# Urban Water Supply Assessment

*Monitoring Progress of the Somali Urban Water Supply towards the Millennium Development Goals*

**Project Report N° W-07**

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Somalia Water and Land Information Management Project
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## Executive Summary

During the millennium declaration in 2000, the United Nations States adopted a number of goals known as the Millennium Development Goals (MDGs) meant for poverty reduction/eradication. A number of targets together with their milestones have been set to meet these goals. Governments everywhere recognize that the MDGs are essentially about people and human development. Since then the UN tracks progress in every part of the world with UNDP in charge for reporting progress at the national levels. Two clear outcomes of this process are now emerging. Firstly, the need to build a broad architecture for monitoring and reporting, and secondly, the need to use the information gathered more strategically to support new policy formulation.

The MDGs comprise 8 goals, 18 targets and 48 indicators. Water is interconnected with all eight MDGs and basic sanitation was added to the list at the 2002 World Summit on Sustainable Development in Johannesburg. *`Halving by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation'* is one of the quantified and time-bound targets defined for the MDGs.

Monitoring progress towards achieving the MDGs in the water supply and sanitation sector is essential if the political commitment of the international community and national governments is to be maintained and put into practice. Monitoring information is also vital for advocacy, to promote the importance of water supply and sanitation issues in national policies and poverty reductions strategies. The need to monitor progress toward achieving the MDGs on water and sanitation has been widely acknowledged and numerous initiatives are under way. However, background information about this sector remains unsatisfactory and the reliability of existing statistics is being questioned. There is no general agreement about the instruments, methodologies or definitions that should be used for MDG monitoring at global, national or local level and no unified and harmonised system seems to have been established.

One and a half decade of civil war in Somalia resulted in loss and damage of most water & land related information collected in the previous half century. SWALIM is trying to recover lost information from different sources all over the world and at the same time re-establish data collection networks in collaboration with partner agencies. One area of great interest is the urban water supply sector. With the help of UNICEF Somalia, and other international agencies involved in the reconstruction of Somalia, some of these urban water supply systems were rehabilitated and upgraded to meet the increasing demands. Reticulated water systems were built and their operation and management structures established and handed over through partnership between the private and public sectors.

This assessment was carried as part of a Memorandum of Understanding (MoU) between UNICEF and FAO/SWALIM. The purpose was to collect the necessary data and information that could help in preparing a methodology for assessing urban supplies and their capacity to meet the millennium development goals, after the major rehabilitation works that carried out by UNICEF in the urban water supply sector.

Since the eruption of the civil war and after rehabilitation of these systems by UNICEF, there has been little or no information on the progress these rehabilitated urban systems are making. With only WHO and UNICEF, Joint Monitoring Programme (JMP), being the main source of information, little; if no, data was available to assess the progress of this Somali sector.

This assessment was commissioned to support MDGs monitoring and reporting in the urban water sector. Only 9 years remain to achieve target 10; “*halve by 2015 the number of people without access to sustainable safe drinking water*”, unfortunately under the current Somali situation, achieving this target might be of great challenge to every one. Most Somalis live in urban areas, where access to improved water sources is poor due to manmade and natural calamities such as civil war, floods and droughts. Success in these areas is the key to achieving MDG urban water target. Significant external assistance is directed towards the humanitarian emergency the country facing for the past 16 years. Little effort spent towards improving urban water supplies.

UNICEF has been helping to improve water supply services in urban areas in Somalia since early in the emergency period following the 1991 civil war. UNICEF administered many water supply rehabilitation and improvement services in cities such as Bossaso, Borama, Baidoa and Erigabo, which restored and expanded urban water supplies and strengthened water services, which is managed by the local authorities and communities investment and services. Three urban water supply systems were selected for the current assessment. These are Bossaso in Puntland and  Borama and Erigabo in Somaliland.

It was not a simple task to carry this assessment without a multidisciplinary team. SWALIM and UNICEF invited the World Health Organization (WHO) and the UN-HABITAT, to share their experiences in monitoring certain parameters, and develop together with SWALIM and UNICEF the methodology and establish a set of parameters to be monitored. Both agencies have experience and programme to support the urban sector in Somalia. UN-HABITAT provided and produced town plans from high resolution satellite images that assisted in zoning of socioeconomic areas which were the basis for all units of analysis, while WHO assisted in carrying the bacteriological water tests for each water source identified by SWALIM team for each town.

A technical assessment of the water sources was carried based on the Somalia Water Sources Information Management – SWIMS Software. The assessment teams included staff from the water authorities in Somaliland and Puntland. The team was able to collect the necessary technical information on the different types of water sources. The team received training on the software and its use and application for assessing the water sources and their potential to meet the demands and collection of other information on the sources and their historical developments. The initial assessment methodology was implemented in Boassaso and Erigabo.

Beside the technical and water quality assessments, a specialised group recommended by UNICEF was chosen to conduct the socioeconomic survey in Erigabo after modification of the methodology by the Water, Sanitation and, Hygiene Sector Committee – WASH; formerly known as the Water, Sanitation, and Infrastructure Sector Committee – WSISC of the Somalia Support Secretariat - SSS.

The data and information collected during these assessments included maps of water supply systems for each town surveyed. The maps produced show each water source (boreholes only), storage tanks, and layout of pipes network, water kiosks, water vendors, and utilities capacity. The water market information needed for analysing water affordability, including assessment of commodity and willingness to pay for improved services, operation and maintenance cost and the social and economic benefits compared to the investment value were also established during the assessments.

The assessment presented in this report is a step forward for monitoring progress in Somali urban water supplies. The assessment team believes that, there are no any clear quantitative indicators and parameters for anchoring progress so far. This is mainly due to the lack of baseline information. Most of the indicators are non-existent, and if exist, are qualitative or non-impact indicators; rather process indicators. For example, while the MDGs call for *sustainable safe drinking water*, the JMP of the WHO and UNICEF calls for *access to improved drinking water sources*. Sustainability measured for the continuous piped water supply system with minimal leakage and breakages with the cost of operation and maintenance generated from the system compared to the revenue collected, while safety measured in terms of water cleanliness and consequently low/no water borne diseases endangered by the system. All water sources were identified for each town, classified and compared against criteria for improved water sources, apart from the boreholes and pipe networks rehabilitated by UNICEF and operated by the utility managers, few of the sources were found to be improved and, consequently are not meeting the MDGs.

The study concluded the following:

1) Detailed baseline information that did not exist before are gathered during this assessment. This can form the baseline and basis for any future monitoring programs.
2) Only one third of the population served by house connections in Bossaso while less than a quarter served by house connections in Boroma and Cerigabo.
3) Apart from the piped connections in each town (35% in Bossaso, 23% in Boroma and 0.02% in Erigabo)[1], few of the sources identified meet the criteria for an improved water source as required by the JMP.
4) Although in all towns surveyed, all the populations have access to water supply in one-way or another, this does not mean, these centres are meeting the MDG targets. This is mainly due in part to un-improved waters sources in use, and completely to the quality of water they use. For example, apart from the boreholes water served by the utilities; which is very safe according to the bacteriological and chemical analyses, most of the other unprotected sources tested positive for bacteriological contamination, e.g. Berkado, other rainwater collection storages and public shallow wells. On the other hand, some of the sources are quite far to achieve sustainable water supply given the time spent in search for water (distance more than 1-kilometre).
5) In some cases, we classified water source as improved, but water handling, delivery and storage are likely to contaminate it, e.g. donkey carts, water tankers, etc. People do not boil, disinfect with chemicals, filter or take any other preventive measures for their drinking water. This is mainly attributed to the lack of hygiene practice by the communities.
6) Water prices compared to the income groups selected are high, with the poor paying more compared to the middle and better off groups, however, when comparing the current utilities' service to the previous instalments, water prices have dropped by 50%. For example in Boroma, the price for 1-$m^3$ was equivalent to $1-US, while now it is sold at 60 cents for piped connections and 50 cents for kiosks and water tankers.
7) Some water sources have elevated levels of Nitrates, Fluorides and Zinc, however none exceeded the recommended limits levels that can lead to consumer complains.

[1] The reason for the low values in Erigabo is being the system still new and not yet functional during this assessment. It was found that, UNICEF through CEFA rehabilitated the wells and distribution network. More than 50% of the town demand will be met by the rehabilitated system.

High salinity levels and that are beyond the WHO recommended standards for electrical conductivity (EC) of 1,500 mS/cm or for the Sphere standards of 2,000 mS/cm were also noted in some of the wells.

8) Despite the huge investment by UNICEF and others, the level of service in all towns is very poor. This is mainly attributed to: i) the small/limited coverage of the reticulated networks despite willingness to pay for piped water supply connections, ii) the utilities' management didn't take any efforts to extend the systems to other areas, iii) high return of IDPS and Diaspora to these towns increased the pressure on the installed system and, iii) the pipes leak excessively due to poor operation and maintenance by the utility managers reducing significantly the amount of water supplied by the system.
9) There are weak/non-existent sound water resources management plans. For example, in Borama, the ground water table has dropped substantially in the past few years leading to drop down of the water levels, placing the town population at high risk due to un-guaranteed sustainability to meet their future demands.
10) There are no studies and information on groundwater recharge patterns, no equipments for measuring the groundwater levels and carrying pumping tests, there are few/no-trained technicians to carry routine checks on the groundwater resources, maintenance, etc.

In summary, this assessment formed the basis for future work and monitoring of any progress achieved since the time it was conducted. We recommend similar assessments be carried out to monitor progress towards MDG target 10 in urban supplies every 3 years.

