials since they use the national curriculum; and a small subsidy per student enrolled.[1] The religious organizations maintain the school facilities and hire their teachers from the graduates of the teacher-training college (IOL).

In the interior, over 60 percent of the schools are private, primarily due to the historical role churches have played in delivering social services, especially education in remote communities.

In the original, it was foreseen that under 2nd BEIP new schools would be constructed. However, in July 2012, following the approval of the loan contract (2742/OC-SU), the Presidential Task Force for Education and the MOECD commissioned 386 new classrooms to reduce overcrowding and increase access to school places in advance of the October 2012 school year. Thus, through 1st BEIP and the government task force the quality and quantity of a large number of public schools in the country have improved. In light of the major construction work undertaken by the Presidential Task Force the 2nd BEIP was mandated to focus solely on the construction of classrooms and teacher houses, and renovations of existing classrooms and teacher houses in the Interior. For the first time, the MOECD will embark on civil works on denominational schools in the Interior. As such, a selection of these schools was decided upon by the MOECD and is presented in Annex 1.

Based on the revised focus for increasing access to school places, through school expansion, the 2nd BEIP loan financing will not be assigned to any new school constructions as originally

[1] Families are charged annually approximately US$4 per child to attend a public school and between US$22 and US$33 for a private school.

foreseen in program design. The CENASU will be the only fully built new standalone structure commissioned under the 2nd BEIP. The civil works will include the construction of additional classrooms, media centers, toilets, and teachers housing, as well as the rehabilitation of existing ones when necessary. Constructions are very simple, made out of concrete bricks, aluminum roofs, cement floors, and open windows. The standard specifications for school structures are presented hereinafter, in section 6.1.

Walls are usually made of concrete bricks, and sometimes also wood on the upper part. Bricks are made in the area before construction starts, to minimize transportation costs. Roofs are of aluminum shingles, over a wooden structure. More recently, steel structures are being used as they are more durable. Classrooms have a board ceiling and sometimes the porches also have a ceiling which provides some thermal comfort underneath. A ventilation area is provided between the ceiling and the roof itself which helps to reduce the temperature underneath. Ventilation is also facilitated within the classrooms by large open windows on the walls, protected only with fencing. In some cases also the doors are fenced.

Toilets are made of brick walls and impermeable floor. Now-a-days MOECD is using tiles on the walls inside toilets. As in many places energy supply is by generator, and this operates only during the night (from 6 to 11 p.m.), the water system does not work during school hours (from 8 a.m. to 1 p.m.). It is necessary to use water directly from the water tanks taps to flush the toilets, to wash hands and to drink.

Water supply is usually provided by water tanks installed underneath the roofs capturing rain water directly into the tanks, with no filtration or any further treatment. Although rain water is considered "safe water", some pollutants laid on the roof are drained directly to the water tanks. In the areas of gold mining and bauxite, the residuals from the effluents add pollutants to the atmosphere and subsequently to the water systems. Additionally, during the dry season, sometimes these tanks are not sufficient to provide potable water for the school, and no additional system is provided. All schools and teachers houses use this water supply system. Waste water is directed into septic tanks.

Solid waste is usually burnt in the backyard of schools or teacher houses, or buried. There is no place to collect and store garbage until it is burnt or buried.

Photographs of some of the selected schools to be renovated are presented in Annex 2.

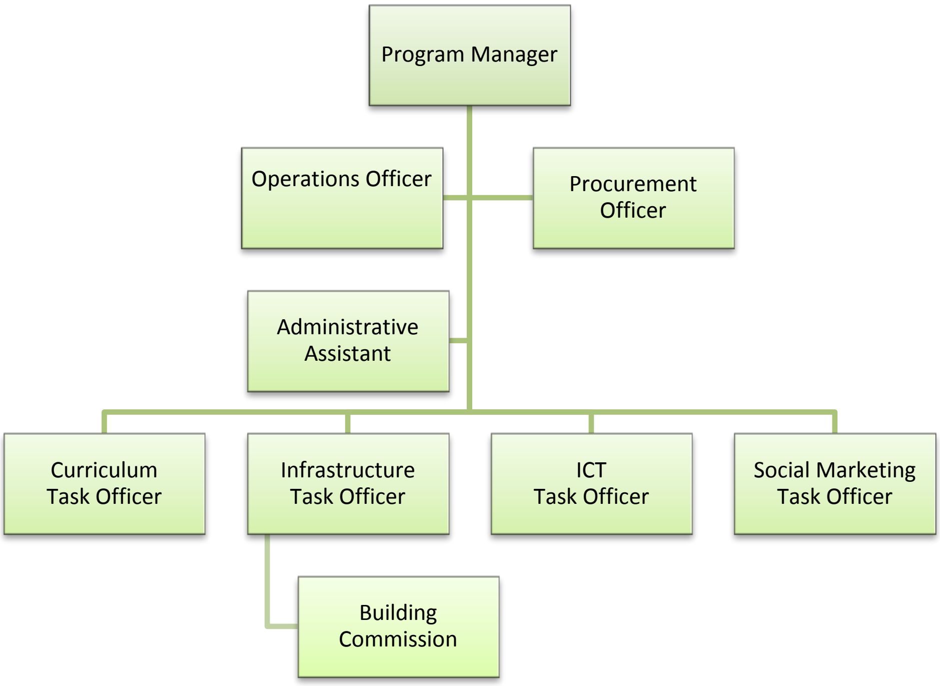
2.4. Institutional Arrangement for Project Implementation

The 2nd BEIP management structure is composed of a *Coordinating Body* to provide the overall program vision and the *Program Management Unit* (PMU) situated within the MOECD. The MOECD is the executing agency responsible for the appointment and recruitment of staff and external consultants with the pertinent skills to support it in the implementation. The Program *Advisory Committee* is composed of key stakeholders that offer regular input and advice on program implementation.

The **Coordinating Body** is composed of the Permanent Secretary and two Technical Advisors who oversees program implementation and provide advisory guidance and policy direction.

The PMU is responsible for all aspects of program implementation, by coordinating closely with MOECD Departments such as curriculum development, bureau education in the interior, guidance, technical department and research and planning. The MOECD Departments assists the PMU to define the activities and implementation modalities within the different program components in their area of expertise; provide input into terms of references and bidding documents; and perform technical leadership and supervision of relevant components.

The PMU includes a core management team and designates from key MOECD departments and from external consultants. For each component a specific officer will be indicated, as shown below.



For the Infrastructure Component a Building Commission was formed comprising professionals from the Bureau for Education in the Interior and the Technical Department of the MOECD.

3. LEGAL AND INSTITUTIONAL FRAMEWORK

3.1. Institutional Framework

The education system of Suriname is under the responsibility of the Ministry of Education and Community Development (MOECD). The MOECD is divided in two Directorates: Directorate of Education and Directorate of Culture. Each Directorate is headed by a Director, who is responsible for the daily management of the Directorate and reports directly to the Minister of Education. The Directorates are divided into several main divisions, each headed by a Deputy Director. These divisions include a number of departments or services (with a support or service function), each one led by a department head or coordinator.

The Directorate of Education includes seven main sections namely:

- Education Division, which is responsible for the implementation and inspection of education in general;
- Administrative Support Division, which includes responsibility for personnel and financial matters;
- Development Service Division, which is responsible for educational innovations;
- Technical Support Division, which includes responsibility for the technical support in the implementation of educational activities;
- School Materials Production and Distribution Division;
- Technical and Vocational Education Division;
- Educational Student Centers Division.

The MOECD is entirely responsible for the school system in Suriname including public and private schools at primary, secondary and tertiary level. The Directorate of Education is responsible for: all matters relating to education and training; supervision of special education; science and technology; the promotion of literacy; libraries and study. The Education Division is responsible for the implementation and monitoring of education and consists of the following departments: primary education office, secondary education office, special education office, inspectorate primary educations, inspectorate junior secondary education, inspectorate senior secondary education, examinations, libraries, and educational information and study facilities.

The Technical Department consists of the following departments: cleaning and security, transport, buildings and premises. The Technical Services Department is responsible for the construction and maintenance of public schools in the entire country.

Although not involved in Program implementation, other institutions are involved in managing educational infrastructure, as follows:

- **Ministry of Regional Development**: responsible for regional governance, decentralization and the development of the interior. It is also responsible for land tenure, waste disposal and cleaning services in Suriname, with the exception of the district of Paramaribo. All District Commissioners and the village's captains are under the coordination of this ministry.

- **Ministry of Heath**: responsible for providing access and good quality healthcare for all. The Bureau of Public Health (BOG) is the national institute of preventive health care that focuses on the promotion and monitoring of the overall health of everyone in Suriname. The Environmental Inspection Division of the BOG is responsible for sanitation inspection in households and public areas, including schools, in all of Suriname.

- **Ministry of Natural Resources**: responsible for maximizing the use of natural resources for community's economic and social development, and provide access to water and electricity. The Energy Company of Suriname NV (EBS) is responsible for the electricity supply in urban and semi-urban areas, and the Electricity Supply Service (DEV) is responsible for the electricity supply in the interior. The NV Suriname Water Company (SWM) is responsible for water supply in urban and semi-urban areas; and the Service Water (DWV) is responsible for water supply in the interior.

- **Ministry of Labor, Technology Development and Environment**: responsible for job opportunities and employment, good labor relations, biodiversity, climate change, combating environmental pollution, quality of life in the country, stimulating innovation and innovations in production. It is responsible for environmental policy and regulation, as detailed in the following section.

The Ministry of Natural Resources and the Suriname Water Company are the main institutions in charge for safe drinking water. In the past years some specific projects have been executed through the Community Development Fund Suriname (CDFS), the Fund for the Development in the Interior (FOB) and the Decentralization Program to increase access to safe water in the Interior areas. The collaboration with the Ministry of Natural Resources and the Ministry of Regional Development could be encouraged so that the water supply is guaranteed. In current situation this already takes place as the MOECD, specifically the Bureau for education in the Interior (BOB) negotiates with these Ministries to provide safe water to the schools. Through the renovation activities the needed sanitary and water facilities will be provided. The actual supply of the water can then be negotiated.

The National Institute for Environment and Development in Suriname (NIMOS) is responsible for waste management in Suriname, although there are no national regulations and guidelines. The World Bank Guidelines are the measures taken into consideration. Within the NIMOS there are two departments which could be of assistance during this project namely the Environmental & Social Assessment department and the Environmental Monitoring & Enforcement department.

Also the Environmental Inspectorate division of the Bureau of Public Health (BOG) of the Ministry of Health periodically inspects the schools on hygienic situations. If there is something wrong they write a report about the steps that has to be taken to correct this, within a certain

period. Information from that division indicated that they execute periodic inspection visits to the interior areas, so collaboration with them could also be supportive to the monitoring of proper solid waste management.

3.2. Environmental Policy and Framework

Although the Constitution of the Republic of Suriname (1987) provides a legal basis for a national environmental policy it has not yet been approved. An Environmental Act has been drafted to lay down rules for the conservation, management and protection of a sound environment within the framework of sustainable development, but it has still not been approved.

A National Environmental Action Plan (NEAP) was compiled in 1996 (also not formally approved), and an institutional framework for environmental management and sustainable natural resource use has been established. The National Environmental Council (NMR) and the National Institute for Environment and Development (NIMOS) have been established since 1997. These institutions provide, together with the various departments, the rules and guidelines for environmental protection and sustainable use of natural resources in Suriname.

The Ministry of Labor, Technological Development and Environment (ATM) is responsible for the environmental policy and regulation, as well as supervision of compliance with employment protection and health and safety inspection regulations. ATM's Environmental Division (created in 2002) oversees governance and administration of environmental affairs. ATM is thus responsible for the coordination of the activities of other ministries regarding the use of natural resources, biodiversity conservation, regional development, etc.

NIMOS is a technical working arm of ATM, responsible for the preparation of national policy and legislation designed to protect the environment, and also to monitor compliance with national environmental laws and regulations.

In the absence of dedicated national environmental legislation, the responsibility for environmental issues remains spread between a number of agencies and departments in other ministries.

The Ministry of Natural Resources (*Ministerie van Natuurlijke Hulpbronnen* – MNH) is responsible for the sustainable management of natural resources, including concessions (rights) for the use of state-owned resources, among which are building materials like sand and crushed stone. The MNH issues permits to exploit quarries, borrow pits and other natural resources for construction purposes

3.2.1. Environmental Regulations

Suriname currently does not have an overarching environmental law that promotes sustainable economic development or governs the systematic application of environmental management tools, such as environmental impact assessments, environmental management plans, and pollution control measures.

Although Suriname has not yet promulgated an Environmental Act as such, elements of environmental protection and the conservation of biological resources can be found in other legislation:

- General environmental rules and regulations for undertakings are provided by the Hindrance Act, further more explained.
- For sand and crushed stone quarries, the Mining Decree is applicable. A Mining Act has been drafted, but it has not been promulgated.
- Archaeological sites are regulated by the Monuments Law (2002).
- Waste management is not yet regulated by law, although some general articles regarding waste have been included in the Penal Code. A Waste Management Act has been drafted and is currently under consideration of policy makers.

Since World War II Suriname accepted various laws with the intention to protect the environment. Some important laws are: The Nature Protection Law of 1954; The Hunting Law of 1954; The Fish Protection Law of 1961; and The Insecticide Law of 1972.

The Nature Protection Act provides the legal framework for nature conservation. The protected areas of Suriname are divided into: four Multiple Use Management Areas, 11 Natural Reserves, and one National Park.

Forest management in Suriname is regulated by the Forest Management Act (1992) that regulates forest exploitation and primary wood-processing. The Act defines concessions and other forms of forest exploitation, respectively under License and Communal Forestry.

Suriname has subscribed multilateral environmental agreements. In 1985, it has deposited the accession to *The Convention on Wetland of International Importance* (Ramsar 1971), especially the waterfowl habitat, for the protection of biodiversity. This protected wetland is limited to the north-central part of Suriname, between the Atlantic Ocean and Saramacca River.

3.3. Building Regulations

Building Code (Bouwverordening, 1956)

This law provides the basic framework for governmental regulation of the construction sector. All building plans are subject to governmental approval, and are evaluated in accordance with the rules & regulations specified in the Building Resolution (*Bouwbesluit, 1956*). However, the law limits itself to the area of the city of Paramaribo, with the possibility of extension to other areas.

There are no specific stipulations that apply for building constructions other than homes. But the resolution does mention to solicit specific instructions for business and industrial structures, schools and hospitals from the assigned Ministries such as Trade and Industries, the Ministry of Education and Public Development, through the permit.

In February 24, 2010, the Building Code was amended by State Resolution to implement article 10 that declares that the Building Code and Building Resolution are applicable in all of Suriname providing that the building is more than 15 m^3 in content and exceeds a height of 2.50 m with a solid nailed construction.

Building Resolution (Bouwbesluit, 1956)

This Building Resolution stipulates rules and regulations for obtaining a building license. Only building plans within the area where the Building Code is in effect are subject to licensing. This law was limited to Paramaribo Town, Nickerie Town and Wanica district, until 2010.

Urban Building Law (Stedebouwkundige wet, 1972)

This law provides the regulation for town planning and land development. The government will provide "*structuurplans*" and "*bestemmingsplans*", and all land development must be carried out in accordance with these plans. The law requires for Greater Paramaribo, that a license is needed for any new construction or for the alteration of an existing construction. Greater Paramaribo is defined as the City of Paramaribo and the corridors of important exit roads coming out of Paramaribo.

3.4. Educational Buildings Regulations

The MOECD is responsible for the planning, administration, monitoring, evaluation and policy development of the education system.

The MOECD has a Technical Department (TD) that is responsible for the maintenance and installation of public schools in the entire country. The department uses a set of standards for public and non-public schools. The main directive for primary schools, mainly in the interior, is that they should be simple and practical execution. The buildings follow a modulated construction plan where classrooms[2] are a 7 x 7 meters, and other facilities – administration office and storage, toilet blocks and library – are half the size of a classroom (3,5 x 7 meters).

The main existing guidelines are detailed as follows (complementary guidelines are further proposed in this ESMP, on section 6).

Site location and dimensions

Location shall consider environmental conditions and public health safety, where sufficient sunlight and air circulation is provided, and no risk of flooding.

The size of the plot depends on the size of the school. The plot must be of such size that construction can fit in and set free from other buildings, providing enough space for classrooms, and other facilities, as well as a playground and physical exercises field. If there is an existing sports field (12x24m or 30x50m) nearby the school it is not necessary to provide one within the school plot. For both construction and sports fields together a 15,000 square meter area should be enough.

[2] The same room space can be used for media center or a library.

The school field must be fenced and provided with two gates. A flagpole is placed in the central of the site.

Buildings

Classrooms: classrooms will be 7 x 7 meters (total floor area: 49 square meters). In the interior, primary schools usually have one classroom for each school year, and one for kindergarten. This same area can also be used for other activities, such a media centre or library.

Kindergarten: a play area shall be provided with a sand box and some equipment as a climbing rack, a seesaw, a slide and a carousel.

Specific rooms: larger schools and junior secondary schools might have other rooms as indicated below:

- geography and biology classrooms: 58 square meters with a common 12-square meters storage space;
- physics laboratory: 70 square meters and a 45-square meters cabinet;
- handwork rooms: 58 square meters with a 12-square meter storage area;
- crafts: 120 square meters and a storage room with 35 square meters;
- drawing and handicraft: 85 square meters and a 20-square meters storage room;
- music room: 58 square meters and a 12-square meters storage room with noise isolation;
- library: 58 square meters.

Gymnasium: 12 x 21 meters with auxiliary spaces

- storage room: 4 x 9 meters with double door;
- dressing rooms: 30 square meters or two with 18 square meters;
- bathroom: 50 square meters, with 16 showers with feet washing facilities or two with 8 showers; each bathroom with one or two cabinets;
- two toilets with a vestibule accessible from the dressing rooms;
- a teachers dressing room (6 square meters) with lockers, sinks, showers and water closets;
- a storage room for instructional materials (8 square meters) adjacent to a storage room (10 square meters) for maintenance equipment for the sports field; classes must have a washing facility.

General specifications:

- floor level of classrooms must be at least 20 centimeters above adjacent ground level;
- the corridors are located at one side of the classrooms, and the width shall be at least 2 meters;
- the walls and ceiling shall be painted in light shades;
- blackboards must be attached to the walls, and must be the size of a one and a half sheet of plywood with chalk tray;
- if connected to electricity system, artificial light shall be provided, consisting of four fluorescent tubes of 40 watts each.

Sanitation facilities: toilets are installed in toilet blocks; one for every 40 students. Toilet blocks can be equivalent to one half (7 x 3.5 m) or one entire classroom (7x 7 meters). The boys must have urinals with partitions in combination with two water closets per male toilet block. The girls must have at least three water closets per female toilet block. The teachers and staff shall have their own facility, one toilet for the female and one for the male. Every toilet block shall have a hand washing facility. As to ensure sanitary awareness, an additional hand wash facility should be provided outside the toilets (to wash hands after playing in the yard and going back to classrooms for example).

Special needs: in Suriname there are schools for students with special needs, but only in Paramaribo; in the interior there are no additional modifications for children with physical disabilities. Although there were no students physically disabled in the schools visited in the interior, it is possible that children with physical disabilities just don't attend schools because of access difficulties.

Teachers housing units: housing units are provided with one, two or even three bedrooms, accordingly to local needs. Each housing unit has a bathroom, kitchen space, living room and bedroom. Housing can be combined into 2-units or 4-units buildings, with one or two floors.

Infrastructure

Water and wastewater systems: at most schools in the interior water supply is provided by rain water and storage tanks installed under roof spouts; water is pumped into the toilets only when electricity is provided; drinking water is taken directly from the water tanks. Wastewater is directed to septic tanks located behind toilet blocks. Water tanks are not always sufficient to provide water during the dry season, leaving the students with no water supply at all. Details on the quality of drinking water are included in Annex 5.

Energy supply: schools in the interior are supplied either by public electricity systems or individual generators.

Waste management: in all schools in the interior waste is mainly burnt at the backyard of the school plot and housing units, sometimes it is buried also in the backyard.

3.5. Other Building and Environmental Related Regulations

Hindrance Act (1930)

The aim of this Act is to prevent the cause of danger, damage or hindrance (nuisance) caused by projects to the outside-fence surrounding environment. Nuisance can be considered as excessive noise, smoke, bad odor, etc.

According to the Hindrance Act, all new undertakings need a written 'Hindrance Act Permit' ('*Hinderwet-vergunning*') issued by the District Commissioner who has to seek advice from NIMOS, the Bureau for Public Health, the Department of Labor Service, the Head of the Fire Department etc. The permit is given on terms which may include environmental requirements. In case of outside-fence hindrance caused by air pollution and noise, soil and water pollution and generation of solid or liquid waste, this Act can be enforced.

This law authorizes the District Commissioner, the police and the Bureau of Public Health to intervene where activities cause nuisance to others. With 'nuisance' is meant excessive noise, smoke, bad odor, etc. So whenever nuisance is caused by road related activities correction can take place.

3.5.1.1. Mining Decree and Mining Act (draft)

The Mining Decree governs exploration and exploitation of mineral resources. The decree stipulates that all mining activities should be carried out taking into account current requirements regarding safety and health, including requirements to protect the ecosystems.

After closure of the mining concession, the holder of the right must take all necessary measures to ensure public safety, the conservation of the deposit, the rehabilitation of the land concerned and the protection of the environment.

A draft Mining Act (2004) has been developed, which reflects increasing international and national awareness of the environmental and social impacts of mining. The draft Act includes provisions for protection of the physical and social environment and for rehabilitation on completion of mining activities. It stipulates that, as Suriname has no environmental norms and standards of its own, the World Bank standards shall apply.

3.5.1.2. Monuments Law (2002)

This law prescribes the procedures to be followed upon the encounter of historic buildings and structures – or the remainders thereof – that are at least 50 years old and have a particular value due to their beauty, artistic quality, scientific meaning, national history, etc, or have been constructed in memory of a specific happening or person.

The law does not regulate the actions to be taken after finding incidental archaeological artifacts. Nevertheless, general courtesy and unwritten rules of conduct require that the nature of such artifacts, their finder, and the coordinates are reported to the Director of the Suriname Museum at the Fort Zeelandia Office. These facts will be recorded in the national archaeological register.

The Monuments Law can provide protection to archaeological sites, but only after Suriname's Minister of Education and Culture has declared the site to be a monument, based on the advice of the Monuments Committee.

3.5.1.3. Waste Management Act (draft)

A Waste Management Act has been drafted that lays down rules for the disposal of waste. This Concept Act defines waste into four categories: household garbage, agricultural and yard waste, commercial and industrial waste and hazardous waste. It empowers the Minister of Public Works to issue licenses for the transport, treatment and disposal of waste.

3.6. Land Tenure

Land tenure in Suriname is public. Land leases can be obtained under formal request to the Ministry of Physical Planning, Land & Forest Management. Decree no. 10 of June 15th, 1982, regulates land tenure. Only 40-year land lease is allowed, while previous law allowed it for 75 years and envisaged full title deeds.

Land rights include: public ownership, lease, inheritance and hereditary tenure. Land occupancy rights can be expropriated for public interest and compensated. As the infrastructure proposed for the 2nd BEIP is public, the Government can order the expropriation of leases and other land rights to expand schools and teachers housing units.

It is important to observe, though, that a formal agreement from the District Commissioners and the local chief of the communities where the constructions will take place shall be obtained prior to initial civil works. The chiefs are recognized as the "owner" of all lands in the community, as so he must agree upon the location of the new buildings. The consent for construction activities in the Interior will be obtained by the MOECD from the local chiefs in writing.

The process of governance decentralization in the country recognizes the importance of local governments and the participation of the community. As so, local governments have obtained more authority over their territory along the last years. It is possible that in the future an environmental division is attached to every District Commission.

3.7. Public Consultation Strategy

When infrastructure projects of the MOECD are executed, the Ministry through the Head of the Bureau Education in the Interior requests a meeting with the local government of the villages. This meeting, called a *krutu* is the forum where the MOECD staff (e.g. Head Bureau Education in the Interior (MOECD), the Permanent Secretary of the Ministry, and the Head of the Technical Department[3]) explains to the local government and villagers what plans the MOECD has and how they want to proceed. When it regards the construction of new schools and

[3] The Head of the Technical Department acts as the MOECD representative of the denominational boards. The history of school establishment in the Interior of Suriname was led by denominations namely Moravian and Roman Catholic since the Government was in those times not able to do so. Over the years the Government has taken the responsibility to set up schools.

teacher housing in the Interior, the local government assigns a location where the building can take place. This assignment is the guarantee that no problem will occur when the actual construction takes place. This is also communicated to the villagers so everyone is informed about the plans. When it concerns renovation and expansion of schools and teacher housing, the current location of the school and other facilities is taken into consideration and the consent is provided by the local government that the renovation and/or expansion can take place. Also all villagers are informed.

The discussions with the local government is of utmost importance because according to custom, they decide where construction can take place and what must be take into account when the actual construction takes place. During the *krutu* it is also decided how the local participation will be e.g. manpower from the village; if materials such as bricks, sand, wood, gravel are available in the village and the use of these and other possibilities. Decisions are also taken on the transportation of workers and materials where the locals are called upon for use of e.g. their boats. Price arrangements are also made as part of the *krutu* process. When the site visits with the contractors take place, these contractors are also informed about the practices in the areas e.g. that materials must be stored safely; hygiene is a priority. It is also decided upon how the waste disposal will take place and that the area is maintained in a proper manner. The contractors have the obligation to dispose of waste; the common practice is that all waste is brought back to the city for disposal.

It must be emphasized that on the information day the contractors usually get instruction on matters regarding the environment by the bidding committee. These instructions are part of the bidding document and are found in the information day report. Some of the instruction are: bottles and aluminum cans must be collected in garbage bags and taken to the city; at the end of the construction the school yard must be free of building materials and brought back in the original state; during the execution of the works no obstacles must be on the school yard or elsewhere which can cause accidents to the pupils or others.

When the works have been completed, a *krutu* is held again with local government and villagers for the delivery of the school to the community.

4. AREA OF INFLUENCE

Suriname is located on the northern coast of South America, and is bordered in the north by the Atlantic Ocean, in the south by Brazil, in the east by French Guyana and in the west by Guyana.

The Republic of Suriname has a total area of approximately 164,000 km^2. Geographically the country can be subdivided into two main regions: coastal (urban and rural) and interior (rural). The interior comprises 80% of the country land and consists of tropical rainforest and sparsely inhabited savannah along the border with Brazil.

Over 88% of the population (approximately 455,000 people[4]) lives in the urban and peri-urban areas situated along the northern, coastal lowlands. Paramaribo, the capital, is home of almost half of the country's population. The remaining 12% (ap. 62,000 people) live in the forested Interior region, which is the ancestral home and traditional territory of several Indigenous peoples and Maroon communities (tribal peoples of African descent). The Maroons, in particular, live in small villages along the major rivers.

The legacies of colonial occupation, slavery, and immigration have made Suriname one of the most multicultural societies, with notable ethnic, linguistic, and religious diversity. It comprises more than eight ethnic groups (Hindustani, Creole, Maroon, Javanese, Chinese, Amerindian, Mixed, and White/Boer) speaking more than 15 languages. Dutch is the only official language; Sranan Tongo, an English based Creole language, is the *lingua franca*. Most of the population (41%) is Christian, followed by Hindu (20%), Moslem (13%), and traditional (6%).

Suriname is ranked 94 out of 182 countries in the UNDP Human Development Index (HDI) 2010, with a GNI per capita of $7,093, placing it in the "Medium Human Development" country category band. Qualitative studies show that the most vulnerable populations live in the interior and in high-risk urban neighborhoods, with women headed households being particularly vulnerable.

Although the country has achieved several improvements related to the MDG, the Government acknowledges that still face a number of challenges, especially in the interior, including: school enrolment in the interior; application of modern technology in the education and health sector; the creation of sustainable employment opportunities for youth between 15 and 24 years of age; better access of pregnant women to health care, birth control and essential medicine; and ensuring that the community, including the interior, has a sustainable living environment.

[4] The Seventh Population and Housing Census, of 2004, is the most recent census available, and had estimated a total of 493,000 inhabitants; in 2012, the General Bureau for Statistics of Suriname started the Eight Population and Housing Census, but results are still not available.

4.1. Environmental Baseline

About 80% of the land area (148.00 sq. km) is covered by tropical rainforest, part of the highly biodiverse Guiana Shield. The rich biodiversity includes at least 50 rare and endemic plant species and several endangered species of wildlife. The forest systems in the higher mountains are extremely vulnerable to the impacts of extractive activities, such as logging and gold mining. The Central Suriname Nature Reserve comprises 1.6 million ha of pristine forest; a large share of the coastline is protected and provides nesting habitat for various bird species and nesting beach for marine turtles.

Suriname is particularly rich in subsoil resources, with minerals being the country's primary source of foreign exchange. The bauxite industry alone accounts for more than 15% of GDP and 70% of export earnings. Gold mining became important for the country economy since the opening of a large-scale company in 2004; and small-scale gold mining provides an income to several thousands of Brazilians and Maroons. Typically performed informally and illegally, small-scale mining supports a large share of poor households and substantially maintains the economy in part of the interior. Additional local industries include lumbering and plywood manufacturing.

Illegal small-scale gold mining and timber logging have led to considerable land degradation and high mercury pollution of several rivers.

Agriculture, which accounts for 13% of GDP, is primarily practiced at the coastal plains area and the river valleys. The main cash crop is paddy rice; other commercial crops include bananas, palm kernels (for oil), coconuts, plantains, peanuts, and citrus fruits. In addition small-scale producers farm a variety of vegetables and fruits for the local market. Shrimp fishing and shrimp farming are expanding along the coast. Thus, Suriname's economic development and social well-being are almost exclusively dependent on the extraction or exploitation of natural resources.

The dense rainforest that covers most of the country makes transport and road infrastructure very limited and costly, access between the urban centers and the interior expensive and time consuming. Reaching much of the interior has to be done by plane or by river, and where roads exist, they can be in basic or very poor condition made worse during the two annual wet seasons.

Flooding occurs annually disrupting the lives of many. Families are displaced, homes, schools, and health centers may be damaged or destroyed, the season's crops may be lost, and roads may be temporarily impassable or damaged requiring rehabilitation in the short and longer term.

4.2. Administrative Structure

The country is divided into 10 districts: Paramaribo, Wanica, Nickerie, Coronie, Saramacca, Commewijne, Marowijne, Para, Brokopondo and Sipaliwini. These districts are further divided into 62 sub-districts or "Resorts Councils" (*ressorten*).

Urban areas include Paramaribo, Wanica, Nickerie (Nw. Nickerie), Commewijne (Meerzorg and Tamanredjo). Rural Interior areas include Brokopondo and Sipaliwini districts while Rural Coastal areas include the remainder of Nickerie, the remainder of Commewijne, Coronie, Saramacca, Para, and Marowijne.

District		Capital	area		population		density
			area (km^2)	%	2004	%	
1	Brokopondo	Brokopondo	7364	4%	13299	3%	1,8
2	Commewijne	Nieuw-Amsterdam	2353	1%	24657	5%	10,5
3	Coronie	Totness	3902	2%	2809	1%	0,7
4	Marowijne	Albina	4627	3%	16641	3%	3,6
5	Nickerie	Nieuw-Nickerie	5353	3%	36611	8%	6,8
10	Para	Onverwacht	5393	3%	18958	4%	3,5
7	Paramaribo	Paramaribo	183	0%	243640	50%	1331,4
8	Saramaca		3636	2%	16135	3%	4,4
9	Sipaliwini		130567	80%	28202	6%	0,2
10	Wanica	Lelydorp	442	0%	86072	18%	194,7
TOTAL			163820	100%	487024	100%	3,0

Census 2004

Central Authority in the districts is with the District Commissioner who is the representative of the central government. Normally the representatives of the various departments function under the District Commissioner, except Foreign Affairs and Defense. Sanitation, waste collection, and cleaning services outside Paramaribo are managed by the District Administrations.

In the interior, traditional authorities are acknowledged by the Government. This traditional and complementary structure operates consisting of a *granman* (tribal chief) and a number of *kapitein* (similar to deputy chiefs) reporting to a *granman*. The *granmans* and *kapiteins* are generally respected. Key decisions and actions in the interior generally require to be processed through both the formal and traditional governance structures.

4.3. Population

The total population of Suriname was 492,829 in 2004, of which 59% lived in urban areas, 30% in rural areas and 11% in the interior. The population density of 3.0 is among the lowest in South America. The population density in the coastal area is 17.2, while in the highlands it is approximately 2.9 inh/km^2.

Women represent 49.7% of the total population. In the year 2004, 129,866 women were 15 to 49 years old, that is, around 53% of the total number of women.

Accordingly to the 2008 estimates, one third of the population was under the age of 18, and one fifth of whom were under the age of 8.

In 2000, the overall literacy rate of the population aged 15 years and over, was estimated at 86% (males 90% and females 82%), with a significant difference in the literacy rate between the

urban population (93%), rural population (87%) and interior (51%). In 2004, a literacy rate of the population aged 15 years and over was estimated at 75.3% (males 77% and females 74%).

4.4. Life quality in the Interior

National averages mask sometimes severe disparities between the urban and rural areas in the country. Disparities between the coast and the interior are partially caused by the challenge of reaching villages in the interior. Such disparities are exacerbated by lack of roads, difficulty to navigate through rivers and rapids, and annual or exceptional flooding.

The interior basically comprises the districts of Sipaliwini, Brokopondo and Marowijne with a total population of 64,991 people, in 2004; 40% of this population was under the age of 15, 50% between 15 and 64, and 10% over the age of 65. Sipaliwini had the larger rate of female as head of household (53%).

In Suriname, the majority of children of primary school age are attending school (95%), except in Sipaliwini where school attendance among children of primary school age is estimated to be 88%. In urban areas, 96% of the children of primary school age are attending primary or secondary school as opposed to 93% in rural areas. While the proportion observed in rural coastal areas (96%) is estimated to be just as high as that observed for urban areas, the proportion observed in the rural interior is noticeably lower being estimated to be 90%.

There are only six junior secondary schools in the interior (1 in Brokopondo, 2 in Moengo, 1 in Apoera, and 2 in Sipaliwini). This means that children from the interior who do not live close by these schools will either have to move to attend secondary school, or will not attend secondary school at all.

The percentage of children in Suriname aged between two and nine with at least one reported disability (physical or mental) is 23.7% with little differentiation between urban (28.6%), rural coastal (17.9%) and rural interior area (11.3%). Though there are specialized schools for these children only in Paramaribo.

Professional teachers and health workers may be less willing to work in the interior due to the poor infrastructure and access to amenities.

Water supply in Marowijne is mainly provided by the Suriname Water Company (96% of households), 61% of these had tapped water inside the house and 32% had tapped water outside within 200m. In both Brokopondo and Sipaliwini, water supply was provided mainly by the Service Water (DWV) of the Ministry of Natural Resources (75% of the households), but most of these had tapped water outside within 200m (73% in Brokopondo and 62% in Sipaliwini).

In Suriname, approximately 69% of household members used drinking water that does not rely on any water treatment method. This is the case for water used for drinking purposes in every region of Suriname except Commewijne where a marginally greater proportion of household members use drinking water that is boiled (45%) as opposed to the 44% who use drinking water that does not rely on any water treatment method. In Suriname, especially in urban

areas, there is no custom to boil water before drinking it because piped water is considered safe.

In the rural interior, approximately 85% of household members live in households that apply no treatment to their drinking water supply with similarly high proportions in Brokopondo (84%) and Sipaliwini (85%). Given the relatively large number of household members relying on drinking water from unimproved sources in Sipaliwini (63%), the relatively low proportion using an appropriate water treatment method is alarming.

The use of improved sanitation facilities is strongly correlated with wealth and is profoundly different between urban and rural areas. In rural areas and especially in the rural interior, Sipaliwini in particular, the population is much more likely to be using pit latrines without slabs, or simply have no facilities. Almost one third of the household members in the interior (30%) had no sanitation facilities; in Sipaliwini 39% had no facilities at all and in Brokopondo 34%. In Marowijne 48% had pit latrines without slabs and 40% had flush toilets connected to a septic tank.

More than one third of the household members (35%) had no electricity in the interior, especially in Sipaliwini where almost one half (49%) had no electricity. In Brokopondo and Marowijne electricity was mainly provided by the Energy Company of Suriname (EBS), 34% and 53% respectively.

Three mobile phone providers now cover 99% of the country and broadband internet is improving steadily although it only reaches 13% of the population.[5] In the interior, TV and internet are only available to a limited extent, mainly due to lack of electricity and poverty. In Sipaliwini 85% of household members had no access to telecommunication facilities and only 1% had mobile phones. In Brokopondo 70% had no access to telecommunication facilities and 12% had mobile phones; while in Marowijne 49% had no access to telecommunication facilities and 34% had mobile phones.

4.5. Diagnostic of Schools in the Interior

The Ministry of Education and Community Development (MOECD) is responsible for overall primary, secondary and tertiary schools in the country. There are 325 primary schools, public and private, in Suriname, 92 of which of located in the interior (28%). There are also 6 junior secondary schools in the interior. The primary schools in the interior include 36 public schools and 56 denominational schools[6], run by religious organizations, mainly Roman Catholic (RKBO) or Moravian (EBGS).

Schools in the interior are generally in poor condition. Many lack toilet facilities, running water, or electricity. In the country, since BEIP several rehabilitations had been implemented along the last years in order to improve the quality of schools. The main funding sources, besides BEIP, were state funds and sector funds. Annex 3 presents a list of rehabilitations implemented since 2005 in both public and private schools in Suriname.

[5] Government of Suriname; MDG Progress Report 2009; November 2009.
[6] These schools operate with government subsidies.

Considering the renovations performed through several funds, the MOECD selected a list of 37 schools[7] in the interior to be renovated in the interior, 11 public schools and the others denominational. The renovation plan considers three phases, from 2012 to 2015, and an additional phase if funds from the 2nd BEIP will be still available. A list of the schools selected to be renovated and services proposed is presented in Annex 1.

The services proposed for these renovations include: the renovation or construction of new classrooms, and other facilities such as media centers, toilets, offices, storage rooms; as well as the restoration of floors, ceilings, roofs, rain water collection systems, electrical installations, painting, etc. Also the restoration or construction of new teachers housing are proposed for these schools.

Apparently the construction, refurbishing and expansion of schools have not been fully planed, and actions are taken under demand from the school principal, but not on a long term planning system. As result many schools were improved by more than one funding program, as works were not sufficient to provide the necessary infrastructure to enforce educational policies.

According to data provided by BEIP[8], schools conditions in Suriname were classified by the following code:

A1: In good to very good condition, new build or recently renovated (< 5yrs); no deficiencies.

A2: In reasonably good condition; needs to be (re-)painted and in need of small repairs.

A3: In moderately to not desirable condition; needs to be renovated.

A4: In bad condition; needs major renovation and rehabilitation urgently; possible risk for health of users.

A5: Unacceptable condition; scale of rehabilitation needs may equal the costs of completely new building; unsafe conditions for users or risk of collapse of (parts of) the building

A complete list of the primary schools with its classification was not provided by the Building Commission/PMU, so it was not possible to evaluate the priority established for the works to be performed on the selected schools.

The list presented in Annex 3 demonstrates the lack of planning of the rehabilitations and expansions. There are schools that received several new classrooms in one year and again more classrooms less than three years later. It is evident that there is not a plan for future expansions required, both on number of classrooms and facilities, nor on teacher's housings. A general construction and expansion plan should be elaborated, based on the actual number of students, classrooms, and teachers, and an estimate of the children population for the next 10 years. This would allow the MOECD to plan the works to be done in the future, along with the regular maintenance on the existing infrastructure.

Renovation is organized and supervised by the Technical Department of MOECD, based on requests from the schools principals and TD supervision. The TD performs a site visit to establish the services that shall be implemented and priorities, based on the requests of the

[7] The selected schools were not renovated since 2005, according to the list presented Annex 3.
[8] IDB. BEIP – Project Completion Report, 2012.

principals and the site technical supervision. Once established the scope of work, the TD details the designs and specifications to initiate the bidding process. This means that schools are renovated without a larger maintenance and rehabilitation plan for the whole country.

During the bidding process stakeholders are supposed to be involved in order to guarantee an understanding about services that shall be implemented and priorities. According to the evaluation of BEIP presented in the PCR, schools principals complain that their requests are not fully accomplished, which demonstrates that even though there were several opportunities to hear about the project, understand the scope and provide feedback to the TD, the principals still lack of a clear agreement of what the scope of the renovation or rehabilitation project would be.

On the other hand, TD complains about the commitment, or lack of, school's principals have with maintenance of the renovated assets. It is necessary to establish a list of principal's responsibilities towards the schools maintenance and surveillance. This commitment would be higher if principals participated more intensely in the decision process to define the scope of work, developing a more solid ownership sentiment over the infrastructure.

Additionally, the schools principals, teachers and workers have no instructions or training on in carrying out basic maintenance. There are no guidelines or a management plan to indicate what has to be done to keep the assets on a good condition. Also there is no environmental guidance, for example, on how to operate the water and wastewater systems, how to deal with garbage, and how to maintain the drainage systems.

A sample of 6 schools listed among the selected ones to be renovated on 2nd BEIP was visited. The actual conditions of these are described below, and photos are presented in Annex 2.

OS Bigi Poika

The Bigi Poika public school is located in a rural community in Para district 3 hours from Paramaribo by car. The school is located along the main road to the community in a flat open space with no fences. There is one health infrastructure nearby the school.

The school has 7 classrooms, 2 toilets (only one functional) divided in male and female, with hand washing, urinals, and water closets. There are no other facilities. There is one playground with few equipments, but no sports fields. The head master required more equipment for the playground. The central area of the school has no grass, just dirt, which during the rainy season might be a problem.

The school is a one floor building, mainly wood and two brick rooms, the roof is aluminum foil, with ceiling inside the rooms. The large windows are open protected only by fencing offering good ventilation.

There is one 2-bedrooms teacher house for the principal, and two units for teachers. There are also two other 2-unit houses for teachers closed as they are said to be haunted.

Water supply is rain water collected into water tanks, with no filtration, and no further treatment. As there is no energy available, water does not flow into the toilets, unless when the community generator is working (from 6 to 12 p.m.) when classes are not going on. This causes a very unsanitary condition in the toilets during the school hours. There is a septic tank

behind the toilet. Garbage is disposed in the school backyard and burnt. There is no proper space for disposal or storage until it is burnt, and no protection from children to walk around.

The backyard of the school is not kept in very good conditions, with some garbage and rubbish.

The school has a fixed pay phone and internet access.

There are 53 students and no disabled children. All students reach the school walking. There are 7 teachers (including head master), 1 cleaner, 1 security and 1 helper.

St. Thomas Moore (Washabo)

The Saint Thomas Moore School is a catholic denomination. The school is located along the main road to the community, in a wide open space, with no fences protecting from the road traffic or ditches, which my jeopardize children safety. The school lies almost 8 hours from Paramaribo by car.

There are a soccer field and a smaller sports field, both with grass, and an equipped playground. The teachers think it would be good to have more sand boxes and slides for the children. The front area between the school and the road has no grass.

The primary school has 8 classrooms, one recreational room, a reunion room, and a small library. School building has half brick and half wooden walls; and windows are fenced providing good ventilation. Rooms have ceiling, and floors are cement. Building is only one floor.

There are one 4-units teacher house (two 2-bedrooms, and two 1-bedroom) and two 2-units houses with 3 bedrooms each. Buildings are made of bricks and have aluminum roofs. Teacher housing is on the other side of the road, one close to the church and others along the road. There is also one health equipment nearby the church.

Water supply is provided by public system from Apoera. There are septic tanks for the school toilets and teachers housings. Electricity is also provided 24hs by public system (EBS) from Apoera. Garbage from school and houses is burnt in the backyards. Teachers have mobile phones but there is no fixed phone in the school and very poor internet access.

There are 183 students and no physically disabled children in the school. They all come to school walking or by bicycle.

There are 7 teachers (including the head master), 4 cleaners, and 1 gardener working in the school.

OS Apoera

OS Apoera is a primary and secondary public school, located in different sites. The secondary school is located along the main road access to the village, while the primary school is more integrated to the urban area. The primary school is located on a paved road and the area is totally fenced.

The school has grown within the site which now has little room for further expansions. There is a playground in the school site, but the sports field is a public field outside the school fenced area.

There are 12 classrooms and one media centre. The school is a one floor building, made of bricks, with glass windows and fences. Ventilation doesn't seem so efficient due to the glass-windows that reduce the open area. Floors are cement, roof is aluminum with ceiling.

The teachers' houses are located along the road in between both schools. There are 2 houses for head masters and 15 2-unit houses (for teachers of primary and secondary schools).

Water supply is provided by public system; schools and houses have septic tanks. Electricity is provided 24hs by EBS; and there is mobile phones and internet access.

There are 240 children in the school and no physically disabled. Children come to school walking or by bicycle.

Sint Gerardus (Albina)

The Sint Gerardus school at Albina is a catholic denomination. The school is located in the urban area of Albina, in a low flat land, subject to periodical flooding. Due to the improvements been implemented on the Meerzorg-Albina road, Albina will be at most 2 hours from Paramaribo.

Classes are arranged into a square with an open space in the centre defining the site, but there is no fence. The front "side" of the square is a two story building while the others are only one floor. There are a total of 13 classrooms, including 3 on the upper floor. As the school is located in a more dense urban area and the classrooms are arranged into a small square, ventilating conditions are poor.

There is no playground, and the open space in the centre of the school has almost no grass left. There is a small recreational covered area. Children use a public sports field nearby, outside of the school area.

There are 6 teachers housing units and one head master house all located across the street also in an area that is subject to flood. Part of the area dedicated to the housing units is occupied by a commercial storage activity, not compatible with residential activity. The housing area is also not fenced.

Buildings are made of brick, cement floors, ceilings and aluminum roof, but are in very poor conditions, especially the teacher housing units. The backyard of both the houses and school are full of rubbish and unsafe conditions, considering that there are children walking and playing around the area.

There is a public water supply but water is not potable. The rain water tanks in the teacher housing are not functioning any longer and teachers have to buy drinking water. There are septic tanks but probably are working in very poor condition as the level of the water table is significantly high in the area. There is a drainage ditch at one side of the school totally open and not safe for children to walk or play around. Water in the ditch is also much polluted.

The flooding of the site indicates a very poor sanitary condition, forcing school to be closed during heavy raining season.

Garbage is collected by a public system. Electricity is provided by EBS. There is one fixed telephone and internet access.

There are 17 teachers and 8 cleaning/maintenance people working in the school. There are 315 students and no physically disabled children.

Daketie (Peto-ondro)

This school is a catholic denomination, located in a small rural community, along the main access road. The school is located in a flat open space with no fence. There is a church on the side of the school. There is an open field next to the school but no playground.

There are 4 classrooms, toilets, office room, and storage space. Building is made of brick, with cement floor, aluminum roof, and ceiling in the classrooms and in the outside corridor. Windows are fenced providing good ventilation, but fences were partially destroyed.

Water supply is from rain water collected into a large tank, with no filtration or further treatment. There is a septic tank behind the toilet block. Garbage is burnt in the backyard of the school with no special space assigned for storing and burning. Electricity is provided by public system.

All around the school and the central area are covered by grass, in good conservation conditions. The space looked clean and well maintained.

OS Ricanaumofo

The Ricanaumofo is a public school located in the Ricanaumofo village. The school is located along the access road in a open space with no fences. The area around the school has grass and the general appearance is that it is well maintained.

There are 6 classrooms, 2 toilets, office, and storage space. Building is made of bricks and wooden walls, cement floor, aluminum roof, ceiling, fenced windows.

Water supply is provided by rain water that is collected into water tanks with no filtration or any further treatment. There are septic tanks for the school and teacher housing. Electricity is provided by a generator for the village.

Moengo

Two schools were seen in Moengo: St. Theresia and Fred Murray, both private schools (the first catholic and the second Moravian). As the scope of work for these schools were not yet defined, no detailed site visit was performed.

The future CENASU site

The future CENASU site is located in the backyard of the MOECD. It consists of a large flat land with no former use. There is no indication that the area has any type of contamination or is

subject to periodical flooding. Some garbage has been burnt in the site but in a very small and limited area.

The scope of the actual building is still not defined. The construction shall meet all the building regulations that apply for Paramaribo area. As it is part of the same site where the MOECD is located, safety conditions shall be especially taken into consideration in order to avoid the risk of accidents.

5. POTENTIAL SOCIAL AND ENVIRONMENTAL IMPACTS

The potential social and environmental impacts associated to the infrastructure component of the 2nd BEIP can be considered minor impacts, as the construction activities are limited to small areas, already altered by human occupation. There are two groups of construction activities: (i) rehabilitation or expansion of existing primary schools and teachers housings in the interior; and (ii) construction of the CENASU and rehabilitation of the departments of the MOECD, in Paramaribo.

During operation phase, impacts are due to human occupation of the said facilities, mainly associated to the use of infrastructure, such as, water supply, wastewater treatment, solid waste management, use of energy provided by generator, etc.

Infrastructure in the Interior

In general the ecological impacts associated with the infrastructure improvements are not substantial, but cumulatively can be considered to be of significance. The potential impacts of infrastructure construction in the interior are mainly related to nuisances to the neighborhood, as described as follows:

- *Dust and noise disturbance.* As construction takes place, dust and noise might be generated from the activities and the gathering of many workers on the site. During dry season dust can be a more important concern than during the raining season. Considering the works will take place during the school year, these disturbances might affect negatively the educational activities, as well as dwelling.

- *Soil erosion and drainage.* Work in some schools will result in the removal of the existing surface soil and upper levels of the underlying subsoil to provide suitable material for foundations. If not controlled, sediment may be washed from the exposed site and into nearby areas and water bodies resulting in the degradation of the sites and local environment. This adverse effect must be prevented through erosion control protection associated with construction, and revegetation of the exposed flat areas. Borrow pits, if necessary, may also affect soil erosion conditions. Construction activities can alter on-site drainage, resulting on puddling or soil erosion processes, as may also improve existing flooding conditions.

- *Alteration of site safety conditions.* As in some schools the available area is very limited, for both construction camp and construction activities, pedestrian circulation around the school might be affected, including areas used by the students for recreational activities. As result safety conditions for the students in the school area and around construction activities can be severely affected.

- *Disturbance of educational and dwelling activities.* During construction activities, due to the fact that school terms are ongoing, some disturbance can be caused to teaching activities by noise, dust emissions, and safety aspects. Also, as teachers are dwelling in the existing

housing units, and schools are located nearby communities, disturbance can also be caused to the local community due to improper attitudes of workers. These conflicts can become more significant when different cultural aspects are involved.

- *Use of water resources.* As in most locations in the interior water supply is provided by rain water collected into water tanks, during dry season some shortage or even lack of drinking water can be experienced within the existing schools or dwellings, due to excessive consumption by workers and construction activities. Also excessive dust can compromise the quality of water captured from roofs into the water tanks, washing dust into the tanks. During operation, water supply can be insufficient during dry season, resulting in the lack of safe drinking water and unsanitary conditions in the toilet blocks.

- *Wastewater.* As many workers will be on site during construction activities, there will be an additional production of wastewater that might not be absorbed by the existing septic tanks, either clogging of the plumbing system or overflowing the septic tanks. Wastewater can also be not properly disposed on to the ground or into rivers close to the residential areas, polluting the environment. During operation, clogging of plumbing system can also occur due to inadequate operation of toilet facilities or even vandalism.