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## List of abbreviations and acronyms

| | |
|---|---|
| *Ecoli* | Escherichia coli |
| *EIA* | Environmental Impact Assessment |
| *GUMCO* | Golden Utilities Management Company |
| *IDP* | Internally Displaced Persons |
| *JMP* | Joint Monitoring Programme (UNICEF/WHO) |
| *JNA* | Joint Needs Assessment |
| *LNGO* | Local NGO |
| *MDGs* | Millennium Development Goals |
| *MWNR* | Ministry of Water and Natural Resources |
| *MPWTCA* | Ministry of Public Works, Transportation and Civil Aviation |
| *NW* | North West (Awdal, W. Galbeed, Tog Dheer, Sool & Sanaag regions) |
| *PPP* | Public Private Partnership |
| *PSAWEN* | Puntland State Agency for Water, Energy and Minerals Development |
| *SWALIM* | Somalia Water and Land Information Management |
| *UN-HABITAT* | United Nations Human Settlement Programme |
| *UNICEF* | United Nations Children's Fund |
| *UN-OCHA* | United Nations Office for the Coordination of Humanitarian Affairs |
| *WFP* | World Food Programme |
| *WHO* | World Health Organisation |

**Glossary of terms**

| | |
|---|---|
| *Artesian well* | A well deriving its water from a confined aquifer, in which water level stands above the ground surface; sometimes also referred to as a spring. |
| *Berkad* | This is a concrete-lined tank. There are three types:<br>1) Concrete-lined underground rainwater tanks, usually covered by natural roofing material to limit evaporation, gravity-filled by channel-guided water runoff. Small to large in size (30 - 600 $m^3$) and mostly lined with a thick wall (450-700 mm) made with stones and concrete. Can be private or communal, and are filled in dry seasons by water trucks.<br>2) The same structure, as found in some villages, collects rooftop rainfall. House *berkad,* is small and mostly constructed for domestic consumption.<br>3) Simple storage *berkad* below or above ground, only meant to be filled by water trucks in dry seasons and mostly found in urban areas for commercial or private domestic use. |
| *Borehole* | A mechanically drilled well with a casement and filtration screens which is usually mechanically pumped. |
| *Borehole yard* | Water supply system equipped with public taps, piping system, standpipes for trucks and donkey carts. |
| *Hand-dug well* | Water hole with a diameter of 1 to 3 m dug manually to tap shallow ground water at depths of 6 - 20 m. Usually unprotected and covered by wooden sticks, and with wooden/concrete troughs used for watering livestock. |
| *Improved hand-dug well* | Hand-dug wells lined and in some cases equipped with filtration screens and covers. |
| *Improved sanitation* | Connection to a public sewer, and/or septic tank, poor-flush latrines, simple pit latrines, ventilated improved pit latrines. |
| *Improved water source* | Household connection, public standpipe, borehole, protected dug well, protected spring or, rainwater collection. |
| *Mini water system* | Pipe system from wells, springs and boreholes with short transmission system pipeline and public |

| | |
|---|---|
| | distribution points such as kiosks, public standpipes and animal troughs |
| *Rehabilitation* | Restoration to at least original functional state, and when applicable upgrading to improved supply facility. |
| *Unimproved sanitation* | Public or shared latrines, open pit latrine, bucket latrine. |
| *Unimproved water* | Unprotected well, unprotected spring, river or ponds, vendor-provided water (tanker truck water, bottled water). |
| *Urban water system* | Pipe system from wells, springs and boreholes, serving collective kiosks and house connections, also referred as reticulated water systems. |

# 1. Introduction

## 1.1 Background

Somalia is slowly recovering from the civil strife that has hampered the country's development for the past decade. Consequently, the delivery of water and sanitation services in most parts of the country dramatically weakened. These services were formerly organised and operated by the Central Government agencies, which no longer operate on a nation wide scale and they were replaced by local public entities reporting to municipalities or directly to the state level, e.g. Somaliland and Puntland. As peace started to establish slowly in some parts of the country, the population quickly drifted into towns resulting in an unprecedented growth of urban populations especially in the pacified regions, further stretching the deteriorated water resources.

In most parts of Somalia, water supplies are drawn from groundwater, but a few systems use surface water. The capacity of these systems in most urban areas is overstretched due to a growing urban population and increasing demand from rural populations, especially in the long dry season and during drought events, UNICEF, WHO, WSISC (2000). As a result, people suffer from inadequate water supply and have few opportunities apart from reliance on aging water sources facilities to meet their needs.

The Somali urban water supply sector has suffered severe deterioration due to ignorance and lack of resources that have resulted from the civil war the country is currently facing. Donor support and interventions almost proved fruitless and unsuccessful. Numerous water supply system assessments and interventions implemented by UN agencies and international NGOs in the region, which have yet to attain the MDG target of reducing by half the proportion of people without sustainable access to safe drinking water by 2015. One of the most important assessments, the water and sanitation sub-cluster recently conducted by the Joint Needs Assessment (JNA) through the UN and The World Bank, provides a through situation analysis and Somali priorities for international support.

As mentioned earlier, before the civil war, water supply systems are developed, operated and managed by central government agencies, which collapsed after the civil war due to destruction, looting and lack of adequate maintenance. Specifically, the Water Development Agency (WDA) was responsible from operation and maintenance of the urban and rural water sectors. Currently with support from UNICEF and the European Commission, Public Private Partnerships (PPP) were established and tested with local utility companies in selected urban centres in the country. The PPP proved suitable for communities with minimum donor support.

UNICEF constructed reticulated urban water systems that are providing clean drinking water. A good example is the water supply agency in Borama; SHEBA, whereby community and the private sector provide the service to the urban population and the necessary operation and maintenance as part of remittance collection.

Since the eruption of the civil war in 1990, there has been little or no information on the progress of the urban and rural water sectors in the country and their capacity to meet the MDGs. With only the WHO and UNICEF Joint Monitoring Programme (JMP) being the main source of information little; if no, data is available to assess the progress of this sector towards the millennium development goals.

Monitoring progress towards achieving the MDGs in the water supply and sanitation sector is essential if the political commitment of the international community and national governments is to be maintained and put into practice. Monitoring information is also vital for advocacy, to promote the importance of water supply and sanitation issues in national policies and poverty reductions strategies. The need to monitor progress toward achieving the MDGs on water and sanitation has been widely acknowledged and numerous initiatives are under way. However, background information about this sector remains unsatisfactory and the reliability of existing statistics being questioned. There is no general agreement about the instruments, methodologies or definitions for use in MDG monitoring at global, national or local level and there no unified and harmonised system seems to have been established.

Since the primary aim of this assessment was to develop and test a methodology that could used to monitor urban Somalia's progress in relation to MDGs. The methodology included a set of well-defined, easily measurable indicators that are harmonised with the JMP ones (Section 1.2.1). According to Baily, (1997), improvements, through halving the proportion of people without sustainable access to safe drinking water by the year 2015, is to be achieved through a series of measures including capacity building, policy development, improved maintenance, operations and investments and expanded consumer involvement.

People are the most important factor in water supply activities. The sustainability of policies, institutional development efforts and system investments depend on an adequate assessment of people's needs and expectations and the availability of adequate information to different groups of people to ensure support for sector improvement. In preparing an urban water supply assessment, it is important to give priority to the status of the poor and otherwise vulnerable groups, in addition to other social groups in terms of sustainability, safety and access to water supplies. Therefore, the status of key stakeholders, including different types of households, industries and government institutions, all require consideration.

FAO SWALIM commissioned the study through funding from UNICEF Somalia and the European Commission. The report highlights findings of this kind of an analysis of the Somali urban water supply sector. Below are some of the definitions that ere used in the assessment.

## 1.2 Millennium Development Goals and Targets

The Millennium Development Goals adopted by the United Nations member states in the year 2000 are broad goals for the entire world. They address essential dimensions of poverty and their effects on people's lives attacking pressing issues related to poverty reduction, health, gender equality, education and environmental sustainability. By accepting these goals, the international community has made a commitment to the world poor, the most vulnerable, in precise terms, established in quantitative targets. Figure 1-1 presents the MDGs' together with their targets and indicators relevant to water supply.

In order to assist member states realize the eight goals of the Millennium Declaration, the United Nations System has set numerical targets for each goal. Further, it has selected appropriate indicators to monitor progress on the goals and attain corresponding targets. The MDGs agreed on in 2000 include a list of eight goals, 18 targets and 48 indicators corresponding to these goals to ensure a common assessment and appreciation of the status of MDGs at global, national and local levels.

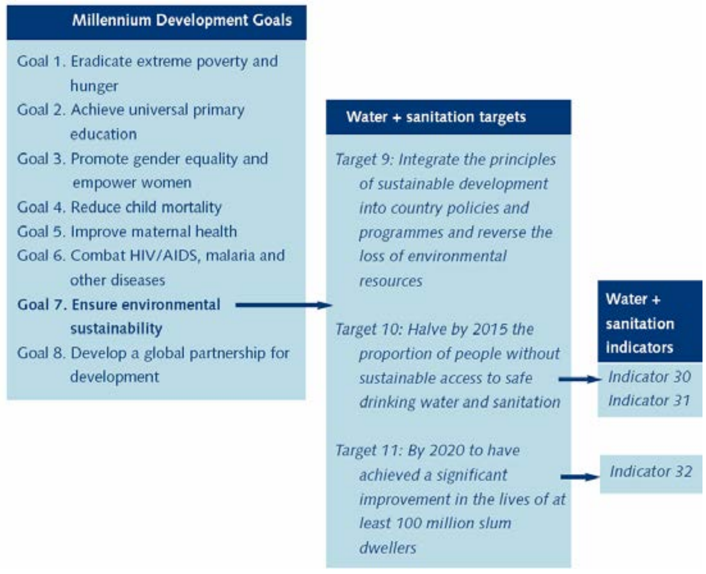


**Figure 1-1: Millennium Development Goals, Targets and Indictors Relevant to Water Supply[1]**

This assessment focused only on target10 of goal 7, *sic "halve, by 2015, the proportion of people without sustainable access to safe drinking water*". The target is by indicator 30: Proportion of population with sustainable access to an improved water source, urban and rural, UNICEF – WHO JMP.

During the assessment we realised that, there is no baseline data for Somalia to monitor progress towards this target. The latest available national coverage data is the Joint Monitoring Programme (JMP) data of UNICEF and the WHO that produced globally for the national levels in 1990 through the Demographic and Health Surveys (DHS). It is difficult to compare such data at municipality's level.

## 1.3 Monitoring the Water MDGs and Standards for Improved Water Sources

MDG monitoring for water supply and sanitation is set in a wider framework involving other institutions central to the MDGs: the Millennium Project Task Force for Water and Sanitation and its monitoring sub-group, the UNDP-centred MDG Monitoring Teams and their related partner agencies in country, the WSSCC Monitoring Task Force, and the Joint Monitoring Programme and its Technical Advisory Group. Any further development for MDG monitoring should involve these international platforms as core actors.