- *Waste dumping.* Waste materials from construction activities might be generated and not correctly disposed of creating inappropriate sanitary conditions around the schools and residential areas. Additional rubbish produced by disposal of food and other domestic waste can be dumped into the environment providing conditions to grow harmful animals or insects that can transmit different diseases. During operation, inappropriate waste disposal can also occur degrading the environment and health safety conditions.

- *Energy supply.* In the case that energy is supplied by a local generator, impacts will be related to air pollution due to emissions caused by oil burning. Also risks are associated to oil (fuel) storage, either due to leaks from the storage tanks or due to the possibility of fire or explosion. During construction, the extra need of energy supply will intensify these risks.

- *Deterioration of vegetation.* The expansion of existing schools and teachers housing may impact negatively some existing vegetation around these structures. Also, a number of workers on the site as well as the construction supply activities, such as brick production, borrow pits, collection of wood, or site camps can also invade still remaining vegetation. No mangroves areas are expected to be affected, as these are not proper areas for settlements or infrastructure.

- *Archaeological sites*. No archaeological sites are expected to be affected by the works as the sites are all located within areas already altered by human occupation, with some level of urbanization. Anyway, in the case of such findings the artifacts, their finder, and the coordinates shall be reported to the Director of the Suriname Museum at the Fort Zeelandia Office and recorded in the national archaeological register.

6. IMPACT MITIGATION AND PREVENTION MEASURES

Impact mitigation and prevention shall be provided since the very early phases of project implementation, including the planning and proper design and specification of the construction activities. Thus, more detailed specifications must be developed and provided to contractors so that impacts can be better prevented or controlled.

During construction, best engineering practices must apply. To ensure best practices and environmental awareness are in fact implemented in all sites it is necessary to include in the bidding papers and in the construction contracts that these practices are required, indicating the mitigation and prevention measures presented in this ESMP.

During operation phase, preventive maintenance should be the priority for the MOECD, especially in the interior, so that corrective measures are kept to a minimum.

The steps for the Infrastructure Component implementation are as follows:

1. Request submitted to the Building Commission;
2. Site visit for evaluation of present conditions and the assessment of services required, in order to establish technical specifications;
3. Office work including draft and final architectural design drawing by technical staff of the Building Commission;
4. Description of the technical specification and works and draft tendering documents;
5. Bidding process including site visits with all pre-qualified contractors, and meetings with local community to evaluate and agree on local conditions to provide labor, materials and services;
6. Decision and assignment of works, and signing of contracts;
7. Execution of Works by specialized contractors and supervision by the technical staff of the Building Commission;
8. Final inspections and delivery of infrastructures.

6.1. Architecture Designs and Specifications

Some of the specifications herein are already taken into consideration by MOECD and some additional ones are proposed.

Site location

As most of the constructions proposed on the 2nd BEIP are rehabilitation or renovation of existing schools site selection is limited to the actual area of the existing school.[9] If a new site is to be considered, flat terrain should be preferred, reducing potential stability or erosion problems. No low lands, mangroves or contaminated soils shall be used for schools or teachers housings construction. Flooding areas must be avoided at all means.

The following aspects shall also be considered:

- location characteristics (clean area, vegetation, previous use);
- regulations affecting the area (restrictions for buildings, use of land, etc.);
- accessibility and distance from inhabited areas (considering that children must get easily to school and preferably protected from intense traffic roads);
- site vulnerability to hazards (ex. flooding, landslides);
- site contamination, due to previous uses (such as garbage dumping areas, industrial sites, etc.), and to the proximity to areas that might contribute with pollutant emissions or effluents, such as effects of mercury and mining on water systems in the interior.

General

- Buildings must be set free from other builds, keeping a distance of at least 5 meters in other to provide proper ventilation and natural light.
- Buildings shall be modulated designed to facilitate future expansions and material requirements.
- Designs should consider the usage of raw materials available in the interior areas where schools and housing units will be built, reducing transportation costs of industrialized materials. Local construction methods shall be considered and adapted to the required uses, as well as local knowledge on how to manage these materials.
- School classes and playgrounds must be set away from roads, keeping a minimum distance of 5 meters, in order to provide safety conditions for children.
- School areas and teachers housing must be fenced if located on a busy or paved road, or if located in a crowded community.
- Schools must have at least one classroom per grade, including kindergarten, and administrative office, one storage room, toilets for students and for teachers, and recreational areas. A flag pole must be placed in the centre of the school plot.
- Schools must be dimensioned based on the natural growth expected for the next 10 years, although it can be built in phases, accordingly to actual demand of space. The

[9] Except in cases such as the Sint Gerardus School in Albina, located in an area that usually floods, that should be moved to another area.

occupation of the plot must be planned for future expansions so that in the future the area will not be too crowded.

- Schools must be prepared for students physically disabled and special accessibility should be ensured. Ramps shall be provided onto outside corridors, and large doors on the classrooms (for wheel chairs). Toilets should also consider the access for disabled people. This can be a special toilet, shared with the teachers for example.

- Teachers housing units shall be provided with one, two or three bedrooms, accordingly to local needs. Each housing unit will have at least one bathroom, one kitchen, one living room and one bedroom. Housing can be combined into 2-units or 4-units buildings, with one or two floors.

Classrooms and other rooms (includes schools and teachers housing units)

- Rooms shall be modulated and standardized as much as possible.

- Classrooms must be 7 x 7meters (49 square meters), provided a minimum of 1.5 square meter per student.

- Laboratories and crafts rooms must provide a minimum of 4 square meters per student.

- Administrative office and storage areas of schools must be at least 3.5 x 7 meters (24.5 square meters).

- Other rooms where people work, sleep or study cannot be less than 5 square meters, provided that a minimum 2-meters diameter circle can fit on the floor of such rooms. Storage rooms can be smaller, as long as no one will remain in such spaces.

- Floor level of all buildings must be at least 20 centimeters above adjacent ground level.

- Ceiling height in all rooms shall be at minimum 3 meters; distance between ceiling and roof shingles must be at minimum 0.4 meters in the lower part, as to provide proper ventilation underneath the shingles. The space between the shingles and the ceiling must be free and open so that ventilation can pass through (screens or grilles can be used to avoid the entrance of animals). Shingles shall be light colored so that it reflects heat as much as possible.

- Walls and ceilings of classrooms must be painted in light colors. A blackboard must be hang onto one of the walls, and must be the size of a half sheet of plywood with chalk tray.

- Rooms must have at least flat cemented floors. Tiles or other materials can also be used.

- Openings, such as windows and doors, must facilitate ventilation and natural light for all rooms. Ventilation and natural light must be provided by openings with a minimum area of 15% of the room floor area, preferably on two opposite walls of each room.

- In classrooms windowsill shall be a least 1 meter from in-doors floor level, and at least 1 meter high. Windows can be provided with screen, hollow blocks or class, as long as the minimum ventilation area is guaranteed. This means the area occupied by these materials (screen, glass, hollow blocks, etc.) must be considered as blocking the ventilation and natural light.

- Doors can also be screened or glazed to enhance ventilation and natural light into the classrooms.

- Proper accessibility for physically disabled children shall be provided.

Outdoors spaces

- Corridors will be provided along one side of the classrooms, and the width shall be at least 2 meters. Corridors must be covered with shingles and a ceiling in order to provide a more comfortable resting area for children. The ceiling must also maintain a minimum 0.4 meters distance from the roof shingles, and the minimum ceiling height at the corridors shall be 2.5 meters.

- Kindergarten and primary schools must be on ground level only. Junior secondary schools can be 2-floors buildings. If primary and secondary schools are combined in one space, only secondary classes can be located on the upper floor.

- Recreational areas shall be provided as follows: 1 square meter per student as covered recreational areas; and 2 square meters per student as open air area. Open air area must comprise playground, and sports fields. Playground shall be provided with a sand box and some equipment as a climbing rack, a seesaw, a slide and a carousel.

Sanitary facilities

- All buildings will have sanitary facilities, connected to water supply and wastewater systems.

- In the teachers housing units, there will be at least one sanitary facility, with one sink, one latrine and one shower.

- For schools, toilets shall be installed in toilet blocks, with a minimum area of 3.5 x 7 meters. There will be at least one latrine and one sink for every 40 students. Toilets will be divided in male and female rooms.

- An additional hand wash facility shall be provided outside the toilets, near recreational areas.

- Male toilets will have urinals in combination with water closets, and females will have water closets. Male toilets will have at least one water closet and two urinals, while female toilets will have three water closets. Both will have at least three sinks or equivalent hand washing facility. Additional hand washing facility or sinks shall be provided outside the toilet block to facilitate hygiene of the children.

- Teachers and staff will have their own toilets, divided in female and male.

- Toilet rooms and bathrooms must have tiled floors and walls up to ceiling height.
- Kitchens must have one sink and a tiled wall where the sink is placed. Kitchens must also have tiled floors. A washing sink for clothes and other activities must be provided separated from cooking area.

Infrastructure

Water supply[10]: all buildings must have safe water supply. In the interior usually safe water is provided by rain water and stored in water tanks installed under roof spouts. As rain water washes all debris, dust and eventually, pollutants that lay on the roofs, at least a filter system should be installed in the water tanks, avoiding some residues to be stored in the tanks. Additional treatment (such as boiling water for drinking) should be enforced among teachers and head masters, providing better water quality for children.

Water tanks must be properly dimensioned to assure water supply to all students and teachers during all dry season. For schools, a minimum of 10 liters per day per student should be considered to dimension water tanks, during the whole dry season. For housing units, a minimum of 50 liters/person/per day should be considered. It is imperative that water supply and storage guarantee minimum health and sanitary conditions for students, staff, teachers and their families living in the area. Additional water supply must be considered during construction phase when there will be more people using the existing facilities.

Alternative water sources should also be explored either as emergency backup or complementary systems. Thus, nearby rivers and water courses should be considered, as long as water quality has been tested. Water pumps can be installed to provide additional water to the system. If water quality does not comply with safe water criteria, this water can be used for flushing the toilets, enhancing sanitary conditions in the toilets, especially during dry season, and reserving safe water for drinking and hand washing. To avoid dependence on energy to pump the water from the river, water wheels can be used. If no nearby river is available, wells should be considered, and water tested.

As most of the systems are based on rain water stored in water tanks installed on the ground level, sanitary flush depends on energy availability, especially during school hours, when children are at school. If energy is supplied by a community system that works only at night, a suspended water tank should be installed, so that during the hours energy is supplied water would be pumped into this reservoir and during the day, during school hours, water can be flushed into latrines by gravity. This upper reservoir can be installed on a higher part of the terrain or over a structure so that its lower part would be above the ceiling level of the toilets. It can also be supported by the walls of the toilet block.

Wastewater systems: all schools and housing units will have a septic tank to receive the wastewater from toilets, kitchens and washing areas. Septic tanks can be combined to receive wastewater from more than one housing units, if necessary. Septic tanks must be located at a minimum 4 meters distance from the houses or school areas, away from pedestrian circulation and recreational areas. No wastewater shall be disposed directly to any river or other water body.

[10] Additional details on water supply quality are included in Annex 5.

Electricity supply: energy can be provided by public electricity systems, community systems or individual generators. If electricity is available, additional artificial light shall be provided in classrooms, administrative office, and other rooms. In classrooms, a minimum of four fluorescent tubes of 40 watts each shall be provided.

If electricity is supplied by an individual generator, dedicated only for school and housing facilities, special car shall be given to oil (fuel) storage. Both storage and generator shall be installed in a separate area, away from classrooms, playground, and residences. All fuel and oil storage areas shall be above ground, with roofing and isolated within an impermeable bunded area. The volume of the bund shall not be less than the total stored volume capacity. Drainage from such bunded areas shall incorporate oil separators before discharge to existing watercourses.

Alternative energy supply shall be taken into consideration, especially solar energy systems, at least as a complementary source for more important uses as for maintaining water pumping systems. Also to ensure to proper functioning of the proposed media centers, safe electricity supply must be guaranteed. Although solar energy is still an expensive source, some essential activities (such as water pumping for toilets) should be benefited by these facilities.

Waste management: solid waste from schools and dwellings must be properly managed in order to avoid soil contamination or the proliferation of vectors. Waste must be dumped in a proper selected area, away from houses and schools, and top-soiled. Waste burning should be avoided as some toxic fumes can be expelled, and there is always a risk of spreading the fire, especially during dry season.

Communication: all schools must be provided with telecommunications systems, either fixed or mobile phones, as well as internet service, when available.

6.2. Construction phase

During construction phase, the best engineering practices must be employed, in order to avoid environmental and neighborhood disturbances.

6.2.1. Site Management

Labor and Housing. The contractor shall employ local labor as much as possible, either directly on the construction activities or indirectly by providing materials or services for the civil works, such as cooking meals, cleaning services, etc. This will help improve local income and economy of small communities in the interior and reduce the need of bringing workers from other places and having to provide housing spaces. For the workers that come from outside the community, work camps shall be provided, away from the schools and housing units, with their own sanitary facilities.

Sanitary Facilities. The contractor shall supply proper and efficient sanitary facilities for employees. The contractor shall equip the facilities with water closets of approved pattern and shall maintain them in a proper and sanitary condition. Temporary toilet facilities, if not connected to existing septic tanks, shall be of the sealed tank type. Tanks shall be monitored for level and emptied regularly. On removal of the facility the sites shall be properly disinfected

and the ground restored. Latrines shall not be installed within 30 meters of wells, boreholes and hand pumps, if any. When construction takes place in Paramaribo, temporary toilets facilities sealed tank type is mandatory.

Tidiness of the Site. The contractor shall be responsible for the cleanliness of the site, and footpaths adjacent to, at all times. The contractor shall establish and enforce daily site clean-up procedures, including maintenance of adequate disposal facilities for construction debris. The contractor shall take every possible precaution against contamination of work site or surrounding areas that could cause any harm to children and teachers. When construction takes place in urban areas and along paved roads, the contractor shall keep the adjacent roads clean of dust and mud that can come out of the construction site.

Equipment Maintenance, Fuelling and Storage. The contractor shall ensure that all equipment maintenance, fuelling and storage is performed in such a manner that no fuels, oils, lubricants, chemicals or other toxic materials can gain access to the soil, groundwater and surface water. All temporary fuel and oil storage areas shall be above ground and isolated within an impermeable bunded area. The volume of the bund shall not be less than the total stored volume capacity. Drainage from such bunded areas shall incorporate oil separators before discharge to existing watercourses. All workshop and equipment storage areas shall be drained such that all surface water runoff passes through an oil separator prior to discharge into watercourses or directly to the soil.

Borrow Pits and Stock Piles. The contractor shall be environmentally responsible when making choices relating to the use of construction materials. Materials shall only be purchased from approved and licensed quarries. The contractor shall ensure materials are sourced from non-sensitive areas or from sustainable sources. The contractor shall prioritize the use of materials near the construction site in order to minimize transportation. The contractor shall ensure that the locations of stockpiles, that have the potential to cause the siltation of water bodies, employ containment devices, perimeter ditching to prevent erosion or runoff. Land used for borrow pits and stock piles shall be restored after construction.

Site Restoration. Upon completion of the contract, all elements of the worksites shall be removed and the site be restored. This shall include final cleaning of the area, restoration of soil horizons, drainage, and re-vegetation.

6.2.2. Water and Wastewater

Prevention of Pollution of Groundwater. The contractor shall minimize the risk of pollution to groundwater through the following minimum requirements: all diesel, fuels and other toxic materials shall be securely bunded as mentioned; bunds shall be inspected and cleaned out at regular intervals. Generators shall be supplied with integral bunds; and all containers for chemicals and lubricants used on site shall be stored in trays of steel or other approved material of appropriate volume.

Pollution of Drinking Water and Other Water sources. The contractor shall ensure that hydrocarbons and sediment are prevented from entering water bodies and wetlands. The contractor shall ensure that activities carried out near wetlands and watercourses are controlled and monitored to ensure the risk of water pollution is minimized.

Water supply. Water supply during construction might be shared with existing water supply, as long as it does not overextend the supply for the students and teachers, especially during the dry season. Additional water tanks must be provided in these cases to ensure proper supply for both worker site and school. If complimentary water supply systems are proposed, these must be settled as soon as possible, at the commencement of works. If hand dug wells or hand pumps are proposed, construct concrete pad around well head to minimize breeding ground for vectors of water-borne diseases; construct a drainage channel to conduct waste water away from pump pad.

Wastewater. Wastewater discharges shall be collected and treated in an approved system installed on site. Wastewater to be discharged from construction site must first be filtered or otherwise treated to eliminate obnoxious material likely to cause pollution into natural watercourses or aquifers. No waste water or other liquid or obnoxious material will be dumped on wetlands.

6.2.3. Soil and Silt Runoff

Soil Erosion. The contractor shall ensure the protection of soil surfaces to minimize soil erosion and silt runoff. Re-vegetation or physical stabilization of erodible surfaces must be provided to create a vegetative ground cover; shrubs and trees must be planted to slow or absorb runoff. Provision shall be made to intercept and divert site drainage into natural channels, infiltration ditches, or areas of suitable and stable ground cover. Paths must be constructed so that water drains away, and puddling is avoided to control vectors. The contractor shall ensure that there is no siltation of water bodies through direct drainage to rivers or wetlands.

6.2.4. Waste Management

Waste Management and Disposal. The contractor is responsible for all waste management. Waste management measures include: minimize the production of waste materials; reuse and recycle materials; separate and recycle solid wastes generated by construction activities; ensure all fuel and chemicals are appropriately contained and bunded in safe locations; site storage depots away from watercourses, areas prone to flooding, or wetlands.

All waste spoil and materials shall be disposed into the ground and top-soiled, and shall not be burnt because it would jeopardize health and safety. Surplus or waste materials shall not be deposited in watercourses or open areas. To the extent possible, such surplus material shall be used in the backfilling of temporary quarries or borrow pits if the quality so warrants. Materials resulting from demolition of existing constructions shall be used to the extent possible for foundations or underlayment. Otherwise materials can be piled into small slopes, top-soiled and vegetated.

The Contractor shall provide garbage receptacles (bags or bins) at convenient locations within the worksite.

The Contractor shall take all necessary precautions to prevent discharge or loss of any harmful material or substance into the watercourse, including but not limited to lead-based paints, hydrocarbons, fresh concrete, and preservatives.

The Contractor shall collect in a leak-proof container for recycling or safe disposal all solvents used in the cleaning of painting equipment.

If construction takes place in Paramaribo, the contractor shall store and dispose waste in the existing waste treatment plant in the city.

6.2.5. Dust and Noise Control

The contractor shall undertake measures to minimize the production of emissions and dust through good practice techniques and ensuring equipment is maintained and functioning correctly. Dust control measures may include the application water over dry soil, or restriction on vegetation removal. The contractor shall avoid dust into adjacent paved roads.

The contractor shall undertake measures to minimize the production of noise through good practice techniques and ensuring equipment is maintained and functioning correctly and is performing within the permitted noise levels for the device.

The contractor shall limit noisy operations such as earthworks and other machinery operations to after school hours. Construction activities in close proximity to residential areas shall be carefully monitored to minimize nuisance.

6.2.6. Vegetation and Fauna Protection

The contractor shall avoid any off-site vegetation removal and damage to vegetation through environmentally sound construction practices. The contractor shall make all reasonable efforts to preserve all vegetation adjacent to wetlands and other water resources. The contractor shall avoid the removal of vegetation that would result in the creation of erosion-prone areas. Where vegetation removal is necessary, the Contractor shall implement all applicable erosion control provisions.

The contractor shall ensure that cleared vegetation is chipped and used in landscaping schemes or to recover areas that must be revegetated. Ground cover shall be restored as soon as earthworks permit, and the necessary measures taken to promote regeneration of native vegetation where possible.

The contractor shall protect fauna living within the site and ensure that hunting, trapping, shooting, bird-nesting or egg-collecting does not occur.

6.2.7. Archaeological Artifacts

The contractor is responsible for familiarizing the work crew with the following procedures, in case culturally valuable materials are uncovered during excavation, including:

- Stop work immediately following the discovery of any materials with possible archaeological historical, paleontological, or other cultural value, announce finding to project manager and notify relevant authorities

- Protect artifacts as well as possible using plastics covers, and implement measures to stabilize the area, if necessary, to properly protect artifacts.
- Prevent and penalize any unauthorized access to the artifacts.
- Restart construction works only upon the authorization of the relevant authorities.

6.2.8. Health and Safety

The contractor shall be responsible for the protection of every person and nearby property from construction accidents, and for complying with all national and local safety requirements and any other measures necessary to avoid accidents.

The contractor shall implement adequate pedestrian safety measures to reduce accident risks. The construction site must be delimitated by temporary fences or other barriers so that children may not enter these areas. A clear pedestrian path must be provided around the works. The contractor's operations shall offer the least possible obstruction and inconvenience to the students and school activities.

The contractor shall conduct safety training for construction workers prior to beginning work. The contractor shall provide first-aid facilities and emergency medical care for the construction crew and will provide suitable and clean sanitary facilities and necessary safety equipment, including hard boots, hard hats, and raincoats for employees when applicable and take measures to assure that this safety equipment is used at all appropriate times.

The contractor shall at all times have transportation on site or readily available to the workers in case of emergencies.

6.2.9. Community Relations

Community relations/liaisons are critical to keep the public informed and to minimize disruption. Since the planning and design phase, MOECD will establish communication with the chief of each community that will receive the improvements either in the schools buildings or housing facilities in order to obtain approval for the construction activities proposed. The District Commissioner of each community will also be consulted before bidding processes take place. At the commencement of the bidding process a disclosure meeting will be held at each community, with the participation of the Building Commission of 2nd BEIP, the local chief, all bidding contractors, and the community. At this meeting, the proposed rehabilitation will be presented, suggestions received, and agreements established upon local labor involvement, materials that can be provided by local businesses and prices.

During all construction phase, the Building Commission will visit the site and discuss with the community other issues that may show along the works. The contractor shall maintain a permanent communication with the chief and school master, in order to avoid or control any possible nuisances to the neighborhood.

The contractor shall inform construction activities schedule and possible nuisances that will affect local activities. A person of contact with local community shall be appointed by the

contractor, and presented to the community as the person to who any questions or complaints must be addressed.

The contractor shall follow a work schedule, procedures and rules of conduct conducive to good community relations during construction. This will entail adequate notification of work schedules for local communities, and hiring practices which provide opportunities for local labor.

The contractor shall orient the work crew to not disturb educational activities or teachers dwelling, as well as the neighboring community. No alcohol or firearms shall be allowed in the construction site.

When construction takes place in urbanized areas such as Paramaribo or larger villages in the interior, the contractor shall take all efforts to prevent traffic disruption on adjacent roads and ensure that footpaths are clear and safely delineated.

6.3. Operation Phase

As mentioned before, preventive maintenance should be a priority during operation phase, in order to avoid emergency works or highly costly repair and rehabilitation after several years of no action at all.

Preventive maintenance shall be performed mainly by local school staff and community help, with the supervision of the Technical Department of MOECD. Thus, local staff and community helpers must be trained to develop basic activities and to recognize the need of major improvements at the very early stages, so that the TD is informed as soon as possible avoiding the structures to deteriorate over time.

This preventive maintenance has been shown to be more required at the denominational schools, were the TD does not have a permanent maintenance plan.

The following directives are basic maintenance and improvement activities that shall be gradually developed in all interior schools.

<u>Water supply</u>. During operations safe water supply must be guaranteed at all means. Thus water tanks maintenance must be a priority, providing that these tanks are cleaned at least twice a year to remove silt deposits or any other materials that might have entered the tank. Rain water collection system shall be verified and maintained on a regular basis. At least once a year water source must be tested to guarantee its adequacy for drinking purposes. Additional complementary or back up sources must gradually be implemented in all interior schools, and water quality shall also be tested. Plumbing and taps must be checked at least twice a year to avoid leaking. The TD shall develop a manual and provide training for teachers and head masters in order to maintain the water systems in proper conditions.

<u>Wastewater system</u>. Septic tanks must be maintained and cleaned every two years (or less if necessary). Maintenance shall verify plumbing, and toilets operation at least twice a year. It is imperative that toilets are properly maintained and regularly flushed, ensuring proper sanitary conditions in the toilets at all times, especially during school hours. The TD shall develop a maintenance manual and training for teachers and head masters, to maintain the toilets in proper conditions, as well as the septic tank.

Energy supply. When energy supply is provided by generators, even if community systems, alternative sustainable sources shall be gradually enforced such as solar systems, biofuel or small hydropower plants. Alternative or complementary energy supply shall be considered for essential activities such as sanitation (flush toilets, hand wash). So it is imperative that the TD articulates with the DEV to ensure proper electricity for these systems.

General maintenance. General building maintenance shall be performed at least once a year, involving roof shingles and woodworks, spouts, ceiling, walls and structures, floor, toilets (basins, sinks, urinals, and tiles), windows and doors. Schools must be repainted every two years. The TD must develop a long term maintenance plan, including all schools under its responsibility, ensuring that budget is used more efficiently. Training programs with all teachers and head masters must be implemented as soon as possible in order to guarantee the quality and conservation of such assets.

Environmental education. Teachers and school staff must be trained for environmentally sound activities, such as waste management, drainage and puddling control, vectors control, basic sanitary facilities maintenance, and safe water supply. Teachers must transmit to students these basic directives, emphasizing the adequate use of safe drinking water, economical use of water and energy, proper wastewater and solid waste disposal. MOECD shall also conduct hygiene education campaigns to raise awareness of the health risks related to improper garbage disposal.

7. ROLES AND RESPONSIBILITIES

This section provides an overview of the roles and responsibilities of the key participants in the implementation of this project.

7.1.1. Construction Phase

Key participants during construction phase include:

- **Ministry of Education and Community Development** (MOECD): responsible for overall project implementation;

- **Project Management Unit** (PMU): responsible for all aspects of program implementation, bidding processes, monitoring and evaluation; and will coordinate closely with the Interior Bureau and Technical Department to implement the Infrastructure Component;

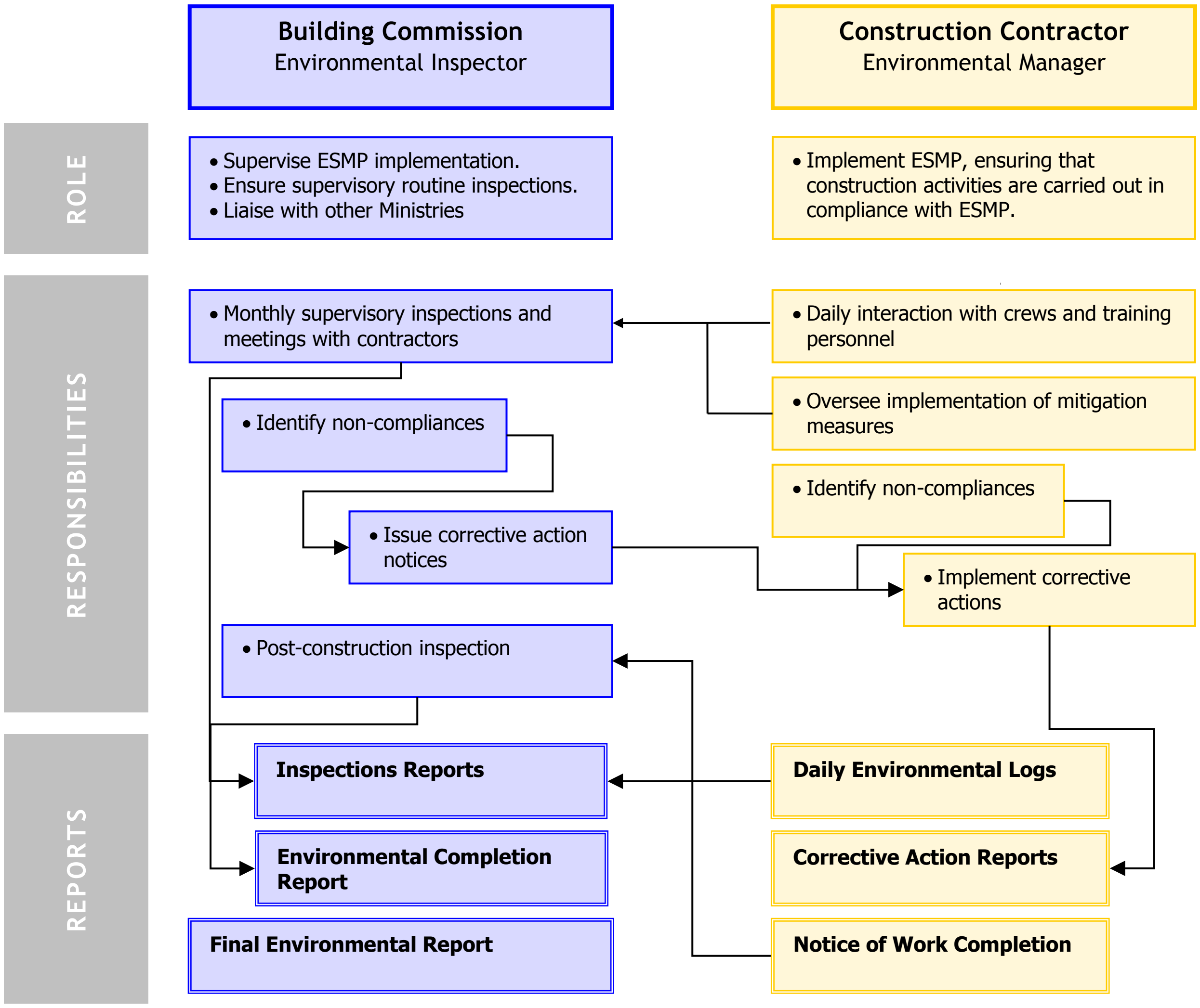
- **Building Commission**: responsible for planning and designs, bidding specifications, community relations during bidding process and construction; the Environmental Inspector will be responsible for the supervision of all contractors activities and this ESMP implementation;

- **Construction Contractors**: responsible for overall management and execution of construction activities and progress; the Environmental Manager will be responsible for implementing the ESMP, assuring environmental quality at and around the construction sites.

The Environmental Inspector will be appointed by the Building Commission, and the Environmental Manager will be appointed by each Construction Contractor, in order to assure this Environmental and Social Management Plan (ESMP) is properly implemented. These people can also perform other activities during project implementation, but must have experience in the implementation of Environmental and Social Management Plans.

It is recommended that the Building Commission hires a professional which such skills as there are no one with environmental and social background in the Technical Department. This person must be available to perform all monthly supervisory inspections. During these inspections, meetings with the Construction Contractors will be held to review the weekly reports and correction action notices. These meetings shall be held throughout all the duration of the construction phase and they shall assess the general environmental status at all construction sites; discuss outstanding non-compliances and violation notifications; and review progress and any outstanding requirements for corrective actions.

A flowchart of all key personnel involved in the implementation of this ESMP, their roles, responsibilities, reports and meetings is presented hereinafter.



7.1.1.1. Construction Contractor Environmental Manager

The Construction Contractors shall designate an Environmental Manager that will be responsible for environmental quality at and around each construction site, and for routine liaison with the Building Commission, as necessary. The Environmental Manager will be responsible for daily environmental management, including implementation of the ESMP.

The primary responsibility of the Environmental Manager is to ensure that the procedures of this ESMP are implemented throughout the construction phase, and to direct the implementation of mitigating measures or corrective actions in any case where the construction is not in compliance. To conduct these responsibilities, the Environmental Manager will be expected to document his observations of progress as well as environmental compliance in *Daily Environmental Logs* (reporting requirements and periodicity are described in Chapter 9).

The Environmental Manager shall work together with the community *kapitein*, District Commissionaires, and representatives of water, energy or communications systems that schools and housings will be connected to. The Environmental Manager will also be responsible for

communicate with local community, the provide information upon the project and receive any claims about project implementation or work crew relations with the community.

During construction phase the Environmental Manager's responsibilities are:

- Daily interaction with construction crews to ensure all construction activities are in compliance with requirements of the ESMP;
- Oversee implementation of the necessary mitigation and prevention measures to ensure compliance with the ESMP;
- Identification of non-compliances and corrective actions required;
- Implementation of the corrective actions and preparation of *corrective action reports*, as necessary.

The Environmental Manager shall ensure that all construction personnel be informed about impact prevention and mitigation procedures. The Environmental Manager will also be responsible for directing personnel on the correct application of environmental and social mitigation and prevention procedures.

Non-compliances identified by the Environmental Inspector must be addressed by the Contractor's Environmental Manager to the satisfaction of the Building Commission. A *Corrective Action Report*, accompanied by photos, must be prepared by the Environmental Manager, presenting the results on how corrective action was taken (reporting requirements and periodicity are described in Chapter 9). Non-compliances may be considered as a restriction for Contractors down payments.

At completion of each construction site, the Environmental Manager will prepare a Notice of Work Completion. This report will be analyzed by the Environmental Inspector and will be one of the conditions for the last disbursement to the Contractor.

7.1.1.2. Building Commission Environmental Inspector

The Environmental Inspector – a qualified environmental specialist (engineer, planner, architect or biologist) with professional knowledge of and experience on construction environmental management – will be responsible for assuring fulfillment of MOECD construction criteria and standards, overall compliance to this ESMP, receiving and approving reports submitted by the Environmental Manager. The Environmental Inspector will also ensure that corrective actions be implemented by the Construction Contractors, as necessary.

The prime responsibility of the Environmental Inspector is to conduct monthly supervisory environmental inspections, and that all necessary actions to correct identified incidents of non-compliance with the ESMP are being addressed by the Contractor and by the Environmental Manager.

The key role of the Environmental Inspector will be to ensure that inspections are carried out thoroughly and on a timely basis, that appropriate reporting has been undertaken and that the ESMP is being implemented as intended.

The Environmental Inspector will prepare an *Inspection Report* and submit to the Building Commission, based on the *Daily Environmental Logs* and monthly inspections (reporting requirements and periodicity are described in Chapter 9). The inspections shall assess the environmental status of all construction sites; identify non-compliances and violation to this ESMP; notifications and corrective actions results. The Inspection Reports may be an appropriate basis for the monthly meeting agendas between the Environmental Manager and the Environmental Inspector.

One month after work completion at each site, the Environmental Inspector will perform a post-construction inspection to verify if the conditions reported on the Notice of Work Completion are accurate and compliant to the ESMP. After this inspection, the Environmental Inspector will prepare an Environmental Completion Report that will be sent to the Building Commission and considered as one of the conditions for the Contractor’s last disbursements.

At completion of the Program, and based on the Environmental Completion Reports of each site, the Environmental Inspector will prepare a Final Environmental Report of all infrastructure implemented by 2nd BEIP.

7.1.2. Operation Phase

The Technical Department of MOECD will be responsible for all maintenance activities and environmental inspections activities after works have been completed and throughout the operation phase.

Based on the *Environmental Completion Report* and the *Final Environmental Report* (prepared by the Environmental Inspector), the Technical Department will conduct follow-up inspections on an annually basis, accordingly to a Long Term Maintenance Plan.

The Technical Department will be responsible for environmental management of the infrastructures rehabilitated during operation. The activities required to carry out this environmental management will focus mainly on water supply and quality, wastewater systems, energy supply, general maintenance and environmental education for schools staff and teachers.

At the end of the construction phase, the Technical Department shall prepare an overall Long Term Maintenance Plan including the environmental and social activities proposed in this ESMP, as well as a training program for teachers and head masters to properly maintain the assets.

8. PROGRAM MONITORING

Program monitoring will be conducted along with all the other components of 2nd BEIP. Monitoring shall include the involvement of the MOECD and the PMU, and the following activities: conducting monitoring visits to selected sites; collecting and analyzing data related to program implementation and non-compliances; and evaluating programs results.

Specifically for the infrastructure component, the following monitoring indicators shall be considered:

Indicator	Formula	Frequency of Measurement	Source of Verification
Schools rehabilitated	Number of schools	Annual	Report from the Building Commission
Sanitary conditions	Number of schools with permanent water supply	Annual	Report from the Building Commission
Electricity availability	Number of schools with permanent electricity supply	Annual	Report from the Building Commission
Inspections performed	Number of inspections and number of schools under construction	Monthly	Report from the Environmental Inspector
Non-compliances notified	Number of non-compliances identified	Monthly	Report from the Environmental Managers and Environmental Inspector
Correction measures	Number of correction measures implemented satisfactorily	Monthly	Report from the Environmental Inspector
Meetings held with the local community	Number of meetings	Monthly	Report from the Environmental Inspector
Complaints from local community and head masters	Number of complaints	Monthly	Report from the Environmental Managers and Environmental Inspector
Maintenance training	Number of training programs performed	Annual	Report from the Building Commission

The PMU will be responsible for the monitoring of the program with assistance of the Building Commission, the Technical Department, and MOECD. Information on the monitoring of the infrastructure component will be included in the overall monitoring and evaluation reports.

9. PROGRAM DOCUMENTATION

The implementation of the Infrastructure Component of the 2nd BEIP shall be documented thoroughly. The environmental reports will be prepared by the Environmental Manager or the Environmental Inspector, as described in the following subsections.

Suggested format for the proposed reports are presented in Annex 4. All reports must have photos attached to represent the information provided in such report.

9.1. Daily Environmental Logs

The Environmental Manager is responsible for maintaining a log of his daily activities for discussion and referencing purposes. *Daily Environmental Logs* shall contain the following information: date; name and signature of manager; location of construction activities; compliance to each aspect of this ESMP; non-compliances; corrective actions taken; and additional comments (such as specific weather conditions, unanticipated impacts detected, community complaints, archaeological findings, etc.).

These reports can be filled in separate sheets, one for each day, or in one sheet per working week, one for each construction site, as suggested in Annex 4. The Environmental Manager must fill in for each working day, to each one of the proposed questions, responding: Y = yes; N = no; n/a = not applicable.

9.2. Notice of Work Completion

At the completion of each construction work site, the Environmental Manager shall submit to the Environmental Inspector a *Notice of Work Completion*. This Notice shall indicate: site location; date of completion; works performed and main difficulties related to work; general site conditions; a summary of non-compliances and correction actions undertaken, and additional comments. Photographs shall be attached to this report to testify completion of works and construction site clean-up and restoration.

Within one month after this works completion notice date, post construction inspection shall be performed by the Environmental Inspector.

9.3. Corrective Action Reports

The Environmental Manager is required to prepare a *Corrective Action Report* to be submitted to the Environmental Inspector within 14 days of receipt of a *Non-Compliance Notice*. The Corrective Action Report shall indicate the nature of the non-compliance and outline the timing

and manner in which non-compliances were addressed, and shall be accompanied by photographs showing post-mitigation condition.

9.4. Inspection Reports

The Environmental Inspector will perform monthly inspections on each active work site, recording his observations on the Inspection Report, and registering photographically non-compliances identified.

Inspections will aim at:

- Verify the correct implementation of environmental control measures;
- Check all environmental items overseen by the Environmental Manager;
- Identify non-compliances with the ESMP;
- Suggest additional control measures, if necessary;
- Check for unanticipated impacts;
- Verify the implementation of required corrective actions;
- Check for possible complaints from the community regarding impacts.

9.5. Non-Compliance and Corrective Notices

The Environmental Inspector will record any violations where activities or general site conditions are not in compliance with the ESMP. The *Non-Compliance Notice* shall describe the items which need to be corrected and specify required measures to be implemented by the Construction Contractor to bring his activities into compliance.

If additional mitigation efforts are required, the Environmental Inspector will advise the Construction Contractor via a written *Corrective Notice*.

9.6. Environmental Completion Report

Within one month after the date of the Notice of Work Completion is issued, a post-construction inspection shall be performed by the Environmental Inspector. At completion of each post-construction inspection, the Environmental Inspector will prepare an Environmental Completion Report, attesting that works had been performed as designed, control measures had been implemented, and site had been properly cleaned-up and recovered.

The report will summarize all non-compliance notifications and corrective actions, and any additional comments. Photographs shall be attached recording the corrective actions, work completion and site clean-up.

This report will be submitted to the Building Commission and will be one of the conditions to allow the Construction Contractor to receive the final down payment.

Once a year, the Environmental Inspector will prepare a compilation of all post-construction inspections reports, accompanied by a summary of any outstanding incidences of non-compliance requiring corrective action.

9.7. Final Environmental Report

The Environmental Inspector will be responsible for preparing a *Final Environmental Report*, based on the compilation of the Environmental Completion Reports.

The report will summarize all relevant information about works performed during the Program, and any outstanding non-compliances and correction actions performed. The report will evaluate the efficiency and efficacy of this Environmental and Social Management Plan, additional measures recommended during construction, lessons learned and recommendations for operation phase.

10. BUDGET

This section provides cost estimates for implementing the ESMP, during construction and operation phase, as herein detailed.

10.1. Construction Phase

The Building Commission Environmental Inspector role may be filled by a qualified environmental specialist (engineer, planner, architect, geographer or biologist) with professional knowledge and experience on construction environmental manager, with 5 to 10 years experience.

The Environmental Inspector will conduct monthly inspections and reporting, post-construction inspections and completion reports, and final environmental report. The Environmental Inspector shall be on the job on a daily basis (US$9,600). The cost of the Environmental Inspector shall be paid by the PMU Building Commission.

The Construction Contractor Environmental Manager role may be filled by a qualified local professional, with 3 to 5 years experience. The Environmental Inspector will conduct daily inspections, non compliances identification and corrective actions implementation, reporting and meeting with the Environmental Inspector. The Environmental Manager will also be responsible for community relations and liaison with other local agencies to ensure water and energy supply.

There shall be one Environmental Manager for each site and shall be on the job every day (US$144,000). The cost of each Environmental Manager shall be included in the Contractor's cost, as well as the implementation of all the environmental and social guidelines laid out in this ESMP.

No specific materials or equipment are required for the implementation of this ESMP.

Total ESMP Implementation Cost – Construction Phase

Professional		Total Cost
Environmental Inspector	12 months x US$800	US$ 9,600
Environmental Managers	18 sites x 8 months x US$1,000	US$ 144,000 *
TOTAL		US$ 153,600

* each Environmental Manager would cost an average US$ 8,000 during all construction phase

10.2. Operation Phase

During the operation phase, the Technical Department of the MOECD will be responsible for overall maintenance activities including environmental inspections. This is the TD's main role in the MOECD, so no additional costs will be added.

Nevertheless, environmental education and training of the school staffs will have to be developed and spread out to the TD professionals and all schools. Budget for developing a training program and one year implementation is presented as follows. This training program shall be financed by the MOECD budget.

Environmental Awareness Training Program

Description		Total Cost
Development phase	Environmental specialist	US$ 5,000
	Environmental/education specialist	US$ 5,000
	Assistants (2)	US$ 5,000
	training materials	US$ 5,000
subtotal		US$ 20,000
Training implementation (1year)	Environmental/education specialist	US$ 10,000
	Assistant (1)	US$ 5,000
	training materials (reproduction)	US$ 10,000
	Vehicle rent	US$ 5,000
	Fuel	US$ 2,500
	Boat rent	US$ 10,000
	lodging/food (US$20/day)	US$ 10,000
subtotal		US$ 62,500
TOTAL		**US$ 72,500**

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ANNEX 1 -
LIST OF SELECTED SCHOOLS FOR 2ND BEIP

Renovation of schools and teacher housing in the interior of Suriname, 2nd BEIP

No	Schools	New teachers housing	New classes	Renovation teacher housing	Renovation classes	Denomi-nation / Public	Other facilities	District	Area	Number student	Phase
Phase 1 **Period: October 2012 - October 2013[11]** **Areas: Marowijne, Sipaliwini Oost, Washabo and Apoera**											
1	Mooitaki	2/2[12]	3	1	3	EBGS		Sipaliwini	Mooitaki	80	1
2	J.Bandaschool	1/2		2	4	EBGS		Sipaliwini	Karmel	51	1
3	St.Th.Moore	1/2	1	6		RKBO		Sipaliwini	Washabo	171	1
4	Godo-olo	6/2	10	-	-	EBGS	Media centre	Sipaliwini	Godo-olo	250	1
5	St.Theresia	4/2	-	12	-	RKBO		Marowijne	Moengo		1
6	Wanhatti	1/2		1		EBGS		Marowijne	Wanhatti	60	1
7	Kalebaskreek[13]	3/2	8			RKBO	Toilet	Saramacca	Kalebaskreek	53	-
8	Fred Murray	4/2		7		EBGS		Marowijne	Moengo	350	1
9	Antonius	2/2		2		RKBO		Marowijne	Galibi	130	1
10	Gerardus	2/2	14	4		RKBO		Marowijne	Albina	315	1
11	Nason	1/2				RKBO		Sipaliwini	Nason		1
12	Daketie	2/2	4			RKBO		Marowijne	Pete-ondo	102	1
13	OS Ricanaumofo	2/2	4			Public	Toilet	Marowijne	Ricanaumofo	91	1
14	OS Dritabiki	3/2	4			Public		Sipaliwini	Dritabiki	319	1
15	OS Manlobi	2/2	3			Public		Sipaliwini	Manlobi	144	1
16	OS Gakaba	2/2	2			Public		Sipaliwini	Gakaba	302	1
17	OS Apoera	-	-	5	-	Public		Sipaliwini	Apoera	310	1
18	OS Bigi Poika	2/2	1	2	4	Public	Media centre	Para	Bigi Poika		1

[11] Period includes procurement
[12] Meaning 2 teacher housing of 2 units each
[13] The building of this school will be coordinated by the ministries of Public Works and Regional Affairs

No	Schools	New teachers housing	New classes	Renovation teacher housing	Renovation classes	Denomi-nation / Public	Other facilities	District	Area	Number student	Phase
Phase 2 Period: October 2013 - October 2014 Areas: Boven-Suriname, Brokopondo											
19	Pt.Voorbraak	3/2	8	-	2	RKBO		Sipaliwini	Jaw Jaw	160	2
20	Kajana	3/2	4	2	4	EBGS		Sipaliwini	Kajana	50	2
21	Frans Pryor	7/2	3		6	EBGS	Media centre	Sipaliwini	Tapoeripa	260	2
22	Poesoegroenoe	5/2	8			EBGS	Media centre	Sipaliwini	Pusugrunu	80	2
23	Nw.Jacobkondre	4/2	-	-	-	EBGS	Media centre	Sipaliwini	Nw.Jacobkondre	45	2
24	Balingsoela	2/2	-	-		EBGS		Brokopondo	Balingsoela	250	2
25	Semoisie	2/2	3	5	-	RKBO		Sipaliwini	Semoisie	235	2
26	Ligorio	2/2	-	6	2	RKBO		Sipaliwini	Ligorio	200	2
27	Panboko	1/2	2			RKBO	Office	Sipaliwini	Panboko	170	2
28	Pt.v/d Pluym	2/2	3			EBGS		Brokopondo	Brownsweg	400	2
29	Kankantrie	2/2	2	6		RKBO		Sipaliwini	Masiakriki	430	2
30	OS Brokopondo	2/2	3	-	-	Public		Brokopondo	Brokopondo	346	2
Phase 3 Period: October 2014 - October 2015 Areas: Coppenamegebied, Boven Nickerie, Boven Saramacca											
31	Corneliskondre	2/2	-	5	2	RKBO		Saramacca	Corneliskondre	26	3
32	Donderskamp	3/2	-	8	3	RKBO		Sipaliwini	Donderskamp	88	3
33	Tapoeripa	1/2	4	-	-	RKBO		Nickerie	Tapoeripa	30	3
Phase 4											
34	Kawenhakan[14]	2/2	4			Public	Toilet	Sipaliwini	Kawemhakan		4
35	Apetina	3/2	4			Public	Toilet	Sipaliwini	Apetina	109	4
36	Cottica a/d Lawa[15]	2/2	4			Public	Toilet	Sipaliwini	Cottica	50*	4
37	Paloemeu	3/2	2		4	Public	Toilet	Sipaliwini	Paloemeu	87	4

[14] Regards building a new school
[15] Regards building a new school

ANNEX 2 -
PHOTOGRAPHS OF INTERIOR SCHOOLS VISITED

Sint Gerardus School
Roman Catholic denomination
(Albina)

Office

Central inner area; upper floor classrooms and recreational area on the ground floor

Classroom

Teachers housing units; water tanks do not function

backyard

OS Apoera public school

Primary school

Inner central area of primary school

Secondary school

Teacher housing units

OS Bigi Poika

Classroom

Outside corridor

Teachers housing

Teachers housing

Fred Murray School
Moengo

Front view

Inner central area

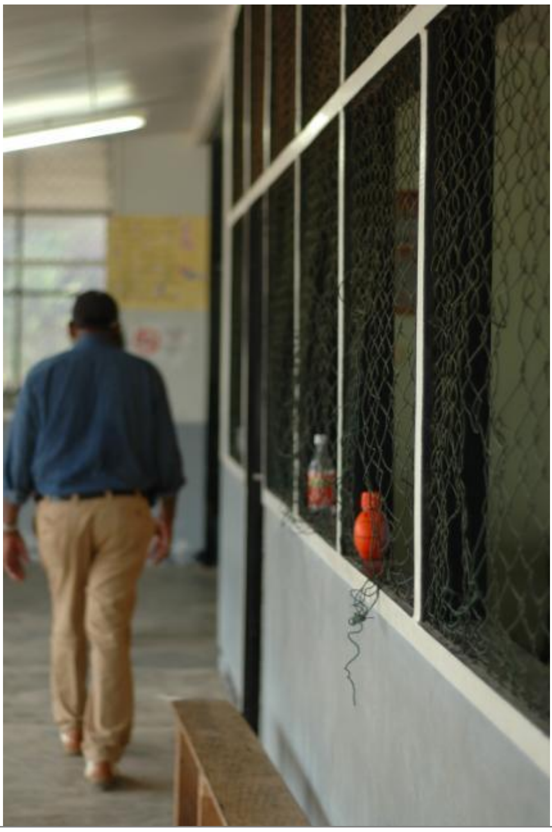
Classrooms

St. Therisia School - Moengo

OS Ricanaumofo

Classroom

Teachers housing

	**Emanuel Daketie School** **Roman Catholic denomination** **Pete-ondo** 
	 Classroom
Outside corridor; windows fences destroyed	

	St. Thomas Moore School Roman Catholic denomination Washabo
Classroom	
	Teacher housing units

	**Future CENASU area**

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ANNEX 3 - LIST OF SCHOOLS RENOVATED SINCE 2005