The Joint Monitoring Programme, which is generally seen as the main mechanism for monitoring progress towards the MDGs in this sector, serves as the international reference for achievements in water and sanitation. However, it has been widely acknowledged that a number of challenges for MDG monitoring are associated with the existing systems and processes. To address these challenges, the MDG Task force for Water and Sanitation and the JMP Technical Advisory Group paid attention to key issues such as comparability of definitions, breadth or scope of terminology, baseline data, questionnaires and collection

[1] Adopted from IRC 2004

methods, data management and analysis, sampling, timeliness, relevance and usability and actual use.

The Joint Monitoring Programme of UNICEF and WHO (JMP) assembled statistics on drinking water and sanitation coverage since 1990. Since 2000, the JMP has based its reporting on household surveys and on the classification of water sources and sanitation facilities as “improved” or “unimproved”. Household surveys used by the JMP includes: USAID supported Demographic and Health Surveys (DHS); UNICEF-supported Multiple Indicator Cluster Surveys (MICS); national census reports; WHO supported World Health Surveys; and other reliable national surveys that allow data to be compared. Unfortunately, none of these data is available for Somalia.

The current assessment focused on establishing baseline data for each urban centre surveyed during the assessment through household surveys and technical assessment of water sources. Classification of improved water sources was adopted from the JMP definitions as given in Table 1-1. It is assumed that if the user has access to an "improved source" then such source would be likely to provide 20 litres per capita per day at a distance no further than 1,000 metres. This hypothesis is being tested through National Health Surveys that are being conducted by WHO in 70 countries, IRC (2004).

**Table 1-1: Definition of access to improved drinking water supply**[1]

| **Improved Technologies**<br>*(Improved sources of drinking water)* | **Unimproved Technologies**<br>*(Unimproved sources of drinking water)* |
|---|---|
| Household connection[2] | Unprotected dug well |
| Public standpipe | Unprotected spring |
| Protected dug well | Vendor-provided water |
| Protected spring | Tanker truck-provided water |
| Rainwater collection | Bottled water[3] |

The current assessment recognizes three specific stages in the global assessment of water supply and sanitation.

1. From 1970 to 1990: Country-level information provided by governments. Global reporting by WHO (Documents: Early WHO reports, IDWSSD: baseline report 1980; Interim reports: 1983, 1985, 1988; End of Decade report: 1990);
2. From 1990 to 1997: WHO and UNICEF collaborating in the Joint Monitoring Programme (JMP) in its initial phase. Country-level information provided by governments. Reporting done per country by the JMP. (Activities: Capacity building at the country level; Documents: Reports of status of monitoring, training; 1986 JMP report)
3. From 1997 to the present: WHO and UNICEF collaborating in Joint Monitoring Programme, current phase. Country-level estimates based on population-based information. Reporting per country by the JMP. Consolidation of JMP for reporting officially to UN (Document: Global Water Supply and Sanitation Assessment—2000 Report)

[1] Source: UNICEF-WHO Joint Monitoring Programme (2004)), Bottled water is considered an “improved” source of drinking water only where there is a secondary source that is "improved”.
[2] Water piped into dwelling, yard or plot
[3] Based on concerns about the quantity of supplied water, not concerns over the water quality

It is clear that little work has been achieved to localise monitoring the MDGs apart from the UN-HABITAT work, UN-HABITAT (2006). There is strong need to develop local data beside the national data for monitoring the MDGs.

### 1.4 Assessment Objectives

The purpose of the urban water supply assessment was to develop and test a methodology to evaluate and monitor progress of three urban water supply facilities in Somalia towards achieving Millennium Development Goal 7, Target 10: *sic "to halve by 2015 the proportion of people without sustainable access to safe drinking water"*. The three chosen urban supplies (completed by UNICEF Somalia) are located in Puntland (Bossaso) and Somaliland (Borama and Erigabo)[1], Figure 1-2.

### 1.5 Assessment Components

Through an inter-agency, multi-disciplinary team lead by SWALIM, it was agreed to conduct the assessment that should focus on water quantity, quality, coverage, affordability and sustainability. The team agreed on five components of the assessment:

1) Development of town plans from high-resolution satellite images and zoning of social/economic areas,
2) Identification of water supply layout,
3) Inventory / technical and management assessment of existing water supplies in terms of their sustainability, quality, continuity and accessibility,
4) Water quality assessment,
5) Socio-economic / Household Survey,

The information and data collected through implementation of these five steps, determined whether the population of the towns studied have access to basic domestic water requirements; assessing constraints for future water development in the towns; and assessing how far the relevant MDGs have been addressed especially with regard to development of water delivery systems in the three towns studied[2].

[1] Bossaso, Garowe, Borama and Ceerigabo have been chosen by SWALIM and UNICEF as representative test sites.

[2] Particularly MDG Action 7: "Within the context of national poverty reduction strategies based on the Millennium Development Goals, countries must elaborate coherent water resources development and management plans that will facilitate the achievement of the goals".

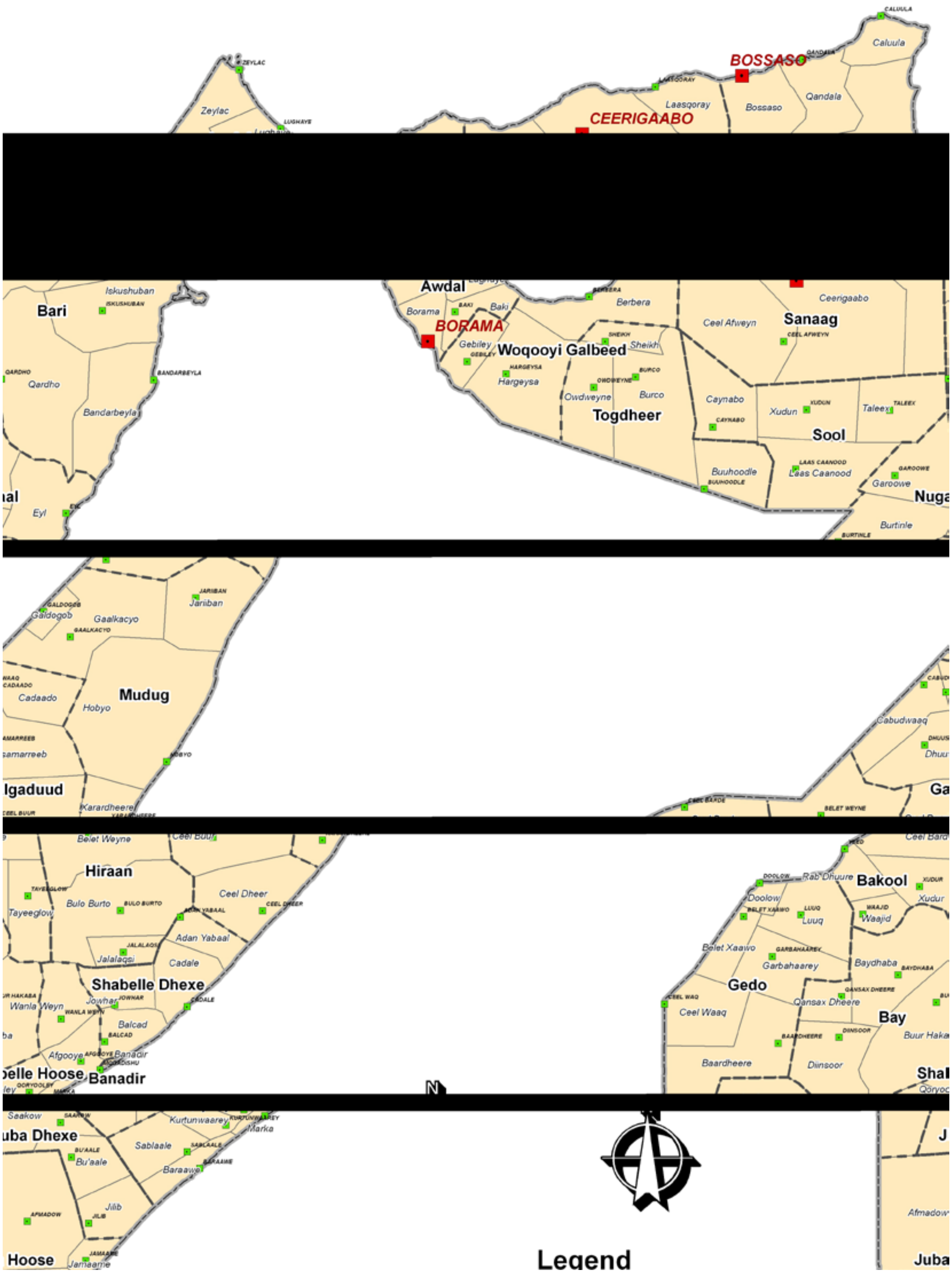


**Figure 1-2: Map of Somalia showing the three urban cities surveyed**

## 2. Field Survey Approach and Methodology

This section considers the approach and methodology used to conduct a sound Somalia Urban Water Supply Assessment to monitor progress towards MDG targets. In evaluating urban water supplies in the assessment area, several criteria had to be considered with regard to sustainability, accessibility and safety. These were best satisfied by considering the hydrology and demography of the project area.

The assessment initially covered two urban centres, Bossaso in Puntland and Borama in, Somaliland. The results of these assessments were later subjected to peer review by the Water, Sanitation and Hygiene Sector Committee (WASH) of the Somalia Support Secretariat – SSS; formerly known as the Water, Sanitation, and Infrastructure Sector Committee – WSISC steering committee and the recommendations implemented in Erigabo town.

The aim of the methodology developed was to make a detailed assessment of available water supplies and demand achieved through gaining sufficient knowledge of utilities performance, water sources, sustainability, accessibility, affordability and water quality. This helped in making sound decisions for optimising Somalia urban water supplies and assess their capacity to meet the MDGs. Logical sequence of investigations were followed, consisting of the following elements:

### 2.1 Field Survey Approach

The survey team consisted of:

1) Two national consultants employed by SWALIM. These are Mr. Gulled Mahamud from Puntland and Mr. Abdulahi Abdalle from Somaliland,
2) SWALIM Liaison Officers, Mr. Ali Ismail (Somaliland) and Mr. Osman Abdule (Puntland),
3) Two to three staff members from each water agency in the two regions: Puntland State Agency of Water, Energy and Natural Resources (PSAWEN) and the Ministry of Public Works, Transportation and Civil Aviation (MPWTCA) in Puntland, and the Ministry of Water and Mineral Resources (MWMR) in Somaliland.
4) Water Quality Technician, Mr. Obsiye of WHO Hargeisa office,
5) Research and Training Group (RTG) from Somaliland was contracted to carry out the household survey in Erigabo.