Public Schools Renovated since 2005

	Funds	State Budget		Sector Fund		BEIP	
	Schools	Year	Work Performed	Year	Work Performed	Year	Work Performed
1	O.S. Alberga					2005	renovation/ painting
2	O.S. Albina	2011	fencing	2006	construction of 5 classrooms and toilet, renovation and painting		
3	O.S. Alkmaar	2008	painting/ renovation				
4	O.S. Apoera	2011	construction of 2 classrooms				
5	O.S. Bacovendam	2010	renovation				
6	O.S. Balona	2011	construction of a library			2006	renovation/ painting
7	O.S. Bambi	2009	demolition of old building; construction of 9 classrooms, office, storage room, library, toilet				
8	O.S. Bigi Poika	2009	construction of 1 classroom, renovation of school and homes, painting				
9	O.S. Blauwgrond					2005	renovation/ painting
10	O.S. Bolletriehe	2011	renovation/ painting / fencing				
11	O.S. Bomapolder	2008	renovation/ painting				
		2010	fencing				
		2011	construction of 3 classrooms and library				
12	O.S. Boxel	2007	painting			2006	renovation/ rehabilitation
13	O.S. Calcutta	2011	renovation/ painting				
14	O.S. Clevia	2007	painting / construction of nursery				
		2011	construction of a library, renovation and painting				
17	O.S. Commissaris Simonspolder	2009	renovation				
		2010	painting				
18	O.S. de Hulp	2009	renovation				
		2010	construction of 2 classrooms, toilet, painting and fencing front				
19	O.S. Debie Sahaiweg					2007	renovation/ painting
20	O.S. Deviensbuitten	2009	renovation				
		2010	painting / fencing				
21	O.S. Dijkveld	2008	renovation				
		2009	painting and construction of 1 office				
22	O.S. Domburo					2005	renovation/ painting
23	O.S. Drambrandersgracht	2010	renovation				
24	O.S. Flora I	2008	renovation/ painting				
		2009	fencing				
25	O.S. Flora II	2008	renovation/ painting				
		2009	fencing				
26	O.S. Flora III	2010	renovation				
27	O.S. Flu I	2007	painting			2006	renovation/ rehabilitation
28	O.S. Flu II	2007	painting			2006	renovation/ rehabilitation
29	O.S. Garnizoenspad	2010	fencing			2006	renovation/ painting
30	O.S. Geyersvlijt I	2010	fencing/ painting				
		2009	fencing				
31	O.S. Geysbertusstraat	2011	renovation/ painting / fencing				
32	O.S. Godo	2009	construction of 5 rooms, 3 2-unit homes, toilet and painting				
33	O.S. Gran Tatai	2009	construction of 2 classrooms, 2 2-unit homes and painting				
34	O.S. Groot Henarpolder	2011	fencing				
35	O.S. Hampton Court I	2011	renovation/ painting / fencing				
36	O.S. Hanna's Lust	2007	construction of 6 classrooms, toilets and painting				
		2010	construction of 2 classrooms				
37	O.S. Houttuin I	2010	fencing			2006	renovation/ rehabilitation
		2007	painting				
38	O.S. Houttuin II	2010	fencing				
39	O.S. Jarikaba	2010	renovation				
40	O.S. Javaweg	2007	painting			2006	renovation/rehabilitation/painting
		2010	fencing				
41	O.S. Kampong Baroe	2011	renovation/ painting				
42	O.S. Koewarasan	2008	renovation/painting				
43	O.S. Kroonenburg			2009	renovation		
44	O.S. Kuldipsingh	2011	renovation/ painting				
45	O.S. Kwatta	2008	painting				
46	O.S. Kwatta (Khargivishnoedathsch)	2008	renovation				
47	O.S. Laarwijk	2011	renovation/ painting				
48	O.S. Latour I					2005	renovation/ painting
49	O.S. Latour II					2005	renovation/ painting
50	O.S. Latour III					2005	renovation/ painting
51	O.S. Leiding 11 A	2010	fencing			2007	renovation/ painting
52	O.S. Leiding 8 A	2009	renovation				
		2010	painting				
53	O.S. Lelydorp					2006	renovation/ painting
54	O.S. Livorno II	2010	painting				
		2010	fencing				
55	O.S. Longmay	2007	painting			2006	renovation/ rehabilitation
56	O.S. Lust em Rust	2009	construction of 2 classrooms, renovation and painting				
		2010	fencing				
57	O.S. Magentapolder	2010	fencing				
		2011	construction of library and office				
58	O.S. Mahoprojekt	2008	renovation				
		2009	painting				
59	O.S. Majosteeg					2007	renovation/ painting
60	O.S. Maretraite	2007	painting			2006	renovation/ rehabilitation
61	O.S. Marienburg	2009	construction of 2 classrooms, renovation and painting				
		2011	construction of 3 classrooms, toilets and library				
62	O.S. Marowijneprojekt I					2007	renovation/ painting
63	O.S. Marowijneprojekt II					2007	renovation/ painting
64	O.S. Matta	2010	renovation				
65	O.S. Mattonshoop I					2006	renovation/ rehabilitation
66	O.S. Mattonshoop II					2006	renovation/ painting
67	O.S. Meerzorg I	2010	fencing				
68	O.S. Meerzorg II	2009	construction 2 classrooms and painting				
		2010	fencing				
69	O.S. Meerzorg III	2011	construction of 3 classrooms, storage and toilet				
		2010	fencing				
		2009	construction of 3 classrooms, renovation and painting				
70	O.S. Middenpad van Kwatta					2006	renovation/ painting
71	O.S. Mijnzorgweg	2011	construction of a library and renovation				

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	Funds	State Budget		Sector Fund		BEIP	
	Schools	Year	Work Performed	Year	Work Performed	Year	Work Performed
72	O.S. Munderbuiten	2010	fencing			2005	renovation/ painting
73	O.S. Nickerie I	2007	renovation/ painting				
		2011	fencing				
74	O.S. Nickerie II	2007	painting			2006	renovation/ rehabilitation
		2006	renovation/ rehabilitation				
75	O.S. Nickerie III	2008	renovation				
		2009	painting				
76	O.S. Nickerie IV	2008	renovation				
		2009	painting				
77	O.S. NW Amsterdam	2010	fencing				
78	O.S. Onverdacht/ Mulo Onverdacht	2010	renovation/ painting/ fencing				
79	O.S. Onverwachr	2007	construction of 4 classrooms and toilet, and painting				
80	O.S. Oude Charlesburg	2010	painting				
81	O.S. Oude Charlesburg M.C. Jesserunschool	2009	renovation				
82	O.S. Paradise	2010	renovation				
		2011	fencing				
83	O.S. Penny em Jon	2009	renovation			2006	renovation/ rehabilitation
84	O.S. Petunia I	2005	renovation/ painting			2005	renovation/ painting
		2011	fencing				
85	O.S. Petunia II	2011	fencing			2005	renovation/ painting
86	O.S. Phedra	2009	renovation/ painting				
87	O.S. Piken Saron	2009	construction of 1 classroom, 1 2-unit home, refurbishment and painting				
88	O.S. Polanen					2005	renovation/ painting
89	O.S. Pomona	2009	renovation				
		2010	painting				
90	O.S. Pontbuiten	2009	renovation				
91	O.S. Pontbuiten	2010	painting				
92	O.S. Rahan					2005	renovation/ painting
93	O.S. Reeberg	2007	painting				
94	O.S. Reebergprojekt	2010	construction of 5 classrooms and fencing			2006	renovation/ rehabilitation
95	O.S. Rijsdijk	2009	construction of 4 classrooms, toilet, painting and fencing				
		2007	Construction of 3 classrooms and painting				
96	O.S. Rust em Werk	2011	the construction of a library, office and renovation				
97	O.S. Santen	2009	renovation/ painting/ fencing				
98	O.S. Santodorp	2007	construction of 6 classrooms, toilets and painting				
99	O.S. Santodorp II	2009	construction of 2 classrooms, library, office, and toilets, renovation and painting,				
100	O.S. Santopolder	2010	fencing			2006	renovation/ painting
101	O.S. Schotelweg					2006	renovation/ painting
102	O.S. Sidoredjo	2008	renovation				
		2009	painting				
103	O.S. Skoertjie	2011	construction of 1 classroom, renovation and painting				
104	O.S. Skoertjieweg	2010	construction of toilets				
105	O.S. Sophia'Lust II	2010	renovation/ painting				
106	O.S. Stolkbuiten					2005	renovation/painting/ new building
107	O.S. Tamanredjo	2009	construction of 4 classrooms,and toilet, renovation and painting				
		2007	construction of 2 classrooms and toilets, and painting				
		2010	construction of a library, and renovation				
108	O.S. Tamanredjo I	2010	painting				
		2009	renovation				
		2010	construction of toilets				
		2010	fencing				
109	O.S. Tamanredjo II	2011	construction of a library				
110	O.S. Tamengaprojekt					2007	renovation/ painting
111	O.S. Totness	2011	renovation/ painting				
112	O.S. Tourtonne III	2010	painting				
		2011	fencing				
113	O.S. Tout Lui Faut	2011	construction of 1 classroom, storage and toilet				
114	O.S. Uitkijk	2008	renovation/ painting				
115	O.S. van Pettenpolder	2007	painting			2006	renovation/ rehabilitation
		2011	fencing				
116	O.S. Victoria	2009	renovation of homes and painting				
117	O.S. Vredenburg	2006	painting				
		2010	fencing				
118	O.S. Wageningen I	2010	fencing			2005	renovation/ painting
119	O.S. Wageningen II	2010	fencing			2005	renovation/ painting
120	O.S. Wageningen III	2010	construction of toilets and fencing				
121	O.S. Wageningen Kleuterblock (nursery block)	2007	renovation and painting of nursery block				
122	O.S. Welgelegen I	2010	painting				
		2008	renovation/ painting				
		2009	renovation				
123	O.S. Welgelegen II	2009	renovation				
		2010	painting				
124	O.S. Wint wai					2005	renovation/ painting
125	O.S. Wita Gron	2009	construction of 1 classroom, 2-unit homes, renovation and painting				
126	O.S. Wonoredjo	2009	fencing	2009	construction of 2 classrooms, toilets, office and renovation		
127	O.S. Zanderij	2009	construction of 8 classrooms, library, 2 offices, toilets; demolition of old wooden classrooms block, and painting				
128	O.S. Ziniastraat					2006	renovation/ rehabilitation
129	O.S. Zinniaschool	2007	painting				
130	S.O. Emma	2009	renovation				
		2010	painting				
131	S.O. Fajalobi	2010	fencing				
132	S.O. Maretraite	2011	fencing				
		2010	renovation/ painting				
133	S.O. Monkou	2010	fencing				
134	S.O. Verl. Welgedacht C					2007	renovation/ painting

Private Schools renovated since 2005

	Schools	Funds	Year	Work Performed
1	5 Dienstwoningen Albina T.B.V nucleocentrum	Sector Fund	2006	painting / new building
2	5 Dienstwoningen Brokopondo T.B.V nucleocentrum	Sector Fund	2006	painting / new build
3	A. Bakkerschool	State Budget	2009	construction of 2 classrooms and painting
4	A.C.I.	State Budget	2009	construction of 5 classrooms and toilet, renovation schoolhouse, office, fencing and painting
5	A.M.S	State Budget	2006	painting
6	A.ms	State Budget	2006	renovation
7	A.MS	State Budget	2009	renovation
8	A.T. Calorschool	State Budget	2006	renovation
		State Budget	2009	fencing
		State Budget	2007	painting
9	Accaribo	State Budget	2011	construction of 8 classrooms, office, media center, storage, and toilet
10	Afakaschool	State Budget	2009	construction of 2 classrooms and painting
		State Budget	2010	fencing
		State Budget	2011	renovation/ painting
11	Akoeba Fowroeschool	State Budget	2011	fencing
12	Albina	Sector Fund	2009	construction of 2 classrooms, 3 2-unit homes, renovation of 4 homes
13	Alfonsdorp	State Budget	2011	construction of 4 classrooms, office, storage, toilet, and 2 2-unit homes
14	Ampoematopoe	Sector Fund	2007	construction of 4 classrooms, toilets, 2 2-units homes, renovation and painting
15	Anton Residaschool	State Budget	2010	painting
16	Atjoni	State Budget	2011	construction of 12 classrooms, media center, library, toilets, office, 6 2-unit homes
17	Bakoe	Sector Fund	2009	construction of 2 classrooms, toilets and a 2-unit home
18	Bambischool	Sector Fund	2009	construction of 6 classrooms and toilet
19	Barronschool	Sector Fund	2009	construction of 2 classrooms
20	Basisschool Brownsweg	State Budget	2010	construction of 6 classrooms, 5 5-units homes
21	Bigi Ston	Sector Fund	2009	construction of 3 classrooms and a 2-unit home, and renovation
22	Brokopondo	Sector Fund	2009	construction of 2 classrooms, toilets and 2 2-unit homes, renovation
23	Bueno Bibaz School	State Budget	2008	renovation
24	C. Van Sypensteynschool	State Budget	2010	painting
		State Budget	2010	fencing
		State Budget	2009	renovation
25	Compagniekreek	State Budget	2011	construction of 4 classrooms, toilets, and 3 2-units homes
26	D.W Mahoprojekt	State Budget	2008	renovation/ painting
27	D.W. 393 von Vreyburg	State Budget	2008	renovation/ painting
28	D.W. 394 von Vreyburg	State Budget	2008	renovation/ painting
29	D.W. 403 von Vreyburg	State Budget	2008	renovation/ painting
30	D.W. 406 von Vreyburg	State Budget	2008	renovation/ painting
31	D.W. Dep. O.S Calcutta	State Budget	2008	renovation/ painting
32	Dan	State Budget	2006	construction of 2 classrooms, 2 2-units homes, renovation and painting
33	Dep Technische Diensten	State Budget	2010	fencing
34	Dependance Technische Diensten Nickerie	State Budget	2007	renovation/ painting
35	Dienst Bodemkartering T.B.V. Natin	State Budget	2006	renovation, reorganization of 10 classrooms and painting
36	Dienstwoning Imeeao II	State Budget	2009	renovation/ painting
37	Dienstwoning O.S. Clevia	State Budget	2009	renovation/ painting
38	Drietabetje	Sector Fund	2007	construction of 2 classrooms and toilets, 2 2-unit homes, renovation and painting
39	E. Cabellschool	State Budget	2010	painting
		State Budget	2009	renovation
40	E.T.O Duisburglaan	State Budget	2006	painting
41	E.T.O. Meerzorg	State Budget	2009	renovation
		State Budget	2010	painting
		State Budget	2010	fencing
42	ETS Lachmonstr	Sector Fund	2009	renovation
43	Examenbureau	State Budget	2006	renovation/ painting
44	Gakaba	Sector Fund	2007	construction of 2 classrooms and toilets, 2 2-unit homes, renovation and painting
45	Gebouw BOS	State Budget	2009	renovation/ painting
46	Gebouw LPD	State Budget	2009	renovation/ painting
47	Gebouw ODTD	State Budget	2009	renovation/ painting
48	George Asinschool	State Budget	2009	fencing
		State Budget	2009	renovation
		State Budget	2010	painting
49	Goninimofo	Sector Fund	2007	construction of 4 classrooms and toilets, 2 2-units homes, renovation and painting
50	H.Waaldijkschool	State Budget	2010	painting
51	Havo II	State Budget	2009	renovation and construction of 2 classrooms, painting, replacement of the mesh in the fence
52	Hendrikschool	State Budget	2006	renovation
		State Budget	2007	painting
53	Hoofdafdeling Administratieve Diensten	Sector Fund	2006	renovation/ painting
54	Imeao I	State Budget	2006	renovation
		State Budget	2006	painting
55	Imeao II	State Budget	2008	construction of 10 classrooms, painting and renovation
		State Budget	2009	painting
		State Budget	2010	fencing
56	Imeao Nickerie	State Budget	2009	renovation/ painting / fencing
57	Imeao Nickerie	State Budget	2011	construction of 3 classrooms
58	Inspectie Moengo	State Budget	2011	fencing
59	J. Koenderschool	State Budget	2010	renovation
		State Budget	2011	fencing
60	J.E. Dennertschool	State Budget	2009	renovation
		State Budget	2010	painting
61	Johannes Vrolijkschool	Sector Fund	2009	renovation
		State Budget	2010	fencing
62	K.R.S. Coleridgeschool	State Budget	2010	painting
		State Budget	2009	renovation
63	Kaykoesyschool	State Budget	2010	fencing
		State Budget	2010	fencing
64	L.A. Simonschool	State Budget	2009	fencing
		State Budget	2009	painting
		State Budget	2008	renovation/ painting
65	L.T.S. I	State Budget	2011	renovation/ painting
66	L.T.S. IV	State Budget	2011	renovation/ painting / fencing
67	LBGO Hanna's Lust	State Budget	2007	painting
68	LBGO Balona	State Budget	2008	construction of 4 classrooms and painting
		State Budget	2009	painting
69	LBGO Beekhuizen	State Budget	2011	renovation/ painting / fencing
70	LBGO Drambrandersgracht	State Budget	2007	renovation/ painting
71	LBGO Hanna's Lust	State Budget	2006	renovation
		State Budget	2009	fencing
72	LBGO Kaykoesie	State Budget	2008	renovation
		State Budget	2008	renovation/ painting
		State Budget	2009	construction of 2 classrooms and painting
73	LBGO Latour	State Budget	2007	painting
		State Budget	2006	renovation
74	LBGO Ramjanee	State Budget	2009	renovation/ painting
75	LBGO Tata Collin	State Budget	2006	renovation

	Schools	Funds	Year	Work Performed
76	LBGO Tata Collin	State Budget	2008	renovation/ painting
77	Lebi Doti	Sector Fund	2009	construction of 2 classrooms, toilets and 2 2-unit homes, renovation of existing homes
78	Lelydorp	State Budget	2011	construction of 9 classrooms, media center, board room, staff room, storage room, toilets and hall
79	Loka Loka	Sector Fund	2007	construction of 4 classrooms and toilets, 2 units homes, renovation and expansion of 3 homes and toilets, renovation and painting
80	M.C. Jesserunschool	State Budget	2010	painting
81	M.J. Poolschool	State Budget	2011	renovation/ painting
82	Manlobi	Sector Fund	2007	construction of 2 2-units homes, renovation and painting
83	Marie Le Fevre	State Budget	2009	painting
		State Budget	2008	renovation
84	Mathoeraschool	State Budget	2010	construction of 3 classrooms, entrance, toilets, renovation and fencing
85	Moengo	Sector Fund	2009	construction of 2 8-unit homes
86	Monkou School	State Budget	2008	renovation
87	Mopiekondre	Sector Fund	2009	renovation
88	Mulo Brokopondo	State Budget	2010	renovation
		State Budget	2010	renovation/ painting
89	Mulo Ellen	Sector Fund	2009	renovation
90	Mulo Geyersvlijt	State Budget	2009	renovation
		State Budget	2010	painting
		State Budget	2010	fencing
91	Mulo Kerklaan	State Budget	2010	painting
92	Mulo Latour	State Budget	2007	painting
93	Mulo Paradise	State Budget	2011	construction of 2 classrooms, renovation and painting
94	Mulo Paranam	State Budget	2009	construction of 6 classrooms, office, storage, fencing, renovation and painting
95	Mulo Schotelweg	State Budget	2007	construction of 6 classrooms and toilets, and painting
		State Budget	2010	fencing
96	Mulo Sitalsing	State Budget	2010	fencing
97	Mulo Wageningen	State Budget	2007	renovation/ painting
98	Natin Complex	State Budget	2011	fencing
99	Natin Leysweg	State Budget	2008	construction of 14 classrooms, and painting
100	Natin Nickerie	State Budget	2011	construction of 6 classrooms, 2 laboratories, office, storage and toilet
101	Nucleus Centrum Albina	State Budget	2011	renovation
		Sector Fund	2005	new build
102	Nucleus Centrum Brokopondo	State Budget	2011	renovation/ painting
		Sector Fund	2005	new build
103	O.N.S.	State Budget	2006	renovation
		State Budget	2008	painting
104	Oedayraising Varma School	State Budget	2006	painting
		State Budget	2007	painting
105	Onderwijssinspektie Nickerie	State Budget	2011	renovation/ painting / fencing
106	Ontwikkelingsdienst aan de commerwijnestraat	Sector Fund	2005	renovation/ expand / painting
107	Penny em Jon	State Budget	2007	painting
		State Budget	2009	fencing
108	Polanenschool	State Budget	2010	construction of toilet and covered corridor
109	Praktijk Centrum Drambrandersgracht	State Budget	2009	painting
		State Budget	2008	renovation
110	R. Bueno Bibazschool	State Budget	2009	painting
111	R. Laigsingschool	State Budget	2007	painting
112	R. Loatoschool	State Budget	2007	painting
113	R. Rahanschool	State Budget	2009	construction of 8 classrooms, 2 kindergarten classes, office and 2 toilets, and painting
114	R. Schoonhovenschool	State Budget	2006	painting
115	R. van Gennipschool	State Budget	2011	construction of media center
116	R.A. Tammengaschool	State Budget	2009	painting
		State Budget	2008	renovation
117	R.D. Simonsschool	State Budget	2008	renovation
		State Budget	2008	painting
118	R.Sewbaranschool	State Budget	2011	renovation/ painting / fencing
119	Rambaran Mishreschool	State Budget	2009	renovation/ painting
		State Budget	2010	fencing
120	Ricanaumofo	Sector Fund	2009	construction of 6 classrooms, facilities, and 3 2-unit homes
121	S.G.N	State Budget	2009	renovation/ painting
122	S.O. Emma	State Budget	2009	renovation
		State Budget	2010	painting
123	S.O. Fajalobi	State Budget	2010	fencing
124	S.O. Marentraite	State Budget	2011	fencing
		State Budget	2010	renovation/ painting
125	S.O. Monkou	State Budget	2010	fencing
126	S.O. Verl. Welgedacht C	State Budget	2010	fencing
127	S.P.I.	State Budget	2011	renovation/ painting
128	S.T.S Nickerie	State Budget	2007	renovation/ painting
129	Schneiders Howardschool Nickerie	State Budget	2011	fencing
		State Budget	2007	renovation/ painting
130	Scholencomplex Onverwacht	State Budget	2009	fencing
131	Sitalsinghschool	State Budget	2008	renovation
132	Sitalsingschool Nickerie	State Budget	2007	construction of 4 classrooms and toilets, and painting
133	Theodoor Juda School	State Budget	2008	renovation
		State Budget	2009	painting
134	V.O.J Koewarasan	State Budget	2009	renovation
135	V.O.J. Apoera	State Budget	2011	construction of 4 classrooms
136	V.O.J. Atjoni	State Budget	2010	*not continued*
137	V.O.J. La Solitude	State Budget	2011	construction of 3 classrooms, toilets, office, renovation and painting
138	V.O.J. Meerzorg	State Budget	2007	construction of 5 classrooms and toilets, and painting
139	V.O.J. Onderwacht	State Budget	2008	renovation
140	V.O.J. Onverwacht	State Budget	2007	construction of 6 classrooms and toilets, and painting
141	V.O.S Internaat	State Budget	2009	painting
142	V.S.O. Flora	State Budget	2007	construction of 14 classrooms and toilets, and painting
143	V.W.O. IV	State Budget	2008	construction of 14 classrooms, and painting
144	Venasteeg te Latour	State Budget	2007	renovation/ painting
145	VOS Copieweg	State Budget	2010	construction of 10 classrooms, ancillary spaces, and fencing
146	Vos Internat	State Budget	2008	renovation
147	VOS Tamanredjo	State Budget	2010	construction of 10 classrooms, ancillary spaces, and fencing
148	VWO 4/Havo2	State Budget	2010	fencing
149	VWO IV	State Budget	2010	laboratory / painting
150	W. Monkouschool	State Budget	2009	painting
151	Welgelegen I	State Budget	2011	fencing
152	Willen Van Lierschool	State Budget	2010	renovation
153	Wim bos Verschuurschool	State Budget	2009	painting
154	Wim Bosch Verschuursch	State Budget	2008	renovation
155	Zaailand Internaat	State Budget	2010	renovation/ painting/ fencing

ANNEX 4 -
SUGGESTED FORMATS FOR PROGRAM REPORTS

DAILY ENVIRONMENTAL LOG

Location:	Week: [from xx to xx]

General Construction and Site Management	M	T	W	T	F	S	S	Comments
• Structures being constructed as shown on the contract drawings?								
• Contractors employ local labor? How many?								
• Adequate sanitary facilities provided for workers?								
• Work site is clean and free from rubbish?								
• Adjacent paved roads are clean and free from dust/mud?								
Water and Wastewater								
• Fuel and other chemicals storage bunded?								
• Fuel and other chemicals stored away from watercourses?								
• Adequate water supply provided for workers?								
• Wastewater discharges properly treated?								
Soil Erosion and Drainage								
• Erosion and sediment control measures in place at and around site?								
• Construction sites free from water/puddling?								
• Exposed soil revegetated?								
• Adequate drainage maintained?								
Waste Management								
• Adequate waste disposal receptacles provided at worksite?								
• No wastes dumped into rivers or vegetated areas?								
• Waste oil, paint and other refuse properly disposed of?								
• Waste materials from construction recycled?								
Dust and Noise								
• Water sprinkled in areas subject to dust?								
• Machines and vehicles well maintained and regulated?								
• Noisy activities during schools hours?								
Vegetation and Fauna								
• Vegetation removed to the extent necessary for the works?								
• Removed vegetation properly disposed?								
• Hunting, shooting, tapping, egg-collection?								
Health and Safety								
• Barricades or fencing provided to ensure public safety?								
• Clear pedestrian paths provided?								
• Safety training provided to workers?								
• Workers wearing protective gears (hard hats, boots, etc.)?								
• First-aid kits available at worksite?								
• Emergency transportation available at worksite?								
Community Relations								
• Are there complaints from the school staff?								
• Are there complaints from the local community?								
• Meetings with local community?								