The approach adopted during this assessment was to carry extensive field surveys for the collection of two types of information that will help track progress in MDGs, these are:

#### 2.1.1 Technical information

The methodology included collection of information on all water sources in each urban centre, including utilities; small private tube wells; water tanker operators; water vendors; bottled water suppliers, pipe layout, beside their technical efficiency and sustainability; management efficiency and sustainability; and maintaining water quality standards.

### 2.1.2 Socio-economic information

Representative samples of 5% of the water consumers were initially considered, including non-domestic ones, e.g. public and government institutions. The representative sample was selected more on the basis of giving information on diverse areas and different types of consumers rather than being a purely random sample. The methodology included collection of information on population numbers and their structures in terms of income (low, middle and better off groups), trends in population, income trends, and water price trends for improved water supply. Domestic consumers comprising the High Income (low density), middle income and iow Income (Low –I in urban high density and Low-II periurban high density) residential household types.

Analysis of the two types of the survey data provided important findings on piped water distribution network coverage, roles of small private water operators and water vendors in the water business, non-revenue water, tariffs, household consumption and cost and the plight of the urban poor.

### 2.2.1 Town Plans Development

If exists, town plans can be used to identify high and low density settlements (income groups), population and water prices trends. This was not available for the centres selected for the survey due to lack of this information in Somalia. This part of the study carried out and provided to SWALIM as ready town plans maps by the UN-HABITA as part of their Somalia Urban Development Programme (SUDP). Identification of areas and groups of low; medium and high incomes was done by the survey teams, to enable collection of the relevant socioeconomic data needed for identification of improved water sources as described in Table 1-1.

### 2.2.2 The Questionnaire

A questionnaire prepared and administered by the survey teams (see Annex – 1). Information on consumer / household (sample size, sample area selection – low; medium and high-income groups and areas), was collected through the questionnaire. The questionnaire translated into Somali language by the survey teams during customers' interviews. The questionnaire helped to collect the socioeconomic information in section 2.1.2 information beside part of the information in section 2.1.1.

The sample size of the consumer survey comprised initially of 5% households in the three major categories of domestic, non-domestic and slum household and later increased in Erigabo town to include 20% of the people served by the water utility. The samples were analysed in a way to make them statistically significant. The criteria for a sub-area selection were, among others: i) population density, ii) economic status of the population in the area, iii) type of dwelling houses and, iv) Whether predominantly domestic, industrial or commercial users. The numbers varied to some extent within each group

### 2.2.3 Water Quality Assessment

One of the important MDGs is to reduce by half the proportion of people without sustainable access to safe drinking water by the year 2015. Water quality has a great influence on public health, in particular the microbiological quality of water is important in preventing ill health. Poor microbiological quality is likely to lead to outbreaks of infectious water-related diseases and may cause serious epidemics, OECD and WHO (2003). Chemical water quality is generally of lower importance as the impact on health tends to be chronic long-term effects and time is available to take remedial action. Acute effects may be encountered where major pollution events have occurred or where natural levels of certain chemicals are high (such as fluoride), or anthropogenic sources, such as nitrates. For this reason, water quality assessment and continuous monitoring are of utmost importance.

Since there is a lack of any national drinking water standards in Somalia to provide maximum permissible concentrations of contaminants in drinking water, the *Guidelines for drinking water quality* published by the World Health Organization (WHO) were followed during this study, WHO (2006). Tables 2-1 and 2-2 present recommended parameters for testing and their methodology. Table 2-3 explains the substances and parameters in drinking water that may give rise to consumer complaints.

Bacteriological water analysis was carried out on-site through use of portable water quality testing kit while, the chemical analysis was carried out by a specialized company in Kenya known as SGS. Water samples tested were collected from all water source types identified; source, pipe network, household connections, kiosks, donkey carts and tankers. The parameters tested for each town's water supply are given in the subsequent relevant sections for each town. No water quality testing was carried for Bossaso town due to lack of local technical capacity.

**Table 2-1: Recommended parameters for testing and methodology[1]**

| Parameters | Description | Recommended Testing Method |
|---|---|---|
| **Microbiological Parameters** | Thermo-tolerant coliforms<br>Faecal streptococci<br>Disinfectant residuals<br>pH<br>Turbidity | These parameters portable kits are appropriate for the tests:<br>(a) 0005829 - Water Quality Testing Kit,<br>(b) Portable *(OXFAM DELAGUA),*<br>**(c)** Potatest by Wagtech and Paqualab by ELE |
| **Physical parameters** | Turbidity<br>conductivity<br>Colour<br>Odour<br>Taste | These parameters usually monitored through visual observation only, However, for quantitative assessments, a light box or a spectrophotometer should be used. |
| **Harmful chemicals** | Nitrate<br>Iron<br>Arsenic<br>Fluoride<br>Lead<br>Cyanide | Testing for chemical parameters can be performed through one or more of the following possible methods:<br>(a) Merck-quant strips:<br>(b) Photometers: |

[1] Sources: Technical Bulletin No.6, the United Nations Children Fund (UNICEF), Supply Division, September 2003.

| Parameters | Description | Recommended Testing Method |
|---|---|---|
| | Metals (aluminium, cadmium, chromium, copper, manganese, mercury) | (c) Laboratory based methods: |
| | Selenium | |
| | Organics (including pesticides and disinfectant by-products), | |
| | Alkalinity | |
| | Corrosively | |

**Table 2-2: Bacteriological quality of drinking water1**

| Organisms | Guideline Value |
|---|---|
| **All water intended for drinking** | |
| E.coli or thermo-tolerant coliform bacteria[2] | Must not be detectable in any 100 ml sample |
| **Treated water entering the distribution system** | |
| E.coli or thermo-tolerant coliform bacteria[3] | Must not be detectable in any 100 ml sample |
| Total coli form bacteria | Must not be detectable in any 100 ml sample |
| **Treated water in the distribution system** | |
| E.coli or thermo-tolerant coliform bacteria[3] | Must not be detectable in any 100 ml sample |
| Total coliform bacteria | Must not be detectable in any 100 ml sample. In the case of large supplies, where sufficient samples are examined, must not be present in 95% of samples taken throughout any 12-month period |

*Sources: Guidelines for drinking-water quality, 2nd ed. Vol. 2 Health criteria and other supporting information, 1996 (pp.940-949) and Addendum to Vol. 2. 1998 (pp. 281-283), Geneva, World Health Organization.*

**Table 2-3: Substances and parameters in drinking water that may give rise to complaints from consumers.**

| Parameters | Description | Levels likely to give rise to consumer complaints[3] | Reasons for consumer complaints |
|---|---|---|---|
| Physical | colour | 15 TCU[4] | appearance |

[1] Immediate investigative action must be taken if either *E. coli* or total coliform bacteria are detected. The minimal action in the case of total coliform bacteria is repeat sampling; if these bacteria are detected in the repeat sample, the cause must be determined by immediate further investigation.

[2] Although *E.coli* is the more precise indicator of faecal pollution, the count of thermo-tolerant coliform bacteria is an acceptable alternative. If necessary, proper confirmatory tests must be carried out. Total coliform bacteria are not acceptable indicators of the sanitary quality of rural water supplies, particularly in tropical areas where many bacteria of no sanitary significance occur in almost all untreated supplies.

[3] The levels indicated are not precise numbers. Problems may occur at lower or higher values according to local circumstances. A range of taste and odour threshold concentrations is given for organic constituents.

[4] TCU - true colour unit

| Parameters | Description | Levels likely to give rise to consumer complaints[3] | Reasons for consumer complaints |
|---|---|---|---|
| | taste and odour | — | should be acceptable |
| | temperature | — | should be acceptable should be acceptable |
| | Turbidity | 5 NTU[1] | Appearance; for effective terminal disinfection, median turbidity = 1 NTU, single sample = 5 NTU |
| **Inorganic constituents** | Aluminium | 0.2 mg/l | Depositions, discoloration |
| | Ammonia | 1.5 mg/l | Odour and taste |
| | Chloride | 250 mg/l | Taste, corrosion |
| | copper | 1 mg/l | Staining of laundry and sanitary ware (health-based provisional guideline value 2 mg/litre) |
| | hardness | — | High hardness: scale deposition, scum formation<br>Low hardness: possible corrosion |
| | Hydrogen sulphide | 0.05 mg/l | Odour and taste |
| | Iron | 0.3 mg/l | Staining of laundry and sanitary ware |
| | manganese | 0.1 mg/l | Staining of laundry and sanitary ware (health-based guideline value 0.5 mg/litre) |
| | Dissolved oxygen | — | Indirect effects |
| | pH | — | Low pH: corrosion<br>High pH: taste, soapy feel<br>Preferably < 8.0 for effective disinfection with chlorine |
| | sodium | 200 mg/l | taste |
| | sulphate | 250 mg/l | Taste, corrosion |
| | Total dissolved solids | 1000 mg/l | taste |
| | Zinc | 3 mg/l | Appearance, taste |

[1] NTU, nephelometric turbidity unit

| Parameters | Description | Levels likely to give rise to consumer complaints[3] | Reasons for consumer complaints |
|---|---|---|---|
| Organic constituents | Toluene | 24-170 µg/l | Odour, taste (health-based guideline value 700 µg/l) |
| | Xylene | 20-1800 µg/l | Odour, taste (health-based guideline value 500 µg/l) |
| | Ethyl benzene | 2-200 µg/l | Odour, taste (health-based guideline value 300 µg/l) |
| | Styrene | 4-2600 µg/l | Odour, taste (health-based guideline value 20 µg/l) |
| | Monochlorobenzene | 10-120 µg/l | Odour, taste (health-based guideline value 300 µg/l) |
| | 1,2-dichlorobenzene | 1-10 µg/l | Odour, taste (health-based guideline value 1000 µg/l) |
| | 1,4-dichlorobenzene | 0.3-30 µg/l | Odour, taste (health-based guideline value 300 µg/l) |
| | Trichlorobenzene | 5-50 µg/l | Odour, taste (health-based guideline value 20 µg/l) |
| | Synthetic detergents | — | Foaming, taste, odour |

### 2.2.3 Analysis of Survey Information

Based on the information collected during the field survey the following elements were analysed and the information obtained used in assessing progress towards MDGs.

i. Identifying and mapping of distribution piping networks and other water supply information
ii. Utility performance
iii. Other water sources (shallow wells, water vendors and consumers)
iv. Population and water demand (sustainability and affordability)
v. Water quality standards

***Mapping water supply system*** - Information on piped network was not available and had to be inferred using a GPS to locate existing pipes layout, water kiosks, storage tanks and wells and/or shallow wells and their locations. This activity carried with the help of the utility managers and in some cases with community participation. Urban water supply maps produced for each town as will be seen later.

***Utility Performance*** - Apart from details of individual customers, this identified recipients of bulk sales including private tanks water distribution operators, kiosks and water vendors. Its focus was on identifying water sources for each type of customer (non-domestic, household connection, standpipe, etc) as needed by the JMP, Table 1-1. The total number of connections, volumes sold per month and revenue gained per month were collected. This provided information on production volume versus consumption volume, and noted the extent of 24-hour piped water coverage.

***Private tube well*** - The survey team conducted interviews with operators of private shallow wells, seeking essentially the same information as for Water Utility excepting the quality of service to customers, such as direct connection or kiosk and bulk connections. Whether community water sources are protected or unprotected sources, was an important dimension ascertained from this interview.

***Water Vendor*** **-** If water vendors operated in a given survey zone their type and total numbers were determined. Pertinent information sought included their source(s) of water, means of transporting water, numbers and types of customers, average distances transported, volumes sold and revenue gained. It was important to establish how much and to whom vendors paid for water.

***Water Consumers*** **-** The survey team obtained a 5% representative sample of all water users in every zone, identifying those served by the utility, by private tube wells and by water vendors and surveying them in numbers proportional to their prevalence.

The information obtained includes:

i. Percentage of 24-hour supply by utility to individual home connection;
ii. Average household consumption per month by different sources of supply;
iii. Average household cost per month by different sources of supply;
iv. Total amount of money paid by vendors at source per month;
v. Average price of utility water, private tube wells; vendor water, and of bottled water;
vi. Revenue turnover of (a) utility, (b) tube wells, (c) vendors, (d) bottled water supplied and, (d) bottled water.
vii. Comparison of consumption and cost – consumer record versus utility record;

The main purpose of the assessment was to focus on those not served with piped water and to compare their plight with those served with piped water. The comparison of consumption and cost for these two groups is critical.

***Sustainability*** **-** To self-sustain water supplies, projects have become critical for long-term development and wellbeing of people. Sustainability, equity, billing collection, cost recovery and beneficiary participation were assessed in each of the three towns.

The ability of water authorities to build new well-fields is limited. Lack of funds limit their ability to accommodate actual water demands. It is apparent to most that the way water is currently provided is unsustainable due to population growth and increased uncertainty about rainfall.

The survey team employed a demand-responsive approach in conjunction with an Integrated Resource Approach (IRA) at the community level, which significantly increased the likelihood of water system sustainability. The approaches advocate that to manage water as an economic good, water supply systems should let consumer demand guide key investment decisions. Specifically, the system should adopt clear and transparent rules that allow users to select the level of service, technology, and location of facilities that best fit their needs, with a clear understanding of the costs and responsibilities that these options bear.

***Affordability* -** One of the central challenges facing water systems, especially small ones, is the provision of safe, affordable drinking water. Affordability is a function both of the price of water service and the ability of households (and other water users) to pay for the service. Thus, drinking water can be made more affordable by reducing the cost of service, increasing the ability of users to pay, or both.

A simple affordability assessment was carried out which measured household affordability or ability-to-pay, screening out communities where the household impact of water system costs was relatively low. The most prevalent household cost measure is: total annual user charges as a percentage of median household income to annual median household income as shown in the equation below.

$$\frac{Total\ Annual\ User\ Charges\ (AUC)}{Annual\ Median\ Household\ Income\ (MHI)} x100 \quad = \quad household\ affordability\ ratio$$

### 2.2.4 Criteria for Improved Water Sources Selection

Survey teams determined means of access using common WHO and UNICEF standards, classifying the type of technology in use and the information obtained in section 2.2.3. Table 1-1 provides the classification of technologies into those considered “improved” and those “not improved”. The reasons for a technology to be considered “not improved” can include limitations on quantity as well as quality. Figure 2-1 shows a typical unimproved dug well.

Generally, definition of a household that has access to improved water supply is having sufficient water that is relatively easily available and affordable. The survey team estimated the litre per capita consumption (LPCD) and percentage of water coverage.

Due to the drudgery of hauling water, productive hours are lost each day fetching waters. Estimating the time taken to fetch water is crucial to sustainable accessibility of drinking water. Figure 2-2 shows vulnerable groups fetching water from a nearby stream, usually in very deep valleys and difficult to access.

**Figure 2-1: Typical unimproved dug (tube) well**

**Figure 2-2: Vulnerable groups fetching water from a stream**

# 3. Bossaso Water Supply Assessment

## 3.1 General

Bossaso; formerly known as Bender Qaasim, is a coastal town located in the north-eastern region (Bari) of Somalia, overlooking the Gulf of Aden in the Red Sea. It was one of the few towns in Somalia that escaped destruction during the civil war that erupted in the early 1990s, prior to which the town had a population of about 10 000 people, Norconsult (1997). Today, the total population of the town is approximately 130 000[1] including host communities, IDPs from southern and central parts of Somalia, Somaliland and those from Ethiopia, Djibouti and other parts of the world who come to search for employment, economic opportunities and security, SRWU (2005). Bossaso town has a vibrant seaport that has good relations with the Arabian States. The port suffered only a moderate level of destruction during the civil war. However, rapid immigration of people has inevitably led to over-stretching and rapid deterioration of the available sanitary and health facilities such as water resources, Norconsult (1997)..

Today, the Golden Utilities Management Company (GUMCO), the only water utility company, supplies the population with relatively clean drinking water. The other common water sources for the people are water tankers, which cover a large population and private tube wells within dwellings, which both are highly vulnerable to any kind of pollutants.

Both field survey and assessment methodology and approach described in the previous chapter were implemented during assessment of Bossaso water supply. This included:

1) Survey of consumers (200 households), including domestic and non-domestic consumers, government institutions and IDPs,
2) Survey of three water vendors and/or utilities (GUMCO, Water Tanker Distributors and Private Tube wells),
3) Identification of the location of the Distribution Network Piping System for mapping using a GPS,

## 3.2 Consumer Survey Results

Enumerators from the Ministry of Public Works, Transportation and Civil Aviation (MPWTCA) and PSAWEN under the overall guidance of the consultant were mobilized for five days between 11–16 November 2006. Enumerators had been in the field conducting various field investigations and data collection to assist in the Bossaso Urban Supply Assessment. Social, water source, quantity and quality assessments were carried out using the questionnaire.

In order to make an effective consumer survey, the survey team modified the questionnaire to assist in establishing population and water demands. This questionnaire contains other data queries that assisted in meter installation, updating the operator's customer database and capturing GPS coordinates for the purposes of mapping water sources. Data relating to the 200 consumers visited was used for the consumer survey and found to be a sufficient sample size to represent the project area (although it was less than the projected figure of 5% of the population due to time factors). The processed survey data covered 35 institutions and commercial premises, 100 residential premises and 65 slum houses in the

[1] this is based on the number of formal properties in Bossaso on a July 2006 satellite*? image

IDPs camps. The survey also provided sample data for various categories of selected areas of high, medium and low income residential dwellings. The residential consumer survey inventory was carried out in selected residential areas for various consumer categories, comprising 35 premises in high income areas, 35 in medium income areas and 30 in low income areas.

The survey team completed a total of 200 questionnaires in Bossaso city. Of the areas visited, the survey team found that people in high-density areas are disproportionately poorer than the average of people in low-density areas. Water supply, sanitation, and health concerns constitute the next level of priority of residents, following income concerns. Figure 3-11 shows a high density area on the west side of the city.

Out of the 100 residential premises visited by the survey team, about 35% have a house connection, 30 % receive water from water tankers that obtain water from the five water private water wells through water tankers, 25% use private tube wells within dwellings and only 5% depend on public hand pumps, Table 3-1. On the other hand, the low income group reported a high dependency on tankers (30%), GUMCO Kiosk and Bulk system (60%) and only 10% share water with neighbours from either hand-dug wells or a neighbour's house connection (see Figure 3-2)

**Table 3-1: Consumer Survey Results for Bossaso**

| Source of drinking water | Domestic | Non-Domestic | Domestic | Non-Domestic |
|---|---|---|---|---|
| | High Density (%) | | Low Density (%) | |
| Household connection | 35 | 50 | 60 | 60 |
| Water Tankers | 30 | 2 | 30 | 2 |
| Private Tube Wells | 30 | 35 | 0 | 38 |
| Gifted Hand dug wells | 5 | 13 | 10 | 0 |

Citizens complain about quality, irregularity and scarcity of the central water supply. Complaints centre on water quality, faulty meter readings and expensive water bills for those with household connections, which the survey estimated was representative for about 35% of the Bossaso population. High pressure in water pipes created exaggerated meter readings, raising costs to Bossaso residents. For high-density areas, complaints were on the distances to water sources, quality and pricing. The survey team estimated that about 30% of the population use water from tankers, 30% from traditional private shallow wells near their houses and 5% use public hand pumps and 35% use GUMCO water (household connections). Figure 3.3 compares different water source in use by people of Bossaso town. The assessment shows that, in high-density areas, people prefer household connections, and this service would dramatically increase if GUMCO expanded its water supply and pipeline distribution network to new residential areas in Bossaso.

**Figure 3-1: Slum houses in Bossaso - locally known as BUUSH**

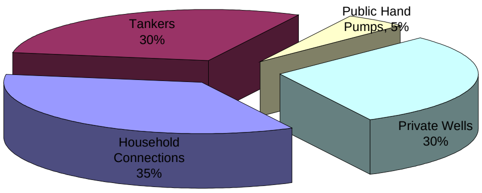


**Figure 3-2: Comparison of the different water-sources in use in Bossaso town**

Table 3-2 provides five principal ways of accessing water in Bossaso town with estimates of the population numbers and each of which are described further below, with observations on performance.