DAILY ENVIRONMENTAL LOG

Location:	Week: [from xx to xx]

NON COMPLIANCES

CORRECTIVE ACTIONS TAKEN

ADDITIONAL COMMENTS

Environmental Manager [name and signature]

Ministry of Education and Community Development
Second Basic Education Improvement Program (2nd BEIP)

NOTICE OF WORK COMPLETION

Location:	Date of Completion:

Works Performed and Main Difficulties:

General Site Conditions:

Non-Compliances and Correction Actions Undertaken:

Additional Comments (attach photos)

Environmental Manager [name and signature]

novoa consultoria ambiental

Ministry of Education and Community Development
Second Basic Education Improvement Program (2nd BEIP)

CORRECTIVE ACTION REPORT

Location:	Date:

Nature of Non-Compliance:

Description of Corrective Action Taken (attach photo)

Environmental Manager [name and signature]

Ministry of Education and Community Development
Second Basic Education Improvement Program (2nd BEIP)

INSPECTION REPORT

Location:	Date:			
General Construction and Site Management	**1**	**2**	**3**	**4**
• Structures being constructed as shown on the contract drawings?				
• Contractors employ local labor? How many?				
• Adequate sanitary facilities provided for workers?				
• Work site is clean and free from rubbish?				
• Adjacent paved roads are clean and free from dust/mud?				
Water and Wastewater				
• Fuel and other chemicals storage bunded?				
• Fuel and other chemicals stored away from watercourses and wetlands?				
• Adequate water supply provided for workers?				
• Wastewater discharges properly treated?				
Soil Erosion and Drainage				
• Erosion and sediment control measures in place at and around site?				
• Construction sites free from water/puddling?				
• Exposed soil revegetated?				
• Adequate drainage maintained?				
Waste Management				
• Adequate waste disposal receptacles provided at worksite?				
• No wastes dumped into rivers or vegetated areas?				
• Waste oil, paint and other refuse properly disposed of?				
• Waste materials from construction recycled?				
Dust and Noise				
• Water sprinkled in areas subject to dust?				
• Machines and vehicles well maintained and regulated, avoiding excessive noises?				
• Noisy activities during schools hours?				
Vegetation and Fauna				
• Vegetation removed to the extent necessary for the works?				
• Removed vegetation properly disposed?				
• Hunting, shooting, tapping, egg-collection?				
Health and Safety				
• Barricades or fencing provided to ensure public safety?				
• Clear pedestrian paths provided?				
• Safety training provided to workers?				
• Workers wearing protective gears (hard hats, boots, etc.)?				
• First-aid kits available at worksite?				
• Emergency transportation available at worksite?				
Community Relations				
• Are there complaints from the school staff?				
• Are there complaints from the local community?				
• Meetings with local community?				

Ministry of Education and Community Development
Second Basic Education Improvement Program (2nd BEIP)

INSPECTION REPORT

Location:	Date:

Complaints From Affected Communities

Unanticipated Impacts

NON-COMPLIANCES	Verbal/written notice issued?

Progress in correcting non-compliances

Environmental Inspector [name and signature]

1 = good condition; 2 = minor correction actions required; 3 = significant correction action required; 4 = significant and immediate correction actions required

NON-COMPLIANCE NOTICE

Location:	Date:

Nature of Non-Compliance:

Description of Corrective Action Required

Environmental Inspector [name and signature]

CORRECTIVE NOTICE

Location:	Date:

Unexpected Impact or Site Conditions

Additional Mitigation Action Required:

Environmental Inspector [name and signature]

Ministry of Education and Community Development
Second Basic Education Improvement Program (2nd BEIP)

ENVIRONMENTAL COMPLETION REPORT

Location:	Date of Completion:

Works Performed:

Construction Site Clean-up and Restoration	Yes	No	n/a	Comments
All latrines and temporary buildings removed from site?				
All garbage, scrap material and waste removed?				
All cut vegetation material removed?				
Surface drainage restored?				
Site has been graded to uniform grade?				
Revegetation performed?				
Stock piles and borrow pits restored?				

Non-Compliances and Corrective Actions

Issues Raised by the Community

Additional Comments

Environmental Inspector [name and signature]

ANNEX 5 - DRINKING WATER QUALITY[16]

[16] The extractions of information in Annex 5 are the World Health Organisation and International Finance Corporation drinking water quality guidelines and the IDB Water Sector Note. The information in this section was compiled from the different sources by José Luis de la Bastida (VPS/ESG); Marcello Basani (WSA/CGY); and Annelle Bellony (EDU/CSU).

1. Introduction

1.1. Construction Work, Renovation and Repairs

If not properly planned and managed, renovation, repairs and modifications to buildings and associated water supplies can lead to introduction of microbial and chemical hazards. Where water distribution systems are extended, modified or repaired, there will be periods when flow is stopped and when pipework is intentionally cut and left open for periods, allowing potential ingress of contamination.

Hazardous events that could occur during construction, extension or repairs of systems include:

- the use of inappropriate materials—this can include using metallic products that are incompatible with existing materials in the system, causing corrosion;
- microbial or chemical contamination during repair or maintenance;
- accidental cross-connection between systems delivering different water qualities—renovation work may highlight deficiencies in labeling of existing pipework, which should be rectified;
- temporary switching to alternative supplies during construction, as well as introduction of temporary stagnation, dead legs and blind ends;
- failure to upgrade heating capacity when hot-water systems are extended;
- changes to the established equilibrium of operation in terms of hydraulic conditions, thermal capacity and corrosion risks; for example, renovating or altering the type of system could change performance, and extending the system may increase the total pressure too much for regulation valves to counterbalance, making equilibrium among loops impossible.

Extensions and renovations should not be assessed as separate entities from the existing system. Modifications can have wide-ranging ramifications on performance of the existing system through changing flow patterns, increasing capacity requirements and complexity.

Renovations leading to change of use (e.g. from a commercial building to an educational institute or government complex) can be particularly complex and involve substantial changes to water systems and water usage. After construction, the existing system and extension should be considered as a single "new" system to be reassessed for potential hazardous events. Water safety plans (WSPs) need to be reviewed and amended following any significant modifications. Changes need to be recorded in system descriptions and distribution system maps.

In new buildings and upgraded parts of buildings, appropriate planning, construction and commissioning provides the first opportunity to apply control measures for preventing hazards and minimizing risks related to potable water supply and quality and related hygiene issues.

1.2 Planning

Initial planning of new buildings and upgrades for existing buildings often give little attention to water quality and hygiene issues. Functional and aesthetic features of a new building are generally given higher priority. Planning and designing safe water systems normally has to adapt to a physical framework that is already set. Planning of water systems is commonly left to subcontractors or subordinates in teams of designers. If not integrated in early stages of

planning, there can be major consequences for the functionality and safety of water distribution within the building. Malfunction of water installations and subsequent retrofitting and remedial action can be very expensive and can interrupt construction or commissioning. Therefore, it is important to include specialists for water utility planning as soon as possible.

Definitions of water usage in new buildings are often imprecise, particularly in multipurpose buildings. This can be exacerbated where the intended uses of a new building are not known or are subject to substantial changes during the planning phase. Owners may not have decided where to put certain devices and end-of-use equipment, and can often be unaware of consequences and associated risks. Calculations of water usage and appropriate dimensions of the water distribution system are essential to ensure that systems are designed with appropriate capacities. This involves consideration of how the system and any associated equipment are to be used (e.g. numbers of users, frequency). Both over- and under-estimation of water capacity can compromise safety. As much detail as possible about projected water use and equipment requirements must be obtained from owners or intended users of buildings.

1.3 Construction phase

The initial plan for water distribution facilities should be followed wherever practical. If changes are made, they need to be incorporated into an amended plan; this includes changes to materials or dimensions of pipework and equipment. It is not appropriate to use working sketches from the planning office that do not reflect the actual installation. Risks of biofilm formation or corrosion can be reduced by using only materials that are certified for use with drinking-water. Using incorrect or inferior—and possibly cheaper— alternatives will generally incur high costs for subsequent corrective measures.

Special care must be taken with procedures that are known to be crucial for system performance. It is essential that only water of drinking quality comes in contact with fittings and materials, even during construction. Alternatively, measures should be taken to ensure that the dead water is completely removed and the new fittings are flushed before being commissioned.

Pressure tests for distribution systems can be critical. Sometimes, water of lower quality is used for this purpose. While draining, flushing and high-dose chlorination can reduce risks from contamination, they may not always be completely successful. The pressure test should be used (with air, oil-free gas or drinking-water) to avoid this risk of residual contamination. If lower quality water is used, the system must be thoroughly drained and disinfected afterwards.

Timing also needs to be considered. Construction of a large building is often done in several phases. It is important to keep all finished parts of the water installation dry until the whole system is commissioned for routine operation. Introducing water into the system too early (e.g. weeks or months before a system becomes fully operational) can cause long-term problems. Retained water will become stagnant and support growth of biofilms, which are difficult to remove. Wherever possible, water should only be added to the system as a final step before it becomes operational. If this is not possible, sections that remain stagnant for extended periods should be thoroughly drained and disinfected before the system is commissioned.

1.4 Operational monitoring of control measures

A key requirement in identifying control measures is that performance can be monitored. Thus, operational monitoring procedures need to be established for each newly identified or existing control measure. Operational monitoring is used to assess the performance of individual control measures to ensure that they are working effectively, as designed. Monitoring frequencies should be selected to ensure that corrective actions can be introduced in a timely fashion to prevent loss of control and development of hazardous situations.

Water Safety Plans (see Section 8.4 for details on WSPs) should incorporate a monitoring plan to answer the following questions:

• What will be monitored?

• How will it be monitored?

• Where will it be monitored?

• When and how often will it be monitored?

• Who will do the monitoring?

• Who will receive the results for analysis and, where necessary, ensure appropriate remedial responses are implemented?

Operational monitoring does not necessarily involve complex and time-consuming microbial or chemical tests. It rather takes the form of a planned sequence of inspections of observable features. Many of the operational monitoring requirements involve regular inspection (e.g. checking structural integrity of storage tanks) or auditing of maintenance procedures (e.g. checking that devices have been maintained according to manufacturers' instructions). Appendix provides example of inspection forms.

Operational monitoring can include relatively simple field measurements, such as monitoring for turbidity, the appearance of the water, temperature and chlorine residuals. The general principle is that frequent performance of quick field tests is preferable to infrequent and expensive laboratory-based testing.

2 Background on Suriname Water Framework[17]

2.1 Overview

Suriname has two rainy and two dry seasons. The big rainy season lasts from April to July and the long dry season from August to November. The annual rainfall is approximately 2,000 mm. However, occasionally droughts can cause difficulties in the provision of adequate water supply. Despite having six major rivers[18], these do not serve as a water supply source, due to tidal effects. As a result the country relies on groundwater to meet water supply needs. The overall water quality is good, but saline intrusion is increasingly affecting water quality. Most of the rural areas use surface water for their water supply. However, mercury pollution from gold-mining processes in the Interior, and the lack of wastewater and solid waste services is a source of contamination. The lack of a national water sector and water law exacerbates these problems.

There is no law that comprehensively regulates the water supply, wastewater and sanitation sector as a whole. The legislation is fragmented in a number of laws, acts, resolutions and instructions, many of which are only in draft form. There is a lack of defined roles and responsibilities; the roles of policy formulation (governance), service provision and regulation are mixed; and there are no law or policies on water resources management and protection.

There is reportedly a Water Supply Law regulating water supply services and protecting water resources, which was submitted to the Cabinet of Ministers in 1994 but never signed. The existing legislation regarding health and environmental issues is vague and antiquated, being more than 50 years old. A number of draft laws will soon be submitted to parliament for discussion and approval.[19] If ratified, these legislations would represent an important step towards a better water, wastewater and sanitation sector. In the absence of national water resources management and protection, this document recommends the use of the guidelines developed by the International Finance Corporation (IFC) and the World Health Organisation (WHO).[20]

The Government of Suriname (GOS) designated responsibilities for drinking water supply to two entities. Potable water supply in the districts of Paramaribo, Wanica, Para, Nickerie, and Marowijne (Albina and Moengo)[21] is provided by the N.V. *Surinaamsche Waterleiding Maatschapij* (SWM, Suriname Water Company), a government-owned utility that supplies water to approximately 70% of Suriname's population[22]. The Department for Water Supply under the Ministry of Natural Resources (DWV/NH) is responsible for supplying drinking water in the

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[17] Information derived from IDB Water Sector Note.

[18] Rivers include the Marowijne, the border river with French Guyana in the east; the Corantijn, the border river with Guyana in the west; and Suriname River; the Commewijne (with its major tributary, the Cottica); the Coppename, the Saramacca and the Nickerie.

[19] A Law on the protection of water and filtration areas (Wet Grondwater beschermingsgebieden); a Law on the Supervision of the production of (ground) drinking water (Wet Onttrekking van Grondwater), and; a Law on the Supervision of drinking water quality (Wet Toezicht Drinkwaterkwaliteit).

[20] The WHO guidelines are available at: http://www.who.int/water_sanitation_health/dwq/en/ The IFC guidelines are available at: www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

[21] In the district of Para, SWM provides water only in the Republic area.

[22] Formed in 1933, N.V. SWM is a wholly government-owned limited liability company. It operates under a concession contract signed with the Government in 1933 for a period of 50 years. The SWM concession contract expired in 1982 and has not been renewed since.

coastal rural areas and in the Interior, which account for approximately 21% of the population of the country. The Ministry of Natural Resources has the overall responsibility for water policy for both institutions. The Fund for Development of Interior (FOB), which works under the auspices of the Ministry of Regional Development, plans and builds water supply systems for the Interior; however it plays no role in providing operation and maintenance of the systems, which resides within the Ministry of Natural Resources.

SWM. SWM, created in 1933, provides water supply services to the large majority of Suriname's population, equivalent to 76,165 households (approximately 350,000 people), all of which are metered. Overall production and distribution capacity has been estimated at 86,000 m^3 per day, which is predominantly extracted from 78 wells relying on three aquifers: the Zanderij, the Coesewijne, and the A-sand aquifer, with the Zanderij being the largest source of water.

NH/DWV. The Water Supply Division of the Ministry of Natural Resources (NH/DWV), created in 1962, is responsible for the water supply of rural areas, namely the coastal area that have not been transferred to SWM and the Interior, which include a population of approximately 180,000 inhabitants. NH/DWV organization is part of the administrative structure of the Ministry and the facilities of the Service are managed as an administrative department.

Other agencies with responsibilities in the water sector include: (i) the Ministry of Health, which monitors environmental health; (ii) the Ministry of Agriculture, Animal Husbandry and Fisheries, which is responsible for irrigation; (iii) the Hydraulic Research Division of the Ministry of Public Works, which promotes the optimum utilization, management and protection of water resources. The National Institute for Environment and Development in Suriname *(Nationaal Instituut voor Milieu & Ontiwikkeling in Suriname, NIMOS),* established in 1998, is the institution responsible for the application of environmental impact assessment at project levels.[23]

A "Sector Analysis of Drinking Water Supply and Sanitation in Suriname" was prepared with the assistance of PAHO in the fall of 1998, and published in 1999. The strategy was adopted by the GOS as national strategy for the development of the water and sanitation sector. Stated policy goals of the Ministry of Natural Resources on the supply of drinking water include:[24]

- Securing the sustainable and efficient supply of potable water in the interest of public health and overall socio-economic development in general;
- Arranging for the protection and sustainable management of drinking water (re)sources;
- Promoting the efficient production of drinking water for the benefit of the NH/DWV habitants at an economical sound but reasonable compensation; and
- Expanding the manageability of the organization of the water supply system by joining some of the production and distribution areas.

2.2 Water Sector: Problems Identified

[23] Currently there is no Environmental Impact Assessment (EIA) legislation in Suriname, and therefore no formal (legal based) environmental permits are issued. However, NIMOS has prepared a set of guidelines based on World Bank guidelines for EIAs using similar categories and terminologies as the World Bank. Furthermore, NIMOS allows public disclosure through their office and website for the benefit of the general public.

[24] Source: Ilaco Suriname N.V., "Feasibility Study of the Wanica Water Supply System", Oct 2009

According to the Pan-American Health Organisation (PAHO), the population with access to an improved drinking water source in Suriname has increased of about 20% in the last 30 years. However, according to the MDG Progress Report 2009, although about 91.7% of the population is obtaining their drinking water from improved sources, large disparities remain between the urban coastal (97.1%), rural coastal (97.9%) and (44.8%) rural interior. In addition, the quality of potable water service is precarious in urban areas and inadequate in many rural communities. Due to the problems faced by the water supply services, the identification of guidelines for water management for the construction of educational facilities in particular in Suriname's Interior requires the articulation of clear guidelines. The water supply problems with implication for the ESMP for educational constructions and renovations include:

1. Water Supply
    a. Groundwater – (i) saltwater intrusion in the coastal areas where most of the population lives and where the abstraction rates are the highest; (ii) low storage capacity.
    b. Surface water - increased pollution from gold-mining activities and lack of proper sanitation.
2. Lack of a proper institutional and legal framework;

2.3 Water Service in the Greater Paramaribo Area. The water supply system in Greater Paramaribo, relies almost entirely on groundwater extraction, and this is operating under constant challenges, the main problems including: (i) old pipes, the majority of which were laid more than 40 years ago (including several kilometers of asbestos-cement pipes laid in the 1950s and the 1960s); (ii) insufficient maintenance of the infrastructure, limited rehabilitation activities and inefficient energy use; (iii) increasing demand for water, with an average annual population growth in the Greater Paramaribo area estimated at approximately 1.2% (from census data); As a result, these problems have led to: (i) a gradual deterioration of the network, with NRW levels estimated as high as 45%, and the number of malfunctioning micrometers (installed on 100% of SWM connections) surpassing 20%; (ii) electromechanical efficiency of equipment as low as 46%, which combined with the current operation and maintenance practices suggest that significant energy and production savings could be achieved through an energy efficiency program, even with the current low energy costs; and (iii) although overall water quality is acceptable, saltwater intrusion has occurred in some wells due to over-pumping, which leads to increase treatment requirements.

2.4 Water Service in the Rural Areas. The rural areas served by NH/DWV, most of which are in the Interior, are comprised of approximately 40 systems.[25] Most of the water supply infrastructure in the areas remote from the capital was damaged in the late 1980s and early 1990s during the civil war. Since then, little has been done to improve or replace the infrastructure. Some of the problems currently being experienced are: (i) depleted infrastructure, with NRW levels estimated to be over 60% in the peri-urban and rural coastal areas; (ii) difficulties in servicing such a large area with a low population density; (iii) potential mercury pollution from gold-mining processes and untreated wastewater in the Interior, where

[25] The information to date is not definite. There are roughly 70 water systems installed in Interior areas. The Interior department of NH/DWV controls about 30 facilities, most of which are operational. The majority of the remaining systems are not operational or abandoned.

surface water is the most common source of supply; (iv) absence of a water quality monitoring program; and (vii) limited inspection, control and enforcement on the production and distribution systems.

Sections 3 – 8 provide excerpts from the WHO and IFC drinking water quality guidelines to include: description of drinking water supply; water supply hazards; water treatment methods; hygiene and disease prevention; hygiene education; and roles and responsibilities of water supply safety personnel.

3 General Description Drinking Water Supply: WHO Perspective

Access to water of an adequate quality is essential for public health and hygiene. A drinking water supply system typically includes the following elements:

- A water source, such as a river, lake, reservoir, or groundwater aquifer where water collects, as well as the surrounding watershed or recharge area that supplies water to the source and a means of extracting and transporting water from the source to a point of treatment.
- A treatment facility for water purification.
- Treated water storage facilities and a distribution system to deliver treated water from storage to consumption.

3.1 Water Sources

Traditional sources for potable water treatment include groundwater resources and surface water. Where surface or groundwater of adequate quality is unavailable, other sources of water including seawater, brackish water, etc. may be used to produce potable water.

3.1.1 Groundwater: Groundwater is recharged from and flows to the surface naturally, and provides a long-term reservoir in the natural water cycle, with residence times ranging from days to millennia. Groundwater quality varies depending on the source, but generally has good clarity because of the natural filtering of groundwater as it passes through porous soil layers. In general, deep groundwater has low concentrations of pathogenic bacteria but may be rich in dissolved solids, especially carbonates and sulfates of calcium and magnesium. The bacteriological quality of shallow groundwater can be variable depending on the nature of the recharge area. A variety of soluble materials may be present including potentially toxic metals such as zinc, copper, and arsenic.

3.1.2 Surface Water: Surface water quality is highly dependent on the source. Upland lakes and reservoirs are typically located in the headwaters of river systems upstream of human habitation. Bacteria and pathogen levels are usually low, but some bacteria, protozoa or algae will be present. Where uplands are forested or peaty, humic acids can color the water. Many upland surface water sources have low pH. Rivers, canals, and low-land reservoirs generally have higher bacterial concentrations and may also contain algae, suspended solids, and a variety of dissolved constituents.

3.1.3 Other Water Sources: Other water sources include seawater and brackish water, which contain high concentrations of dissolved solids, which must be removed to make the water suitable for domestic, agricultural, and industrial uses.

3.2 Main Forms of Water Access in Suriname's Interior

In Suriname, drinking water is accessed through piped distribution, wells and rain water harvesting. The pertinent issues related to these forms are discussed below.

3.2.1 Piper Water Distribution and Storage

Water distribution systems include all of the components necessary to carry drinking water from a centralized treatment plant or well supplies by means of gravity storage feed or pumps through distribution pumping networks to the consumers, including distribution and equalization storage. These systems consist of pipes, pumps, valves, storage tanks, reservoirs, meters, fittings, and other hydraulic appurtenances. Distribution systems are designed and operated to deliver water of quality acceptable for human consumption and of sufficient quantity to meet all the needs of the customers. Many distributions also provide sufficient capacity for non-potable uses, including irrigation, landscaping, and fire suppression. Most water distribution pipes are constructed of ductile iron, prestressed concrete, polyvinyl chloride, reinforced plastic, and steel. In the past, unlined cast iron and asbestos cement pipes were also used, and may be important components of existing systems.

Water distribution systems may have a branch or loop network topology, or a combination of both. In a branch system, smaller pipes branch off or larger ones throughout the system such that water can take only one pathway from the source to the consumer. A loop system comprises connected pipe loops throughout the service area such that water can take several pathways from the source to the consumer. In a loop system, if any one section of water distribution main fails or needs repair, that section can be isolated without disrupting all users on the network. Most water distribution networks include both loop and branch components.

Storage tanks and reservoirs are used to provide storage capacity to meet fluctuations in demand, to provide reserve supply for fire suppression and other emergency needs, to stabilize pressures in the distributions system, to increase operating convenience an provide flexibility in pumping, to provide water during source or pump failures, and to blend different water sources. Elevated tanks are used most frequently, but other types of tanks and reservoirs include in-ground tanks and open or closed reservoirs.

The water distribution system needs energy in the form of pressure to deliver the treated water. That energy can be supplied by a pump, by gravity feed from a water source (such as a reservoir or a water tower) at a higher elevation, or, in smaller systems, by compressed air. Valves are used to isolate sections of the network for maintenance and repair. Control valves are used to control the flow and pressure in the distribution system.

Ideally, the water quality should not change between the time it leaves the treatment plant and the time it is consumed. However, substantial changes can occur to finished water in the distribution system as the result of complex physical, chemical, and biological reactions. For example, tanks sized to provide adequate supply for fire suppression needs may have low turnover rates and low levels of disinfectant residual, leading to biofilm growth and other biological changes in the water such as nitrification. Design and operation of the distribution system can minimize such effects.

3.2.2 Wells

Open or poorly covered well heads pose the commonest risk to well-water quality, since the water may then be contaminated by the use of inappropriate water-lifting devices by consumers. The most serious source of pollution is contamination by human and animal waste from latrines, septic tanks, and farm manure, resulting in increased levels of microorganisms,

including pathogens. Contamination of drinking-water by agrochemicals such as pesticides and nitrates is an additional and increasing problem for small-community supplies.

Dug wells are generally the worst groundwater sources in terms of fecal contamination, and bacteriological analysis serves primarily to demonstrate the intensity of contamination and hence the level of the risk to the consumer.

The upgrading of unprotected wells and the construction of protected wells for community use should be strongly promoted. Many families worldwide still depend on private and public dug wells (for example in Commewijne District in Suriname); technical assessment and improvement of these wells is therefore very important. The commonest physical defects leading to fecal contamination of dug wells are associated with damage to, or lack of, a concrete plinth, and with breaks in the parapet wall and in the drainage channel. However, the most hazardous gross fecal contamination is most commonly associated with latrines sited too close to the well. Emergency relocation of either the latrines or the water source is essential when such serious problems are encountered.

An open dug well is little better than an unprotected hole in the ground if the above-mentioned physical barriers to surface-water contamination are not regularly maintained. The majority of open dug wells are contaminated, with levels of at least 100 faecal coliforms per 100 ml, unless very strict measures are taken to ensure that contamination is not introduced by the bucket.

A community dug well with a windlass whereby *one* bucket is suspended over the well in a narrow opening is an improvement on each individual using his or her own bucket. Water quality should be greatly improved by the installation of a hand-pump and the fitting of a sanitary cover to an open dug well, access being restricted by a lockable sanitary lid, which prevents any contamination of the well by buckets. However, even this relatively costly improvement may fail to reduce contamination significantly unless the well lining is made watertight down to the dry-season water-table.

3.2.3 Rainwater harvesting: Rainwater harvesting is widely practiced at a household level and is a noticeable source of water for educational institutions in some areas in the Interior of Suriname. The development of formal water safety plan at the household and schools level may not always be practical, but promotion of sanitary inspection with simple good practice is important. Well-designed rainwater harvesting systems with clean catchments, covered cisterns and storage tanks, and treatment, as appropriate, supported by good hygiene at point of use, can offer drinking-water with very low health risk.

Rainwater is initially relatively free from impurities, except those picked up by the rain from the atmosphere. However, the quality of rainwater may subsequently deteriorate during harvesting, storage and household use. Wind-blown dirt, leaves, fecal droppings from birds and other animals, insects and litter on the catchment areas, such as roofs and in cisterns, can contaminate rainwater, as can particles from the atmosphere, such as soot from burning materials (e.g. old tires, school waste and other communal waste). Regular cleaning of catchment surfaces and gutters should be undertaken to minimize the accumulation of debris. Wire meshes or inlet filters should be placed over the top of downpipes to prevent leaves and other debris from entering storage containers and cleaned regularly to prevent clogging.