**Table 3-2: Modes of access to water in Bossaso**[1]

| Water Source | Description | Population (%) | Flow ($m^3$/month) (%) |
|---|---|---|---|
| GUMCO | GUMCO Water Supply System with household connection & dependant neighbouring families including leakage | 40,000 (31%) | 49,600 94% |
| | GUMCO Water Supply System with kiosks | 5000 (4%) | 1500 3% |
| | GUMCO Water Supply System for Bossaso Port | Boats/Ships/ Staffs | 1200 3% |
| Tanker Distribution | Improved source but unimproved handling, delivery likely contaminated | 56,000 (47%) | No metering system |
| Private shallow wells | Improved shallow wells within dwellings but highly vulnerable to contamination | Unknown | Unknown |

[1] Sources: GUMCO and Water tankers in Bossaso town

GUMCO Water Supply Systems (GWSS) draw on an improved water source, with a local distribution system providing access from a reticulated household (or yard) connection or from kiosks or public taps (supplied by reticulation). The GMWSS system is based on five drilled-dug wells with pump houses, a 500 $m^3$ elevated water tank, about 30 km of installed PVC pipes, five water kiosks for high-density areas and one kiosk serving Bossaso Port. The survey team estimated about 40,000 people access this service (about 35% of the Bossaso population) consuming about 43,000 $m^3$ of water per month.

Tanker Distribution System (TDS) draws on an improved water source and is a major source of water to about 30 % of households with a tanker distribution system. Tankers deliver water to household water reservoirs locally known as *Berkads*, the average size of which is about 6 $m^3$. Water quality during handling and delivery to storage is vulnerable to contamination. People do not boil, disinfect, filter or take any other preventive measures for their drinking water.

Private dwelling shallow wells, including hand pump wells draw on an improved water source and are the second most important source of water for about 40% of the population. This category includes high and low income groups, private businesses such as hotels and cafeterias, and government institutions. Water from shallow wells is stored in small reservoirs with an average size of 2 $m^3$. Water quality at source is likely contaminated due to probable seepage of wastes from toilets.

### 3.3 Population and Water Demand

The biggest urban growth in Puntland occurs in Bossaso. The authorities have a difficult time keeping up with the pace of immigration, resulting in inadequate delivery of basic environmental services. The concentration of people in Bossaso town is resulting in increased pollution levels and stress on water sources and systems, further intensifying water scarcity issues.

The population increased after the civil war through immigration of displaced and refugee populations from other parts of Somalia and adjacent countries. Most of the residential suburbs are quite recent. Until the end of the 1950s there were hardly any permanent houses, Bossaso being a small, remote, sleepy town in northern Somalia. With the introduction of boreholes, improvement of roads and the civil war in the south, people started to settle in Bossaso. Prior to the civil war the population of Bossaso was estimated to be 10 000 Norconsult (1997). In order to estimate the current population level, the survey team divided Bossaso residents into two main categories - IDPs camps and local residents.

*Population estimate for IDPs in Bossaso-* The population estimate for IDPs in Bossaso is based on a survey conducted by the Somali Reunification Women's Union (SRWU) in May 2005. Their surveyor's team targeted 15 IDP camps with approximately 4 000 households where the average household was estimated to be five persons. The total population of visible IDPs was then estimated to be 20 000 (see Table 3-3). Note that the invisible IDPs count is included in the population estimate for local residents in Bossaso.

*Population estimate for local residents in Bossaso-* The survey team estimated the number of formal properties in Bossaso at 15 162 buildings in 2002 and 17 238 in July 2006, from the aerial imagery produced by UN-HABITAT. Annual growth rate in the number of formal properties assumed as 3.3%. It was also assumed that, six people inhabited each property on average, including residential and non-residential properties. A population figure in the range of 100 000 to 110 000 was arrived at for those residing in formal properties (103 000 was the extrapolated figure).

If residents in IDPs camps are added to the above population estimate for local residents, an educated estimate for the total current Bossaso population is within the range 120 000 to 130 000. For the purposes of this study, the survey team assumed the total population of Bossaso in 2006 to be 125 000.

With the limitations of available data, it is difficult to make population projection years for the future. Any future Bossaso urban assessments should consider this as a priority for further assessment.

**Table 3-3: Population distribution in the IDP camps - Source SRWU (2005)**

| No. | Name of the camp | # Of HH | IDP Population | Percentage |
|---|---|---|---|---|
| 1. | 100ka Bush Camp | 775 | 4,106 | 21.0 |
| 2. | Buulo Mingis | 479 | 2,538 | 13.0 |
| 3 | Biyo kulule | 426 | 2,258 | 11.4 |
| 4. | Buulo - Elaay | 379 | 2,009 | 10.0 |
| 5. | Ajuuraan | 326 | 1,728 | 9.0 |
| 6. | Absame | 267 | 1,415 | 7.1 |
| 7. | Shabeelle | 193 | 1,023 | 5.0 |
| 8. | Buulo - Qodah | 192 | 1,017 | 5.0 |
| 9. | Inji Camp | 188 | 994 | 4.9 |
| 10. | 10ka Bush Camp | 162 | 856 | 4.0 |
| 11. | Buulo Abow | 93 | 493 | 3.0 |
| 12 | Tuur jaalle | 91 | 482 | 2.0 |
| 13. | Buulo Ifo | 65 | 344 | 1.9 |
| 14. | Baalade | 47 | 248 | 0.9 |
| 15. | Haadoole | 33 | 175 | 0.8 |
| **Total** | | **3 716** | **19 689** | **100** |

## 3.4 Current Water Demand

The current water consumption for Bossaso was found to be following trends as shown in Table 3-4 below.

**Table 3-4: Current Water Demand Estimation**

| Type | 2006 | | |
|---|---|---|---|
| | Population | Litres | Total |

| | | | |
|---|---|---|---|
| Kiosks | 5,000 | 20 | 100,000 |
| Household | 40,000 | 20 | 800,000 |
| Vendors (water tankers) | 35,000 | 20 | 700,000 |
| Dwelling Tube wells | 35,000 | 20 | 700,000 |
| Public hand pumps | 10,000 | 15 | 150,000 |
| 5% leakage (assumed) | | | 122,500 |
| **TOTAL** | **125,000** | | **2,597,500** |

## 3.4 Utility Performance
### 3.4.1 GUMCO Utility Performance and Piping Distribution Network

Data collected from the utility is presented in Table 3-5 below. The city has a population of about 125 000. GUMCO utilities directly serves 35% of the population, of which 80% is through house connections. Around 5 000 persons are served by five kiosks. On average the utility supplies around 52 300 $m^3$/month of water/month against a demand of 75 000 $m^3$/month (this is based on 20 litre/person). Total monthly consumption by population using house connections, kiosks and bulk connection are 49 600, 1 500 and 1 200 $m^3$/month, respectively. Presently there are 3 300 house connections, of which 97% are metered and 100% in excellent working condition (as reported by the utility). No new connections have been made during the last 12 months, either for domestic and non domestic demands. The reason for this is that the production wells are at capacity and unless a new source can be found, water supply cannot be increased (see Table 3.5). According to the utility, 100% of house- and bulk connections have access to 24 hours/day water supply. Repair and maintenance time of any leakage is minimal, as the system was fairly recently installed. The utility employs 25 persons in administrative and technical capacities and there are 12 people on the Board of Directors.
The location of the water distribution network was established in order to produce a map of the actual pumping regime, using GPS. The available Bossaso town mapping of 1:12 000 was produced by SWALIM based on data acquired on 5th March 2003. The aim was to superimpose the water distribution network map over 2003 digital photomap/satellite imagery of the town and to produce maps to be used in the Bossaso water supply assessment (see Figure 3.4).

**Table 3-5: Golden Utilities Management Company (GUMCO) Survey Results**

| No. | Description | Responses from Utility |
|---|---|---|
| 1 | Population in Utility Service Area | 120,000 |
| 2 | Population Served by Household Connections | 35% |
| 3 | Population Served by Kiosks | 5,000 |
| 4 | Number of House Connection | 3,300 |
| 5 | Number of Metered Connection | 97% |
| 6 | Number of Metered Not Working | 3% |
| 7 | Number of Kiosks | 7 |
| 8 | Number of metered Kiosks | 5 |
| 9 | Combined Capacity of Kiosks | 1,500$m^3$/month |
| 10 | Number of Bulk Connection | 1 |
| 11 | Number of Metered Bulk Connection | 1 |
| 12 | Production Sources Metered and working | 100% |
| 13 | Combined Capacity of Bulk Connection | 1,200$m^3$/month |

| No. | Description | Responses from Utility |
| --- | --- | --- |
| 14 | Number of wells | 5 |
| 15 | Total Production Potential | 60,000 $m^3$/month |
| 16 | Actual Production | 52,380 $m^3$/month |
| 17 | Estimated Water Demand of the Service Area | 65% |
| 18 | Losses due to average billing, illegal onnection, under billing, illegal sale of water, not paying etc | 5% |
| 19 | Number of meters replaced during last 12 months | 12 |
| 20 | Total consumption by house connection | 49,680$m^3$ (94%) |
| 21 | Total money billed to household connection per month | 45,000 USD/month |
| 22 | Total money billed to Kiosks connection per month | 1500USD/month |
| 23 | Total money billed to Bulk connection per month | 4000USD/month |
| 24 | Number of new connection installed in last 12 months (Domestic) | None |
| 25 | Number of new connection installed in last 12 months (Non domestic) | None |
| 26 | New Connection fee and terms of payment | 100USD for system installation, 5 USD for reconnection services if it disconnection due to un paid of bill for two months. |
| 27 | Number of personnel employed by the utility | 14 |
| 28 | Technical efficiency (leakage) | 81% |
| 29 | Billing efficiency (metering) | 96% |
| 30 | Collection efficiency (paid bills) | 95% |
| 31 | Unaccounted for water | 5% |
| 32 | Number of staff | 25 |

### 3.4.2 Tankers Water Distributions

In Puntland, trucks are used to distribute water in urban towns such as Bossaso Galkayo, Garowe, and Gardo, as well as in rural areas where water is transported over long distances. Even if water utility systems are constructed, the use of these trucks is still necessary. The tankers, are privately owned and most are in poor condition. As many people will continue to depend on these trucks for their water, future assessment programmes should investigate how a future authority could guarantee this type of distribution without taking over the business from the entrepreneurs. Transporters should be educated on how to keep water free of contamination during filling, transport and distribution.

Numerous water tankers fetch water from mainly private tube wells, and deliver water to the population of Bossaso. Many residents are attracted to water distribution tanker's points due to cheaper water.

### 3.4.3 Private tube wells

There are five main private tube protected wells in Bossaso that supply water to tankers at very cheap prices. These wells are shallow hand dug wells with an average total depth of about 19 m (see Table 3.6), and sell about 1 930 m$^3$/day of water to the residents of Bossaso city[1].

**Figure 3-4: An example of privately owned tube well in the outskirts of Bossaso city**

**Table 3-6: Water well abstractions from both GUMCO and private wells in Bossaso**

| Water source | Borehole Name | Latitude | Longitude | Elevation (m) | Depth (m) | Q (m3/day) | EC | Type of Well |
|---|---|---|---|---|---|---|---|---|
| GUMCO | BH-1 | 11º27’39.8” | 49º16’40.7” | 17 | 20 | 534 | 3.90ms | Drilled Well |
| | BH-2 | 11°16´04 | 49º09´56.8" | 22 | 27 | 183 | 5.65ms | Drilled Well |
| | BH-3 | 11°15´53.4" | 49°10´30.8" | 48 | 48 | 220 | 4.24ms | Drilled Well |
| | BH-4 | 11°15´19.6" | 49°12´08.1" | 51 | 51 | 304 | 1,702µs | Drilled Well |
| | BH-5 | 11°15´07.5" | 49°12´18.2" | 59 | 59 | 416 | 2.73ms | Drilled Well |
| PWS | Ali Shanle | 11°16´911" | 49°12´28.6" | 16 | 19 | 360 | 1,693µs | Dug Well |
| | Habeb | 11°16´994" | 49°12´237" | 21 | 18 | 150 | 1,746µs | Dug Well |
| | Ali Shanle | 11°16´931" | 49°12´306" | 16 | 20 | 150 | 3,050µs | Dug Well |
| | Ali Dahir | 11°16´87.1" | 49°12´201" | 19 | 19 | 150 | 1,678µs | Dug Well |
| | Ali Shanle 2 | 11°16´931" | 49°12´306" | 16 | 21 | 1120 | 2,890µs | Dug Well |

[1] Personal communication between Gulled Mahamud, SWALIM Consultant, and Mr. Ali Shanle private shallow well owner, *on 13 November 2006*).

### 3.4.4 Water Prices

In urban centres such as Bossaso, households spend between US$ 6–40/month on water, the average being about US$ 10/month[1]. A typical family of six persons might spend US$ 14/month for a household connection provided by GUMCO. This includes water used for washing clothes and baths. Assuming an average household income of US$ 100/month, 10% of the income is spent on water (see Table 3.7).

**Table 3-7: Scheduled prices of 1 $m^3$ of water in NE Somalia, Source: GUMCO**

| No. | Water suppliers &/or vendors | Water supplied ($m^3$)/month | Scheduled Prices (US$) for 1 $m^3$ of water | | | | |
|---|---|---|---|---|---|---|---|
| | | | House hold | IDPs | Public Institutions | Bossaso Port | Kiosk Vendors/Truck Filling Point |
| 1 | GUMCO | 55,000 | 1US$/$m^3$ | 0.6[2] USD$/$m^3$ | 0.6[3] USD$/$m^3$ | 2.5[4] USD$/$m^3$ | 1.7[5] USD$/$m^3$ |
| 2 | GWC | 60,000 | 1US$/$m^3$ | 0.67US$/$m^3$ | 0.67US$/$m^3$ | NA | 0.79-0.86 |
| 3 | HWC | 2,400 | 1US$/$m^3$ | Free | Free | NA | 0.67 USD$/$m^3$ |
| 4 | Berkads | Unknown | 1.2-7 USD$/$m^3$ | 1.2-7 USD$/$m^3$ | 1.2-7 USD$/$m^3$ | 1.2-7 USD$/$m^3$ | 1.2-7 USD$/$m^3$ |
| 5 | Water Tankers | Unknown | 3-7 USD$/$m^3$ | 3-7 USD$/$m^3$ | 3-7 USD$/$m^3$ | 3-7 USD$/$m^3$ | 3-7 USD$/$m^3$ |
| 7 | Private Water Treatment Companies | Unknown | 15 USD$/$m^3$ | 15 USD$/$m^3$ | 15 USD$/$m^3$ | 15 USD$/$m^3$ | 15 USD$/$m^3$ |

### 3.4.5 Water Quality Analysis and Standards

There are currently no official drinking water quality standards in Puntland. During this study, the World Health Organization (WHO) guidelines were applied. The proposed water quality assessment was postponed to a later date, until such time as the survey team has been trained to use a portable water quality kit.

## 3.5 Conclusions

Population increase has been dramatic since the early 1990s after the civil war, when Bossaso witnessed a mass immigration of Puntlanders from southern Somalia. During the following years population increases have been from rural settlements due to prolonged years of drought. The survey team estimated the population of the town to be about 125 000 inclusive of the IDPs population.

[1] Information from Director General of GUMCO, Mr. Salad, general trend supported by GWC and QWC.
[2] 40% discount given for IDPs
[3] 40% discount given for all public institutions such as schools, mosques, Health Posts and MCH
[4] Bossaso Port are provided with a special water supply kiosk for ships and boats. The tariff includes 20% tax from the Ministry of Fisheries and Ports and Ministry of Local Government and Rural Development.
[5] These vendors buy water from PPP at a discount rate of US$ 0.6 and sell at US$ 1.7.

The GUMCO utility serves 35% of the population through 3 300 house connections, five kiosks and at Bossaso Port. As for monitoring MDG performance concerns, the number of household connections are known to be approximately 3 300 and it can be cautiously concluded that about one in five formal households are served by the GUMCO supply system. However, coverage of informal households is still desperately low. The population with access to improved water sources is estimated to be 65% (this figure include both people served by GUMCOs 35% and 30% by tanker distribution). In summary, the utility supplies around 52 300 $m^3$/month of water per month against a demand of 75 000 $m^3$/month based on at least 20 l/p/d.

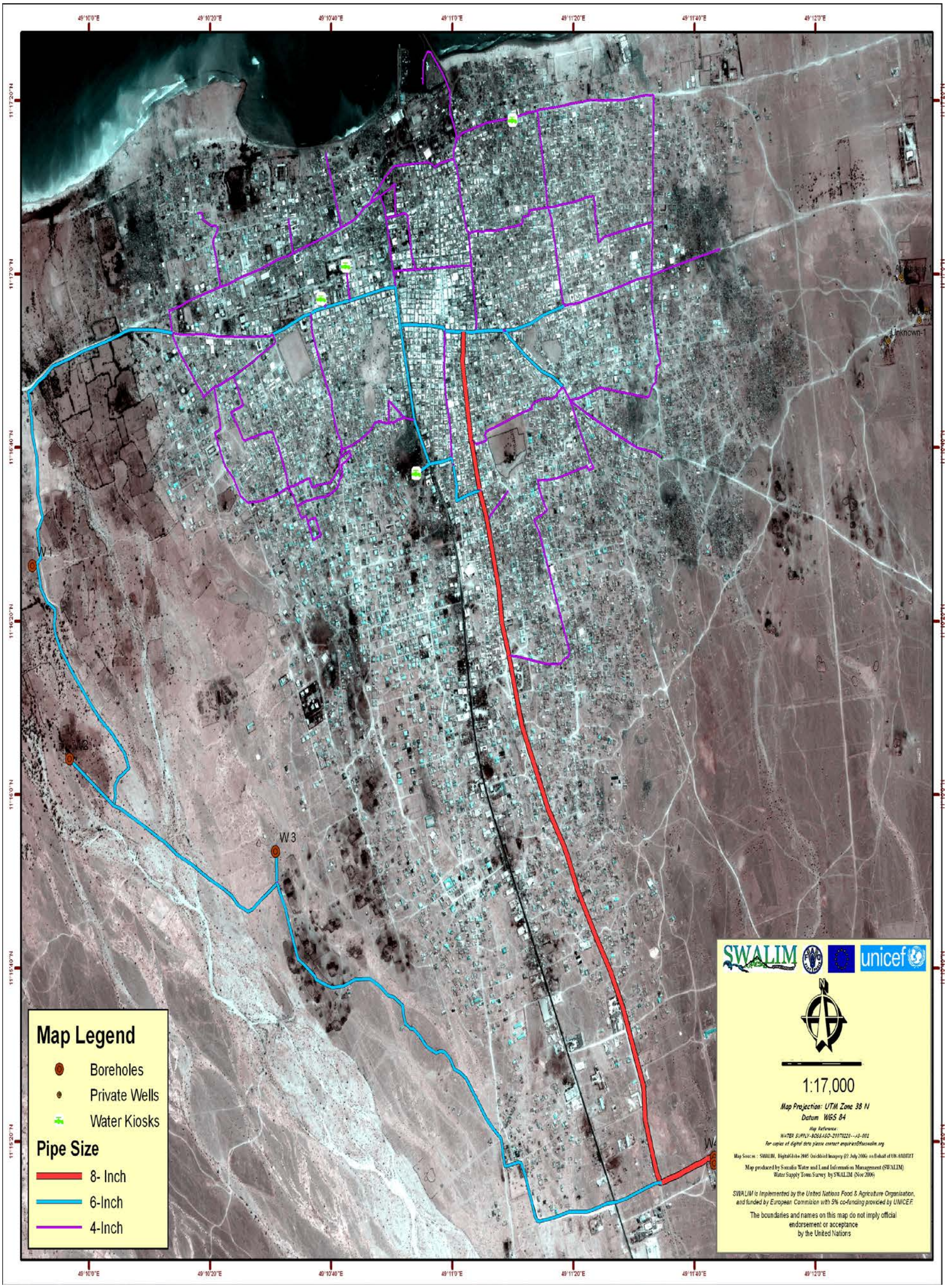


**Figure 3-3: Map of GUMCO's piping distribution network in Bossaso**

# 4. Borama Water Supply Assessment

## 4.1 General

Borama is the capital of Awdal Region, the most westerly region of Somaliland (see Figure 4-1). Awdal borders with Djibouti to the west, has a shoreline that faces the Gulf of Aden and borders Ethiopia to the south. It is located about 110 km west of Hargeisa, the capital city of Somaliland. Borama is a well-developed town with a well-educated population as one of the oldest secondary schools was built there during the colonial era. At present, the former secondary school has been transformed into a community-run university with connections to other universities throughout the world. The university is well-equipped with computers and has a well-stocked library with the most recent books. The town is well laid out in some places, but the recent spate of new buildings do not appear to follow a proper plan of layout, which might create problems while constructing new water systems. The town has few roads in good condition but this will not hinder the laying of the distribution system.