Materials used in the catchment and storage tank should be approved for use in contact with drinking-water and should not leach contaminants or cause taste, odor or discoloration. As rainwater is slightly acidic and very low in dissolved minerals, it can dissolve metals and other impurities from materials of the catchment and storage tank, resulting in unacceptably high concentrations of contaminants in the water.

Most solid roof materials are suitable for collecting rainwater, but roofs with bitumen based coatings are generally not recommended, as they may leach hazardous substances or cause taste problems. Care should be taken to ensure that lead-based paints are not used on roof catchments. Thatched roofs can cause discoloration or deposition of particles in collected water.

Poor hygiene in water storage and abstraction from storage containers or at the point of use can also represent a health concern, but risks can be minimized by good design and practice. Fecal contamination is quite common, particularly in samples collected shortly after rainfall, but can be minimized by good practice. Higher microbial concentrations are generally found in the first flush of rainwater, decreasing as the rain continues; therefore, microbial contamination is less in rainy seasons when catchments are frequently washed with fresh rainwater. A system to divert the contaminated first flow of rainwater from roof surfaces is necessary, and automatic devices that prevent the first flush of runoff from being collected in storage are recommended. If diverters are not available, a detachable downpipe can be used manually to provide the same result.

Storage tanks can present breeding sites for mosquitoes, including species that transmit dengue virus. Covers discourage mosquito breeding and help to prevent fecal contaminants and sunlight, which will promote algal growth, from reaching the water. Covers should be fitted, and openings need to be protected by mosquito-proof mesh. Cracks in the tank can result in contamination of stored water, whereas water withdrawal using contaminated containers is a potential cause of both fecal and chemical contamination. Storage containers should preferably be fitted with a mechanism such as a tap or outlet pipe that enables hygienic abstraction of water.

Further treatment at the point of consumption may be applied to ensure better quality of drinking-water and reduce health risk. Solar water disinfection and point of- use chlorination are examples of low-cost disinfection options for the treatment of stored rainwater. These and other household water treatment technologies are discussed in more detail in the microbial and chemical sections below.

4. Hazard Associated with Drinking Water

There are two main types of hazards associated with drinking water, and these include: microbial and chemical hazards. The details on both types follow below:

4.1 Microbial hazards associated with drinking-water

Infectious diseases caused by pathogenic bacteria, viruses and parasites (e.g. protozoa and helminths) are the most common and widespread health risk associated with drinking-water. The public health burden is determined by the severity and incidence of the illnesses associated with pathogens, their infectivity and the population exposed. In vulnerable subpopulations, disease outcome may be more severe.

Breakdown in water supply safety (source, treatment and distribution) may lead to large-scale contamination and potentially to detectable disease outbreaks. In some cases, low-level, potentially repeated contamination may lead to significant sporadic disease, but public health surveillance is unlikely to identify contaminated drinking- water as the source.

Waterborne pathogens have several properties that distinguish them from other drinking-water contaminants; key of these is that pathogens can cause acute and also chronic health effects; if infection is established, pathogens multiply in their host and certain waterborne pathogens are also able to multiply in food, beverages or warm water systems, perpetuating or even increasing the likelihood of infection.

Quantitative microbial risk assessment, a mathematical framework for evaluating infectious risks from human pathogens, can assist in understanding and managing waterborne microbial hazards, especially those associated with sporadic disease.

4.2 Chemical hazards in drinking-water

A few chemical contaminants have been shown to cause adverse health effects in humans as a consequence of prolonged exposure through drinking-water. However, this is only a very small proportion of the chemicals that may reach drinking-water from various sources. In the case of Suriname, mercury in surface water is a source of concern.

The substances considered here have been assessed for possible health effects, and guideline values have been established only on the basis of health concerns. Some substances of health concern have effects on the acceptability of drinking-water that would normally lead to rejection of the water at concentrations significantly lower than those of health concern. For such substances, no formal guideline value is usually proposed, but a health-based value may be needed, for instance, in order to assist in judging the response required when problems are encountered and in some cases to provide reassurance to health authorities and consumers with regard to possible health risks.

Regulators are required to establish health-based targets that must be met through water safety plans. In the case of chemical contaminants, these are normally based on the guideline value, which is, in turn, based on health-related end-points. In this case, the guideline value and the local water quality target are similar, but not necessarily identical, because the latter value may need to be adjusted to take into account local sociocultural, economic and

environmental/geological circumstances. Guideline values provide a benchmark for the development of local water quality targets for chemicals. Hence, in developing national drinking-water standards based on these WHO Guidelines, it will be necessary to take account of a variety of environmental, social, cultural, economic, dietary and other conditions affecting potential exposure. This may lead to national standards that differ appreciably from these Guidelines.

The probability that any particular chemical may occur in significant concentrations in any particular setting must be assessed on a case-by-case basis. The presence of certain chemicals may already be known within a particular country, but others may be more difficult to assess.

In most countries, whether developing or industrialized, water sector professionals are likely to be aware of a number of chemicals that are present in significant concentrations in some drinking-water supplies. A body of local knowledge that has been built up by practical experience over a period of time is invaluable. Hence, the presence of a limited number of chemical contaminants in drinking-water is usually already known in many countries and in many local systems. Significant problems can occur, however, when chemicals posing high health risk are widespread but their presence is unknown, because their long-term health effect is caused by chronic exposure as opposed to acute exposure. Such has been the case of arsenic in groundwater in Bangladesh and West Bengal, India, for example.

For many contaminants, there will be exposure from sources other than drinking water, and this may need to be taken into account when setting, and considering the need for, standards. It may also be important when considering the need for monitoring. In some cases, drinking-water will be a minor source of exposure, and controlling levels in water will have little impact on overall exposure. In other cases, controlling a contaminant in water may be the most cost-effective way of reducing exposure. Drinking-water monitoring strategies should therefore not be considered in isolation from other potential routes of exposure to chemicals in the environment.

Chemical contaminants in drinking-water may be categorized in various ways; however, the most appropriate is to consider the primary source of the contaminant— that is, to group chemicals according to where control may be effectively exercised. This aids in the development of approaches that are designed to prevent or minimize contamination, rather than those that rely primarily on the measurement of contaminant levels in final waters.

In general, approaches to the management of chemical hazards in drinking-water vary between those where the source water is a significant contributor (with control effected, for example, through source water selection, pollution control, treatment or blending) and those from materials and chemicals used in the production and distribution of drinking-water (controlled by process optimization or product specification).

In these Guidelines, chemicals are therefore divided into five major source groups, as shown in Table 4.1.

Table 4.1. Categorization of source of chemical constituents

Source of chemical constituents	Examples of sources
Naturally occurring	Rocks, soils and the effects of the geological setting and climate; eutrophic water bodies (also influenced by sewage inputs and agricultural runoff)
Industrial sources and human dwellings	Mining (extractive industries) and manufacturing and processing industries, sewage (including a number of contaminants of emerging concern), solid wastes, urban runoff, fuel leakages
Agricultural activities	Manures, fertilizers, intensive animal practices and pesticides
Water treatment or materials in contact with drinking-water	Coagulants, DBPs, piping materials
Pesticides used in water for public health	Larvicides used in the control of insect vectors of disease

4.3 Estimations of Exposure Assessment to Pathogens

Exposure assessment in the context of drinking-water consumption involves estimation of the number of pathogens to which an individual is exposed, principally through ingestion. Exposure assessment inevitably contains uncertainty and must account for variability of such factors as concentrations of pathogens over time and volumes ingested. Exposure can be considered as a single dose of pathogens that a consumer ingests at a certain point in time or the total amount over several exposures (e.g. over a year). Exposure is determined by the concentration of pathogens in drinking-water and the volume of water consumed.

It is rarely possible or appropriate to directly measure pathogens in drinking-water on a regular basis. More often, concentrations in raw waters are assumed or measured, and estimated reductions—for example, through treatment—are applied to estimate the concentration in the water consumed. Pathogen measurement, when performed, is generally best carried out at the location where the pathogens are at highest concentration (generally raw waters). Estimation of their removal by sequential control measures is generally achieved by the use of indicator organisms such as *E. coli* for enteric bacterial pathogens.

The other component of exposure assessment, which is common to all pathogens, is the volume of unboiled water consumed by the population, including person-to-person variation in consumption behavior and especially consumption behavior of vulnerable subpopulations. For microbial hazards, it is important that the unboiled volume of drinking-water, both consumed directly and used in food preparation, is used in the risk assessment, as heating will rapidly inactivate pathogens. This amount is lower than that used for deriving water quality targets, such as chemical guideline values.

The daily exposure of a consumer to pathogens in drinking-water can be assessed by multiplying the concentration of pathogens in drinking-water by the volume of drinking-water consumed (i.e. dose). For the purposes of the example model calculations, drinking-water consumption was assumed to be 1 liter of unboiled water per day, but location-specific data on drinking-water consumption are preferred.

5. Water Treatment Methods

Water treatment could be applied in a drinking-water treatment plant (central treatment) to piped systems or in the home or at the point of use in settings other than piped supplies.

5.1 Central treatment

Waters of very high quality, such as groundwater from confined aquifers, may rely on protection of the source water and the distribution system as the principal control measures for provision of safe water. More typically, water treatment is required to remove or destroy pathogenic microorganisms. In many cases (e.g. poor quality surface water), multiple treatment stages are required, including, for example, coagulation, flocculation, sedimentation, filtration and disinfection.

5.2 Household treatment

Household water treatment technologies are any of a range of devices or methods employed for the purposes of treating water in the home or at the point of use in other settings. These are also known as point-of-use or point-of-entry water treatment technologies (Cotruvo & Sobsey, 2006; Nath, Bloomfield & Jones, 2006. Household and schools water treatment technologies comprise a range of options that enable individuals and communities to treat collected water or contaminated piped water to remove or inactivate microbial pathogens. Many of these methods are coupled with safe storage of the treated water to preclude or minimize contamination after household treatment (Wright, Gundry & Conroy, 2003).

Household water treatment and safe storage have been shown to significantly improve water quality and reduce waterborne infectious disease risks (Fewtrell & Colford, 2004; Clasen et al., 2006). Household water treatment approaches have the potential to have rapid and significant positive health impacts in situations where piped water systems are not possible and where people rely on source water that may be contaminated or where stored water becomes contaminated because of unhygienic handling during transport or in the home. Household water treatment can also be used to overcome the widespread problem of microbial unsafe piped water supplies.

Not all household water treatment technologies are highly effective in reducing all classes of waterborne pathogens (bacteria, viruses, protozoa and helminths). For example, chlorine is ineffective for inactivating oocysts of the waterborne protozoan *Cryptosporidium*, whereas some filtration methods, such as ceramic and cloth or fiber filters, are ineffective in removing enteric viruses. Therefore, careful consideration of the health-based target microbes to control in a drinking-water source is needed when choosing among these technologies.

A summary of water treatment processes are presented in Table 5.1, while the full details on the individual processes are described in Appendix 2.

Table 5.1 Water treatment processes and ranking of technical complexity

Ranking	Treatment Processes (Examples)
1	Simple chlorination Plain filtration (rapid sand, slow sand)
2	Pre-chlorination plus filtration Aeration
3	Chemical coagulation Process optimization for control of DBPs
4	Granular activated carbon treatment Ion exchange
5	Ozonation
6	Advanced oxidation processes Membrane treatment

Source: World Health Organisation

6. Hygiene and Disease Prevention

6.1 Water-washed diseases

A reliable, safe water supply plays an important role in disease prevention, especially by facilitating personal, domestic, and food hygiene. The diseases most affected by the provision of adequate quantities of water for hygienic purposes are referred to as *water-washed*. They may be divided into the following three groups:

- Diseases transmitted by the fecal–oral route, such as hepatitis A, bacillary dysentery, and many diarrhoeal diseases; these are transmitted by water and also by other means, such as food or hands. Improved hygiene therefore contributes to their control.
- Infections of the skin and eyes, such as trachoma, skin infections, and fungal skin diseases. The prevalence of these diseases is related to poor hygiene.
- Infections carried by lice or mites, such as scabies (mites), and louse-borne epidemic typhus (caused by *Rickettsia prowazeki* and transmitted largely by body lice). Good personal hygiene can assist in control.

Provision of water for domestic purposes in adequate quantities and quality will contribute to reducing the incidence of diseases transmitted by the fecal–oral route and other transmissible diseases.

7. Hygiene education

7.1 Scope of hygiene education

7.1.1 Community-based surveillance

Effective and sustainable programmes for the surveillance of water supplies require the active support of local communities, which should be involved at all stages in such programmes, including initial surveys; monitoring and surveillance of water supplies; reporting faults, carrying out maintenance, and taking remedial action; and supportive actions including sanitation and hygiene practices. This will involve setting up a comprehensive educational programme to ensure that the community:

- is aware of the importance of water quality and its relation to health, and of the need for safe water supplies;
- accepts the importance of surveillance and the need for a community response;
- understands and is prepared to play its role in the surveillance process;
- has the necessary skills to perform that role.

7.1.2 Hygiene behaviors

The provision of a good drinking-water supply alone is insufficient to ensure health. There are many stages in the collection, storage, and handling of food, the disposal of excreta, and the care of children at which drinking water can become contaminated and the community exposed to pathogens in excreta. Children, especially those under 5 years of age, are particularly vulnerable to diarrhoea. A common belief is that children's faeces are harmless, whereas in fact they are the main source of infection of other children. Parents may not hygienically dispose of their young children's faeces, young children may not use latrines, and the yards surrounding homes are often contaminated.

There are many transmission routes for water-related and sanitation-related diseases, and hygiene education can therefore cover a wide range of actions. The most important behaviors from the point of view of health will depend on the community, the disease pattern, and the climate. One of the functions of the initial field inspection and surveillance is to determine which behaviors the hygiene educational programme should seek to promote in the community (see Box 7.1. below).

Box 7.1. Behaviors to be recommended in hygiene education

Water source:
- All children, women, and men in the community should use safe water sources for drinking and food preparation.
- Adequate water should be used for hygiene purposes such as bathing, household cleanliness, and clothes washing.
- Water should be efficiently used and not wasted. Wastewater should be properly drained away.
- Improved water sources should be used hygienically and be well maintained.
- There should be no risk of contamination of water sources from nearby latrines, wastewater drainage, cattle, or agricultural chemicals.

Water treatment:
- Simple purification procedures, e.g. chlorination, should be carried out on the water source if necessary.
- If necessary, water should be filtered to remove any solid material, guinea worm, etc.

Water collection:
- Drinking-water should be collected in clean vessels without coming into contact with hands and other materials.
- Water should be transported in a covered container.

Water storage:
- Water should be stored in vessels that are covered and regularly cleaned.
- Drinking-water should be stored in a separate container from other domestic water wherever possible.

Water drinking:
- Drinking-water should be taken from the storage vessel in such a way that hands, cups, or other objects cannot contaminate the water.

Water use:
- Adequate amounts of water should be available and used for personal and domestic hygiene. (It is estimated that a minimum of 30–40 liters per person per day are needed for personal and domestic hygiene.)

Food handling:
- Hands should be washed with soap or ash before food is prepared or eaten.
- Vegetables and fruits should be washed with safe water, and food should be properly covered.
- Utensils used for food preparation and cooking should be washed with safe water as soon as possible after use and left in a clean place.

Excreta disposal:
- All men, women, and children should use latrines at home, at work, and at school.
- The stools of infants and young children should be safely disposed of.
- Household latrines should be sited in such a way that the pit contents cannot enter water sources or the groundwater table.
- Hand-washing facilities and soap or ash should be available, and hands should always be washed after defecation and after helping babies and small children.

Wastewater disposal:
- Household wastewater should be disposed of or reused properly. Measures should be taken to ensure that wastewater is not allowed to create breeding places for mosquitos and other disease vectors or to contaminate safe water.

8. Roles and responsibilities of Water Supply Safety Stakeholders and Surveillance

This section describes the roles of stakeholders and other responsible personnel to ensure that the water supply is safe. Many people are involved in water safety, from the initial water planners to ongoing operation and maintenance providers, and their range of duties is illustrated in this section.

8.1 Background

A large number of stakeholders can influence the safety of water systems within buildings. These stakeholders can be involved in the planning, design, construction and renovation of buildings, as well as development of water safety plans (WSPs), and the ongoing maintenance and operation of water systems. The specific titles of stakeholders and divisions of responsibilities will vary between different countries and jurisdictions, but the broad range of tasks will remain fairly consistent. Stakeholders can include:

- building commissioners who are involved before construction of new buildings or renovation of existing buildings, such as developers, planning officers, architects, design engineers, builders, plumbers, manufacturers and suppliers;
- building operators, including building managers and owners, tenants and employers;
- employees, residents and users of buildings;
- service providers and specialist consultants who provide technical assistance, such as plumbers, maintenance contractors, water-treatment specialists, risk assessors and auditors;
- professional bodies who develop guidance and training;
- infection-control personnel in dental and medical facilities, and infection-control teams in hospitals and health-care facilities;
- regulators responsible for oversight of building and plumbing codes, public health requirements and occupational health and safety;
- public health and environmental health officials;
- standard-setting bodies and certification agencies;
- training providers;
- providers of laboratory services.

8.2 Surveillance of water supplies

Independent surveillance of water supplies is an important element of quality assurance. Surveillance of water systems in buildings will include features similar to those applied to drinking-water supplies, but may also incorporate additional elements to deal with specific uses of the water, with water-using devices such as cooling towers, and with occupational health and safety needs. The resulting surveillance programmes may include a range of activities and agencies. Specific surveillance programmes could also involve agencies responsible for public health and for occupational health and safety.

The role of different agencies and the requirements for specific surveillance programmes should be identified and coordinated to avoid unnecessary duplication, and to ensure that appropriate levels of surveillance are applied to all parts of water systems in buildings. In some cases, surveillance could be performed by third parties such as contractors or registered auditors

under programmes directed by regulators. Such programmes should include mechanisms to monitor the effectiveness of the third-party audits. Surveillance and auditing should include processes for approving WSPs, as well as processes for verifying that WSPs are being implemented appropriately and protect public health effectively.

8.3 Sampling frequencies and parameters

Frequent sanitary inspections and water-quality testing, particularly for microbiological contamination, are essential elements in any surveillance programme aimed at ensuring that drinking-water meets the standards established. In rural areas, where water sources may not be exposed to industrial wastes or agricultural chemicals, testing for most micro-pollutants may not be necessary or feasible. Realistic and flexible sampling frequencies should be established for the parameters that are to be measured. The basic water legislation should not specify sampling frequencies but should give the administration the power to establish a list of parameters to be measured and the frequency of such measurements. However, it must be emphasized that water-supply surveillance is not based solely on laboratory testing, but also on regular sanitary inspections and surveys accompanied by recommendations for remedial action. Follow-up visits will also be required to ensure that such remedial action is taken. Examples of sanitary inspection forms are provided in Appendix 1.

8.4 Water safety plans

This section describes, in more detail, water safety plans (WSPs), including the steps required to set one up, and how the key principles can be applied to buildings. Information is also provided on how to organize a WSP team, and what actions to take if a water supply becomes contaminated. This section also explains risk assessments, control measures, operational monitoring and management procedures. Information that should be considered when designing and constructing new installation systems is also provided.

8.4.1 Background

The continuous delivery of safe water requires effective management and operation throughout the water-supply chain, from catchments to consumer taps and points of use. WSPs provide a preventive risk-management approach that builds on other risk management and quality-assurance principles. They systemize long-established principles and good practices in drinking-water supply, covering both water quality and quantity management issues. These principles also apply to management and use of water-using devices and equipment. WSPs for buildings should address drinking-water networks and consider connected devices and equipment.

The development and implementation of WSPs can be the responsibility of various stakeholders: while WSPs for water treatment and distribution of public water supplies are typically the responsibility of the supplier, WSPs for buildings are the responsibility of building owners or managers, with support from various other stakeholders. The level of detail and complexity of WSPs will depend on the size and nature of the building, including the level of

risks posed by the installation, and on the population exposed to the water system inside the building. Nevertheless, the implementation of well-designed WSPs is recognized as the most effective tool to ensure provision of safe water supplies.

Development of WSPs should not be considered as overwhelming or too complicated. The aim is straightforward: to ensure consistent supply of safe water to consumers. To a large extent, WSPs document established good practice, and the most important step is getting started.

8.4.2 Key principles of WSPs

WSPs are typically developed after the supply system has been designed and constructed. However, where possible, new or renovated systems should be designed and constructed in a way that supports implementation of WSPs. This should include identifying potential hazards, incorporating appropriate control measures (e.g. treatment processes) and considering practical aspects (e.g. ease of access for maintenance, inspection and monitoring).

Irrespective of when they are developed, WSPs should be working documents that are kept up to date and reviewed periodically to ensure that they remain current. WSPs should be reviewed if there are major changes to water supplies and uses.

The mechanisms by which WSPs are developed and applied can vary. In some cases, tasks associated with implementation could be undertaken by an owner, manager or employer. However, they could also be delegated or assigned to competent individuals employed within a building, or to specialist contractors. When tasks are either delegated or contracted, the owner, manager or employer retains the responsibility to ensure that those charged with performing designated functions are competent and that required tasks identified in the WSP are completed and documented appropriately.

8.4.3 Assembling a WSP team

Assembling a team is a core preparatory requirement for the development and implementation of a WSP in a building. The team will be in charge of developing and implementing the WSP—a role that includes identifying hazards, assessing risks, identifying and monitoring control measures, and developing incident protocols.

A responsible person (or WSP coordinator) needs to be identified to lead the team. This person should be either the building manager or a competent person delegated to this task by the manager. The WSP coordinator should have (or acquire) a good knowledge of the technical facilities in the building, and their daily work should be related to the building. Since the coordinator's primary task is to coordinate the process of WSP development and implementation, they should understand the principles associated with development and implementation of WSPs. However, a special technical knowledge in drinking-water and/or sanitation, while useful, is not necessarily required. The coordinator should have the authority to ensure that the WSP is implemented. A building manager is a good choice for the WSP coordinator.

The WSP coordinator needs to form a team of experts who will support WSP development and provide access to all relevant information needed. Team members should include the range of expertise needed for a thorough analysis of the building's water system. The team should include expertise in design, operation and management of drinking-water supplies; engineering; plumbing; and public health risk assessment. The team will include employees with relevant specialist expertise, as well as representatives of key users of the building water systems. Development of WSPs could also involve consultation with specialist contractors.

Some hazards that may compromise water quality in a building may be obvious to the building management; others may be more concealed. Therefore, it is essential that the WSP team is able to deal with all possible risks associated with delivering drinking water. Managers of small buildings or facilities with simple water systems may not have "in-house" expertise. In this case, the manager or operators of the water system should coordinate development of the WSP and use health and water-quality expertise from external sources. This could include external agencies (e.g. health, water utilities), private consultants, or external specialists to provide expert advice. In some cases, health agencies may develop generic plans and guidance that can be applied.

8.4.4 Describing the water system

The first step of the WSP team is to compile available information on the design and operation of the water-distribution system in the building. This needs to be described in a comprehensive plan, starting with the nature and quality of water supplied to the building up to points-of-use (taps and outlets) by building occupants, users and visitors.

The plan should document all components of the building water systems, including point-of-entry and point-of-use treatment, distribution systems, and water-using devices.

Appendix 1. Examples of sanitary inspection forms

Examples of sanitary inspection forms are given here as follows: Non-piped supplies: open dug well; dug well with windlass and partial cover; covered dug well with hand-pump; rainwater collection and storage; and tanker trucks, filling stations, and household tanks. Piped supplies: surface sources and abstraction; piped distribution.

The use of these forms enables a hazard score to be assigned to the particular water supply based on the total number of hazards found; however, differential weighting may be necessary to allow for local conditions.

Latrines and other point sources of potential fecal contamination should be located sufficiently far from groundwater sources used for drinking purposes to ensure that the risk of pathogen survival is very low. Once the “travel time” of microbial pathogens through the ground has been established, it is possible to determine a minimum safe distance (MSD) of potentially polluting activities from water sources. The travel time of microbes depends on local hydrogeological conditions, in particular the hydraulic conductivity or permeability of the soil and rock in the unsaturated and saturated zones. Thus it is difficult to set MSDs that are universally applicable. Travel time will also be affected by the volume and concentration of contamination introduced into an area. It has been shown that in rural areas of low population density, the majority of viruses and bacteria will die after 10 days in groundwater. Thus, in these areas, where small-scale water supplies and sanitation are introduced, this travel time may be used as a basis for establishing MSDs.

In urban areas where municipal wastewater is discharged and in those where there is intensive use of on-site sanitation, a figure of 50 days is more appropriate. It is often difficult to obtain sound hydrogeological information. However, some idea of the local hydrogeological conditions can be gained by carefully recording the changes in soil and rock type during test drilling and by conducting infiltration tests in the area where latrine construction is proposed. The infiltration capacity of the soil in the area should be assessed when the water table is at its highest.

A.1.1 Example of sanitary inspection form for open dug well

I Type of facility OPEN DUG WELL

1. General information: Health center ....
   Village ....
2. Code no.—Address ....
3. Water authority/community representative signature ....
4. Date of visit ....
5. Water sample taken? .... Sample no. .... Thermotolerant coliform grade ....

II Specific diagnostic information for assessment Risk

1. Is there a latrine within 10 m of the well? Y/N
2. Is the nearest latrine on higher ground than the well? Y/N
3. Is there any other source of pollution (e.g. animal excreta, rubbish) within 10 m of the well? Y/N
4. Is the drainage poor, causing stagnant water within 2m of the well? Y/N
5. Is there a faulty drainage channel? Is it broken, permitting ponding? Y/N
6. Is the wall (parapet) around the well inadequate, allowing surface water to enter the well? Y/N
7. Is the concrete floor less than 1m wide around the well? Y/N
8. Are the walls of the well inadequately sealed at any point for 3m below ground? Y/N
9. Are there any cracks in the concrete floor around the well which could permit water to enter the well? Y/N
10. Are the rope and bucket left in such a position that they may become contaminated? Y/N
11. Does the installation require fencing? Y/N

Total score of risks .... /11

Contamination risk score: 9–11 very high; 6–8 high; 3–5 intermediate; 0–2 low

III Results and recommendations

The following important points of risk were noted: .... (list nos 1–11) and the authority advised on remedial action.

Signature of sanitarian ....

A.1.2 Example of sanitary inspection form for dug well with windlass and partial cover

I Type of facility DUG WELL WITH WINDLASS AND PARTIAL COVER

1. General information: Health center ....
   Village ....
2. Code no.—Address ....
3. Water authority/community representative signature ....
4. Date of visit ....
5. Water sample taken? .... Sample no. .... Thermotolerant coliform grade ....

II Specific diagnostic information for assessment Risk

1. Is there a latrine within 10 m of the well? Y/N
2. Is the nearest latrine on higher ground than the well? Y/N
3. Is there any other source of pollution (e.g. animal excreta, rubbish) within 10 m of the well? Y/N
4. Is the drainage poor, causing stagnant water within 2m of the well? Y/N
5. Is there a faulty drainage channel? Is it broken, permitting ponding? Y/N
6. Is the wall (parapet) around the well inadequate, allowing surface water to enter the well? Y/N
7. Is the concrete floor less than 1m wide around the well? Y/N
8. Are the walls of the well inadequately sealed at any point for 3m below ground? Y/N
9. Are there any cracks in concrete floor around the well which could permit water to enter the well? Y/N
10. Are the rope and bucket left in such a position that they may become contaminated? Y/N
11. Does the well require a cover? Y/N
12. Does the installation require fencing? Y/N

Total score of risks .... /12

Contamination risk score: 9–12 very high; 6–8 high; 3–5 intermediate; 0–2 low

III Results and recommendations

The following important points of risk were noted: .... (list nos 1–12) and the authority advised on remedial action.

Signature of sanitarian ....

A.1.3 Example of sanitary inspection form for covered dug well with hand-pump

I Type of facility COVERED DUG WELL WITH HAND-PUMP

1. General information: Health center ....

Village ....

2. Code no.—Address ....

3. Water authority/community representative signature ....

4. Date of visit ....

5. Water sample taken? .... Sample no. .... Thermotolerant coliform grade ....

II Specific diagnostic information for assessment Risk

1. Is there a latrine within 10 m of the well and hand-pump? Y/N

2. Is the nearest latrine on higher ground than the hand-pump? Y/N

3. Is there any other source of pollution (e.g. animal excreta, rubbish) within 10m of the hand-pump? Y/N

4. Is the drainage poor, causing stagnant water within 2m of the cement floor of the hand-pump? Y/N

5. Is there a faulty drainage channel? Is it broken, permitting ponding? Y/N

6. Is the wall or fencing around the hand-pump inadequate, allowing animals in? Y/N

7. Is the concrete floor less than 1m wide all around the hand-pump? Y/N

8. Is there any ponding on the concrete floor around the hand-pump? Y/N

9. Are there any cracks in the concrete floor around the hand-pump which could permit water to enter the hand-pump? Y/N

10. Is the hand-pump loose at the point of attachment to the base so that water could enter the casing? Y/N

11. Is the cover of the well unsanitary? Y/N

12. Are the walls of the well inadequately sealed at any point for 3m below ground level? Y/N

Total score of risks .... /12

Contamination risk score: 9–12 very high; 6–8 high; 3–5 intermediate; 0–2 low

III Results and recommendations

The following important points of risk were noted: .... (list nos 1–12) and the authority advised on remedial action.

Signature of sanitarian ....

A.1.4 Example of sanitary inspection form for rainwater collection and storage

I Type of facility RAINWATER COLLECTION AND STORAGE

1. General information: Health center ....
Village ....
2. Code no.—Address ....
3. Water authority/community representative signature ....
4. Date of visit ....
5. Water sample taken? .... Sample no. .... Thermotolerant coliform grade ....

II Specific diagnostic information for assessment Risk

1. Is there any visible contamination of the roof catchment area (plants, dirt, or excreta)?	Y/N
2. Are the guttering channels that collect water dirty?	Y/N
3. Is there any deficiency in the filter box at the tank inlet (e.g. lacks fine gravel)?	Y/N
4. Is there any other point of entry to the tank that is not properly covered?	Y/N
5. Is there any defect in the walls or top of the tank (e.g. cracks) that could let water in?	Y/N
6. Is the tap leaking or otherwise defective?	Y/N
7. Is the concrete floor under the tap defective or dirty?	Y/N
8. Is the water collection area inadequately drained?	Y/N
9. Is there any source of pollution around the tank or water collection area (e.g. excreta)?	Y/N
10. Is a bucket in use and left in a place where it may become contaminated?	Y/N

Total score of risks .... /10

Contamination risk score: 9–10 very high; 6–8 high; 3–5 intermediate; 0–2 low

III Results and recommendations

The following important points of risk were noted: .... (list nos 1–10) and the authority advised on remedial action.

Signature of sanitarian ....

A.1.5 Example of sanitary inspection form for filling stations, tanker trucks, and household tanks

I Type of facility FILLING STATIONS, TANKER TRUCKS, AND HOUSEHOLD TANKS

1. General information: Health center ....

Village ....

2. Code no.—Address ....

3. Water authority/community representative signature ....

4. Date of visit ....

5. Water sample taken? .... Sample no. .... Thermotolerant coliform grade ....

II Specific diagnostic information for assessment Risk

Tanker filling stations

1. Is the chlorine level at the filling station less than 0.5 mg/liter? Y/N

2. Is the filling station excluded from the routine quality-control programme of the water authority? Y/N

3. Is the discharge pipe unsanitary? Y/N

Tanker trucks

4. Is the tanker ever used for transporting other liquids besides drinking-water? Y/N

5. Is the filler hole unsanitary, or is the lid missing? Y/N

6. Is the delivery hose nozzle dirty or stored unsafely? Y/N

Domestic storage tanks

7. Can contaminants (e.g. soil on the inside of the lid) enter the tank during filling? Y/N

8. Does the tank lack a cover? Y/N

9. Does the tank need a tap for withdrawal of water? Y/N

10. Is there stagnant water around the storage tank? Y/N

Total score of risks .... /10

Contamination risk score: 9–10 very high; 6–8 high; 3–5 intermediate; 0–2 low

III Results and recommendations

The following important points of risk were noted: .... (list nos 1–10) and the authority advised on remedial action.

Signature of sanitarian ....

A.1.6 Example of sanitary inspection form for surface source and abstraction

I Type of facility SURFACE SOURCE AND ABSTRACTION

1. General information: Health center ....
Village ....
2. Code no.—Address ....
3. Water authority/community representative signature ....
4. Date of visit ....
5. Water sample taken? .... Sample no. .... Thermotolerant coliform grade ....

II Specific diagnostic information for assessment Risk

1. Is there any human habitation upstream, polluting the source?	Y/N
2. Are there any farm animals upstream, polluting the source?	Y/N
3. Is there any crop production or industrial pollution upstream?	Y/N
4. Is there a risk of landslide or mudflow (causing deforestation) in the catchment area?	Y/N
5. Is the intake installation unfenced?	Y/N
6. Is the intake unscreened?	Y/N
7. Does the abstraction point lack a minimum-head device or dam to ensure minimum head of water?	Y/N
8. Does the system require a sand or gravel filter?	Y/N
9. If there is a filter, is it functioning badly?	Y/N
10. Is the flow uncontrolled?	Y/N

Total score of risks .... /10

Contamination risk score: 9–10 very high; 6–8 high; 3–5 intermediate; 0–2 low

III Results and recommendations

The following important points of risk were noted: .... (list nos 1–10) and the authority advised on remedial action.

Signature of sanitarian ....

A.1.7 Example of sanitary inspection form for piped distribution

I Type of facility PIPED DISTRIBUTION

1. General information: Health center ....
   Village ....
2. Code no.— Address ....
3. Water authority/community representative signature ....
4. Date of visit ....
5. Water sample taken? .... Sample no. .... Thermotolerant coliform grade ....

II Specific diagnostic information for assessment Risk

1. Is there any point of leakage between source and reservoir? Y/N

2. If there are any pressure break boxes, are their covers unsanitary? Y/N

If there is a *reservoir*:

3. Is the inspection cover unsanitary? Y/N

4. Are any air vents unsanitary? Y/N

5. Is the reservoir cracked or leaking? Y/N

6. Are there any leaks in the distribution system? Y/N

7. Is the area around the tap stand unfenced (dry stone wall and/or fencing incomplete)? Y/N

8. Does water accumulate near the tap stand (requires improved drainage canal)? Y/N

9. Are there human excreta within 10 m of the tap stand? Y/N

10. Is the plinth cracked or eroded? Y/N

11. Does the tap leak? Y/N

Total score of risks .... /11

Contamination risk score: 10–11 very high; 6–9 high; 3–5 intermediate; 0–2 low

III Results and recommendations

The following important points of risk were noted: .... (list nos 1–11) and the authority advised on remedial action.

Signature of sanitarian ....

APPENDIX 2. Treatment methods and performance

A2.1 Treatment methods

A2.1.1 Chlorination

Chlorination can be achieved by using liquefied chlorine gas, sodium hypochlorite solution or calcium hypochlorite granules and on-site chlorine generators. Liquefied chlorine gas is supplied in pressurized containers. The gas is withdrawn from the cylinder and dosed into water by a chlorinator, which both controls and measures the gas flow rate. Sodium hypochlorite solution is dosed using a positive-displacement electric dosing pump or gravity feed system. Calcium hypochlorite has to be dissolved in water, and then mixed with the main supply.

Removing excess chlorine is important to prevent taste problems. It is used mainly when the bacterial load is variable or the detention time in a tank is not enough. Marginal chlorination is used where water supplies are of high quality and is the simple dosing of chlorine to produce a desired level of free residual chlorine. The chlorine demand in these supplies is very low, and a breakpoint might not even occur.

Chlorination is employed primarily for microbial disinfection. However, chlorine also acts as an oxidant and can remove or assist in the removal or chemical conversion of some chemicals—for example, decomposition of easily oxidized pesticides, such as aldicarb; oxidation of dissolved species.

A disadvantage of chlorine is its ability to react with natural organic matter to produce trihalomethanes and other halogenated disinfection by-products. However, by-product formation may be controlled by optimization of the treatment system.

A2.1.2 Ozonation

Ozone is a powerful oxidant and has many uses in water treatment, including oxidation of organic chemicals. Ozone can be used as a primary disinfectant. Ozone gas (O3) is formed by passing dry air or oxygen through a high-voltage electric field. The resultant ozone-enriched air is dosed directly into the water by means of porous diffusers at the base of baffled contactor tanks.

The performance of ozonation relies on achieving the desired concentration after a given contact period. For oxidation of organic chemicals, such as some oxidizable pesticides, a residual of about 0.5 mg/l after a contact time of up to 20 minutes is typically used. The doses required to achieve this vary with the type of water but are typically in the range 2–5 mg/l. Higher doses are needed for untreated waters, because of the ozone demand of the natural background organics.

Ozone reacts with natural organics to increase their biodegradability, measured as assimilable organic carbon. To avoid undesirable bacterial growth in distribution, ozonation is normally used with subsequent treatment, such as biological filtration or granular activated carbon (GAC), to remove biodegradable organics, followed by a chlorine residual, as ozone does not provide a disinfectant residual. Ozone is effective for the degradation of a wide range of pesticides and other organic chemicals.

A2.1.3 Other disinfection processes

Other disinfection methods include chloramination, the use of chlorine dioxide and UV radiation, as well as alternative disinfection techniques that may be used in smaller- scale applications, such as for household water.

Chloramines (monochloramine, dichloramine and trichloramine, or nitrogen trichloride) are produced by the reaction of aqueous chlorine with ammonia.

Chlorine dioxide has been used in recent years because of concerns about disinfection by-product production associated with chlorine disinfection. Typically, chlorine dioxide is generated immediately prior to application by the addition of chlorine gas or an aqueous chlorine solution to aqueous sodium chlorite. Chlorine dioxide decomposes in water to form chlorite and chlorate.

UV radiation, emitted by a low-pressure or medium-pressure mercury arc lamp, is biocidal between wavelengths of 180 and 320 nm. It can be used to inactivate protozoa, bacteria, bacteriophage, yeast, viruses, fungi and algae. Turbidity can inhibit UV disinfection. UV radiation can act as a catalyst in oxidation reactions when used in conjunction with ozone or hydrogen peroxide.

Numerous possible disinfection techniques are being developed and are typically used in smaller-scale applications, such as household point-of-use and point-of-entry water treatment systems. Some of these, including bromine and iodine, show promise for expanded use. Bromine and iodine are halogens, like chlorine, and they are well-known biocides. Iodine is commonly used for short-term applications, such as by travellers in areas where water quality is questionable. It will be necessary to develop a more thorough analysis of the biocidal efficacy, potential disinfection by-products and risks from long-term exposures and application conditions for these lesser-used treatment chemicals to provide appropriate guidance as to their potential for wider applications.

A2.1.4 Filtration

Particulate matter can be removed from raw waters by rapid gravity, horizontal, pressure or slow sand filters. Slow sand filtration is essentially a biological process, whereas the others are physical treatment processes. Rapid gravity, horizontal and pressure filters can be used for filtration of raw water, without pretreatment. Rapid gravity and pressure filters are commonly used to filter water that has been pretreated by coagulation and sedimentation. An alternative process is direct filtration, in which coagulation is added to the water, which then passes directly onto the filter where the precipitated floc (with contaminants) is removed; the

application of direct filtration is limited by the available storage within the filter to accommodate solids. Bank filtration is a process that produces an influx of surface water through the groundwater, via the bed and banks of the surface water body. This is commonly achieved through abstraction from boreholes adjacent to the surface water source. It is a relatively simple and low-cost means for removing particulates and microorganisms from surface water by placing pumping wells in alluvial sediments of the river or stream banks. The sediments act as both a filter and bio-filter, trapping and reducing the concentrations of microorganisms and many organic pollutants.

A2.1.5 Aeration

Aeration processes are designed to achieve removal of gases and volatile compounds by air stripping. Transfer can usually be achieved using a simple cascade or diffusion of air into water, without the need for elaborate equipment. Stripping of gases or volatile compounds, however, may require a specialized plant that provides a high degree of mass transfer from the liquid phase to the gas phase.

Increasing the dissolved oxygen content of water can increase its corrosivity towards some metallic materials used in distribution pipes and plumbing, and this should be taken into account when considering aeration as a treatment process.

A2.1.6 Chemical coagulation

Chemical coagulation-based treatment is the most common approach for treatment of surface waters and is almost always based on the following unit processes. Chemical coagulants, usually salts of aluminum or iron, are dosed to the raw water under controlled conditions to form a solid flocculent metal hydroxide. The precipitated floc removes suspended and dissolved contaminants by mechanisms of charge neutralization, adsorption and entrapment. The efficiency of the coagulation process depends on raw water quality, the coagulant or coagulant aids used and operational factors, including mixing conditions, coagulation dose and pH. The floc is removed from the treated water by subsequent solid–liquid separation processes such as sedimentation or flotation and/or rapid or pressure gravity filtration.

A2.1.7 Activated carbon adsorption

Activated carbon is produced by the controlled thermalization of carbonaceous material, normally wood, coal, coconut shells or peat. This activation produces a porous material with a large surface area (500–1500 m2/g) and a high affinity for organic compounds.

When the adsorption capacity of the carbon is exhausted, it can be reactivated by burning off the organics in a controlled manner. However, PAC (and some GAC) is normally used only once before disposal. Different types of activated carbon have different affinities for types of contaminants.

A2.1.8 Ion exchange

Ion exchange is a process in which ions of like charge are exchanged between the water phase and the solid resin phase. Water softening is achieved by cation exchange. Water is passed through a bed of cationic resin, and the calcium ions and magnesium ions in the water are replaced by sodium ions. When the ion exchange resin is exhausted (i.e. the sodium ions are depleted), it is regenerated using a solution of sodium chloride.

Anion exchange can be used to remove contaminants such as nitrate, fluoride, arsenate and uranium (as the uranyl anion), which are exchanged for chloride.

A2.1.9 Membrane processes

The membrane processes of most significance in water treatment are reverse osmosis, ultrafiltration, microfiltration and nanofiltration. These processes have traditionally been applied to the production of water for industrial or pharmaceutical applications, but are now being applied to the treatment of drinking-water.

A2.1.10 Other treatment processes

Other treatment processes that can be used in certain applications include:

- precipitation softening (addition of ·lime, lime plus sodium carbonate or sodium
- hydroxide to precipitate hardness at high pH);
- ion exchange softening;
- biological denitrification for removal of nitrate from surface waters;
- biological nitrification for removal of ammonia from surface waters;
- activated alumina (or other adsorbents) for specialized applications, such as removal of fluoride and arsenic.

A2.2 Corrosion of metals used in water treatment and distribution

A2.2.1 Brass

The main corrosion problem with brasses is dezincification, which is the selective dissolution of zinc from duplex brass, leaving behind copper as a porous mass of low mechanical strength. General dissolution of brass can also occur, releasing metals, including lead, into the water.

A2.2.2 Concrete and cement

Concrete is a composite material consisting of a cement binder in which an inert aggregate is embedded. Cement is primarily a mixture of calcium silicates and aluminates together with some free lime. Cement mortar, in which the aggregate is fine sand, is used as a protective lining in iron and steel water pipes. In asbestos–cement pipe, the aggregate is asbestos fibers,

which are not of concern in drinking-water. Cement is subject to deterioration on prolonged exposure to aggressive water, due either to the dissolution of lime and other soluble compounds or to chemical attack by aggressive ions such as chloride or sulfate, and this may result in structural failure. Newly installed cement materials will leach lime, with consequent increases in pH, alkalinity and hardness. Cement contains a variety of metals that can be leached into the water.

A2.2.3 Copper

The corrosion of copper pipework and hot water cylinders can cause blue water, blue or green staining of bathroom fittings and, occasionally, taste problems. Copper tubing may be subject to general corrosion, impingement attack and pitting corrosion. General corrosion is most often associated with soft, acidic waters; waters with pH below 6.5 and hardness of less than 60 mg of calcium carbonate per liter are very aggressive to copper. Copper, like lead, can enter water by dissolution of the corrosion product, basic copper carbonate.

The pitting of copper is commonly associated with hard ground waters having a carbon dioxide concentration above 5 mg/l and high dissolved oxygen. Phosphates have been used to suppress copper corrosion in those cases. Surface waters with organic color may also be associated with pitting corrosion. A high proportion of general and pitting corrosion problems are associated with new pipe in which a protective oxide layer has not yet formed.

A2.2.4 Iron

Iron (either cast or ductile) is frequently used in water distribution systems, and its corrosion is of concern. While structural failure as a result of iron corrosion is rare, water quality problems (e.g. "red water") can arise as a result of excessive corrosion of iron pipes. The corrosion of iron is a complex process that involves the oxidation of the metal, normally by dissolved oxygen, ultimately to form a precipitate of iron (III). This leads to the formation of tubercules on the pipe surface. The major water quality factors that determine whether the precipitate forms a protective scale are pH and alkalinity. The concentrations of calcium, chloride and sulfate also influence iron corrosion. Successful control of iron corrosion has been achieved by adjusting the pH to the range 6.8–7.3, hardness and alkalinity to at least 40 mg/l (as calcium carbonate), oversaturation with calcium carbonate of 4–10 mg/l and a ratio of alkalinity to chloride plus sulfate of at least 5 (when both are expressed as calcium carbonate).

A2.2.5 Lead

Lead corrosion (plumbosolvency) is of particular concern. Lead piping is still common in old houses in some countries, lead solders have been used widely for jointing copper tubing and brass fittings can contain substantial amounts of lead. Galvanized iron pipe plumbing can accumulate incoming lead and release it at a later time as particulates. The solubility of lead is governed by the formation of lead carbonates as pipe deposits. Wherever practicable, lead pipework should be replaced. Lead can also leach from lead-based solders and brass and bronze fittings.

Lead concentrations increase with increasing standing time of water in lead pipe. Flushing the pipework before drawing water for consumption can be used as an interim measure to reduce exposure to lead. Showering, bathing and flushing the toilet can be used to flush out the system.

Lead can corrode more rapidly when it is coupled to copper. The rate of such galvanic corrosion is faster than that of simple oxidative corrosion, and lead concentrations are not limited by the solubility of the corrosion products. The rate of galvanic corrosion is affected principally by chloride concentration. Galvanic corrosion is less easily controlled but can be reduced by dosing zinc in conjunction with orthophosphate and by adjustment of pH.

A2.2.6 Nickel

Nickel in water may arise due to the leaching of nickel from new nickel/chromiumplated taps. Low concentrations may also arise from stainless steel pipes and fittings. Nickel leaching falls off over time. An increase of pH to control corrosion of other materials should also reduce leaching of nickel.

A2.2.7 Zinc

Galvanized pipes will release zinc (from the galvanizing layer) and can also leach cadmium and lead. Corrosion can be a particular problem where galvanized steel or iron piping is connected to dissimilar materials, such as brass, in taps and fittings.

With galvanized iron, the zinc layer initially protects the steel by corroding preferentially. In the long term, a protective deposit of basic zinc carbonate forms; however, galvanized pipe is also prone to uncontrolled deposition and clogging. Recent findings have shown that lead can accumulate on galvanized pipe particulates and become re-suspended by physical disruption, such as water hammer. Protective deposits do not form in soft waters where the alkalinity is less than 50 mg/l as calcium carbonate or waters containing high carbon dioxide concentrations (> 25 mg/l), and galvanized steel is unsuitable for these waters. Electrolytic corrosion can occur where galvanized steel or iron pipes or fittings are connected with copper tube or brass fittings.

Appendix 3. Checklist: Considerations for Drinking Water

A. Water Intake (Water Supply Protection)

Both surface water and groundwater supplies can become contaminated with potentially toxic substances of natural and anthropogenic origins, including pathogens, toxic metals (e.g. arsenic), anions (e.g. nitrate), and organic compounds. Such contamination might result from natural sources, actions or releases that are routine (e.g. discharges within permit limits), accidental (e.g. from a spill), or intentional (e.g. sabotage).

Recommended measures to protect the quality of the water supply include:

1. Determine the area that contributes water to the source (e.g. watershed of a stream or recharge area for groundwater), identify potential sources of contamination with the area, and collaborate with public authorities in the implementation of management approaches to protect the source water quality, such as:
    a. Zoning ordinance provisions
    b. Facility inspection or hazardous material survey program
    c. Information to businesses concerning applicable requirements
    d. Environmental permits checklist for new businesses;
    e. Strategic monitoring within area
    f. Development and implementation of educational campaigns to promote best management practices that reduce the risk of water contamination
    g. Incorporation of surface water protection into regional land use planning
2. Evaluate the vulnerability of the water source to disruption or natural events, and implement appropriate security measures as necessary, such as:
    a. Continuously monitor raw water for surrogate parameters (such as pH, conductivity, total organic carbon, and toxicity)
    b. Inspect sites at random times
    c. For reservoirs and rivers, implement a neighborhood watch program with local park staff and other community users of the reservoir/lake
    d. Equip wellheads with intrusion alarms

B. Drinking Water Quality and Supply

An adequate supply of clean drinking water is critical to community health and hygiene.

Recommended measures related to water treatment include:

1. Ensure that treatment capacity is adequate to meet anticipated demand;
2. Construct, operate and maintain the water treatment facility in accordance with national requirements and internationally accepted standards to meet national water quality standards or, in their absence, as is the case for Suriname, utilize WHO Guidelines for Drinking Water Quality
3. Evaluate the vulnerability of the treatment system and implement appropriate security measures, such as:
    a. Background checks of employees
    b. Perimeter fencing and video surveillance
    c. Improve the electrical power feeds to the facilities.

C. Water Distribution

The water distribution system is a critical component in delivery of safe potable water. Even if water is effectively treated to remove contaminants and destroy pathogens, waterborne diseases outbreaks can occur because of deficiencies in the water distribution system.

Recommended measures to prevent or minimize potential community health risks associated with the water distribution system include:

1. Construct, operate, and manage the water distribution system in accordance with applicable national requirements and internationally accepted standards.
2. Construct and maintain the distribution system so that it acts as a barrier and prevents external contamination from entering the water system by, for example:
    a. Inspecting storage facilities regularly, and rehabilitate or replace storage facilities when needed. This may include draining and removing sediments, applying rust proofing, and repairing structures
    b. Ensuring that all installation, repair, replacement, and rehabilitation work conforms to requirements for sanitary protection and materials quality
    c. Testing material, soil, and water quality and implementing best practices to prevent corrosion, such as cathodic protection
    d. Preventing cross-connections with sewerage systems.
    e. Separating water lines and sewer pressure mains (e.g., at least 10 feet apart or in separate trenches, with the sewer line at least 18 inches below the water line)
3. Maintain adequate water pressure and flow throughout the system, for example by:
    a. Implementing a leak detection and repair program
    b. Maintaining positive residual pressure of at least 20 pounds per square inch (psi)
4. Monitoring hydraulic parameters, such as inflows, outflows, and water levels in all storage tanks, discharge flows and pressures for pumps, flows and/or pressure for regulating valves, and pressure at critical points, and using system modeling to assess the hydraulic integrity of the system
5. Prevent introduction of contamination from the distribution system itself, for example by:
    a. Minimizing microbial growth and biofilm development (e.g. by ensuring adequate residual disinfection levels). Collect samples from several locations throughout the distribution system, including the farthest point, and test for both free and combined chlorine residual to ensure that adequate chlorine residual is maintained
    b. Choosing residual disinfectant (e.g. chlorine or chloramines) to balance control of pathogens and formation of potentially hazardous disinfection byproducts.
    c. Using construction materials that do not contribute to release undesirable metals and other substance or interact with residual disinfectants.