Borama's water system has been in continuous development since the colonial era. The oldest water system was based primarily on a shallow water well/cistern system, which was operational until late 1986. After the Somalia-Ethiopian war in 1977, Borama was an area for refugee camps for Somalis nomads used to live on the Ethiopian side of the border. Water demand became acute, as the old system could not supply the city as well as the refugee camp near Borama. The New Trans-century Foundation started underground water research in January 1987 and as a result drilled two boreholes in the surroundings of Borama town. One of the wells was rehabilitated successfully by the Chinese rural water development programme, which drilled eight boreholes in both Dumuk (Dumuq) and Amood *togas* in 1988. Well depths were between 45-75 m, but the piping distribution system was not established.

The civil war in 1988 resulted in devastation of all water sources as well as the relevant governmental administrative bodies. Numerous initiatives were made by the international community to re-establish the Borama water system, but this proved to be unsustainable due to weak public administration and corruption. Some of the electrical generators either ceased to function due to a lack of spare parts, or simply looted. Over the past 10 years, the Borama water supply has been aided at various times by UNICEF, OXFAM UK, UN-HABITAT and UNHCR. The net balance is a system that is inadequate for the present population and cannot be run in an economical manner, while the few who do get water have to pay more for water than in Hargeisa.

UN-HABITAT tried to install a management system but failed as the political will was lacking. The present management inherited a system with problems that cannot be solved. The municipality will have to take the responsibility of dealing with the system, as the new system should not be mixed with the previous system. Later under request from the community and fund from USAID, UNICEF assisted in construction of the current system and a group of elders and elites established the current utility known as SHABA

Borama was well known among UN agencies and INGOs working in Somaliland, as the “graveyard of machines”. Water-related problems became severe, and prominent citizens initiated the present Borama Water Supply Project in 2000 through a workshop on the water situation in Borama. Community members (intellectuals and elders) gathered at a workshop promised to support and to look after the contribution and involvement of the community.

UNICEF was invited to the workshop and undertook the task of writing a proposal for the town's water supply system. The proposal designed to mesh with both present needs and for the next five to 10 years, depending on the growth rate of the town. USAID agreed to fund the proposal if the system would run on a private basis with public oversight as a partnership.

### 4.1.1 Boroma Aquifer Hydrogeology

Trends of major fault belts around Borama can best be understood in terms of extensional tectonic stresses acting at the right angles to each of the three plate boundaries, viz. the Arabian plate; situated between the Red Sea and the Gulf of Aden rift, the Somali plate; situated between the Gulf of Aden rift and the East Africa rift, and the Nubian plate; situated between the East African rift and the Red Sea rift. The present position of the intersection of the three plate boundaries is the Gulf of Aden, a little over 100 km north of Borama. In each case, the plates on opposing sides of the rift are gradually moving away from each other as the intervening voids are filled with newly generated lithosphere materials. The absolute plate is moving northeast wards towards Turkey and western Iran, while the Somali plate is moving to the southwest. Geological evidence suggests that the Nubian plate is stationary with respect to the upper mantle.

Improvement in water infiltration is required to overcome the problem of aquifer depletion, which could be realized by construction of sand storage dams on the upper portion of the Damuq River known locally as Qorgab.


**Figure 4-1: Generator station room for the Borama water supply project**

## 4.2 Consumer Survey Result

The residents of Borama were divided and ranked by wealth according to regional authorities and the municipality mayor, counsels, Sheba shareholders and other elite persons living in Borama. They assisted in identifying the wealth ranking with the assessment team, as shown in Table 4-1. The estimated population of Borama is about 136,217 persons, with a population growth of about 7%. The populations in 2015 are expected to reach 220,034 persons. The quantity of water consumed daily per person in litres/capita/day is very difficult to estimate as there is no realistic statistical data and no national census has been made for the past 17 years, since the collapse of the Somali government.

From the amounts of water being pumped and the revenue from the small quantities of water being sold makes it clear that there are problems, see overview of Borama design (2001). Sales clearly show that ends cannot be met and therefore shortcuts are being made that will leave machines un-maintained and/or personnel not being paid, which will create motivational problems.

**Table 4-1: Wealth Group Ranking of Borama City**

| No | Wealth Group | Percentage of the community |
|---|---|---|
| 1 | Poor | 45% |
| 2 | Middle | 45% |
| 3 | Better off | 10% |

The questionnaire was conducted to include the different social fabric of the community of Borama. Due to limited time and resources, only 45 questionnaires were collected by the assessment team. Despite a proper socio- economic survey requiring many members, the team tried to take a representative sample of households that included low- and high-density areas in the city. Furthermore, the team took a gender-balanced approach where men were interviewed in 20 households and women were interviewed in 25 households.

A summary of the questionnaire results in terms of income analysis showed that:

- Better-off income > 1,000 US $/month
- Middle income = 300 - 600 US $/month
- Poor income = 100 to 150 US $/month
- Average water consumption, poor households = 6 - 7 US $/month
- Average water consumption, middle households = 10 – 12 $/month
- Average water consumption, better-off households = 15-20 US $/month.
- 80% of incomes of poor and middle families are spent on food
- 5% of income of poor families is spent on education
- 10% of income of middle families is spent on education
- All families interviewed have children at school
- Better-off families' food expenditure is between 400-600 US $/month

The better off and the middle-class families stated that there is no problem with water supply, service and management of the water utility company. This group appreciates how the water system operates. Despite the fact that water problems are solved in Borama, poor families cannot afford to pay for water connections. Household water connections cost between US$ 80-350/connection, which caused complaints by poor families against SHEBA, the water management company.

The average amount of water extracted in the year 2004 was 1,134 $m^3$/day for the total population. The average amount of water extracted in 2005 was 1,168 $m^3$/day for the total population. The average amount of water extracted in the first half of 2006 was 1,254 $m^3$/day. Considering the JMP standard of improved drinking water sources, the Borama water system could be considered as an improved source of drinking water. Every tap stand and kiosk was located within 1 km range of residents.

### 4.3 Population and Water Demand

There is no current town plan and no consensus on population size at present, and the various estimates for the population vary widely. The truth is that there is a fluctuating population, as the Somali are great travellers and the population also fluctuates depending on the level of heat at the coast. A number of people come from Djibouti and the coast (from Zeila to Lughaya) to Borama and stay only during the hot season (at least during August).

The old water system limited consumption to the minimum needs of people in the town. Few kiosks widely placed had a negative effect on the amount of water collected by women and girls, meaning that a minimum of water was being consumed. The distance water needed to be carried had a direct effect on the quantity being used, less collected per head of household when distances are greater. The amount of water trucked into town was at least the same as the water pumped into town; while prices are the same unless the municipality system is not functional, when the price might increase. More lorries were seen during the hot season on the coast, as more persons come to Borama.

*Resident population estimates for Borama*

Using a similar method of estimation as was used in Bossaso town, i.e. based on the number of properties extracted from the UN-HABITAT town maps and assumptions of :

- an average of six persons per household
- an estimated growth rate of 3.5% per annum, and
- an additional 5% living in informal areas

The population of Borama at the end of 2006 was estimated between 65 000 - 75 000. The water required per day to meet UNICEF standards was estimated at 1,400 $m^3$/day.

In meeting the MDG water objectives for Borama, the town should have a supply of 1,400 $m^3$/day. As the actual figure of water pumped to Borama is an average of 1,254 $m^3$/ day, it can be said that the Borama water supply system has reached the MDG of 23% house connections, but future development is only possible if additional water sources are found or the rate of infiltration water to the current aquifer is increased. The Borama water system has reached its peak in terms of water extraction, coverage area and wastage water.

With available data, any meaningful population projections for Borama are not possible, and it is recommended that future assessments include a proper population count and population projection. Table 4-2 shows an estimate of possible development over time.

**Table 4-2: Possible Development of Water Distribution over time**

| **Type of Supply** | **Individual connections (%)** | | | **Communal Water points (CWP) or kiosks (%)** | | |
|---|---|---|---|---|---|---|
| ***Demand Period*** | ***Initial*** | ***Future*** | ***Ultimate*** | ***Initial*** | ***Future*** | ***Ultimate*** |
| Urban Areas Population >5,000 | 60 | 70 | 90 | 40 | 30 | 10 |
| Population <5,000 | 40 | 50 | 70 | 60 | 50 | 30 |

## 4.4. Utility Performance

### 4.4.1 Sheba Utility Performance and Pipe Distribution Network

The activities carried to assess this parameter were as follows:

a. Assessment of the access road to reach of the tanks locations on top of the Farahood hill. The road enabled pipe-laying and construction of a tank with a capacity of 7 000 $m^3$ on the saddle of Farahood hill.
b. Rehabilitation of boreholes 1, 2, 3 and 8. Eight boreholes were drilled by the Chinese in 1988 and named BH-1 to BH- 8. These wells have been working since 1988, and only four of those boreholes were rehabilitated.
c. Borehole cleaning tested and connected by 100 mm ductile iron to the pumping mains. Checked the state of borehole and pump-tested to see if capacity is still as stated when they started production. Four 100 mm ductile iron pipelines from the wells carry the water to the 200 mm pipe (the raising main) that leads to the tank on top of Farahood hill.
d. Rehabilitation and repair of the suspension bridge carriying two pipes from Wells 2 & 8 in the direction of Borama (see Figure 4.4). BHs 2 & 8 were on the eastern side of the *toga* and arrived at the booster station via a suspension bridge. The suspended bridge was straightened, cables renewed and a pair of 4” pipelines laid on the bridge to improve the carrying capacity of the pipes from the two wells on the eastern side of the Togga Dhamug. Ductile pipes will be incorporated and the bridge strengthened.
e. Installation of new generator, overhead power line and new submersible pumps. Booster pump-house is built of permanent materials and gensets are installed in the rehabilitated booster pumphouse.
f. Installation of new pumped rising mains. This 200 mm pipeline carries water pumped from the well field to the main tank on Farahood hill. Because the ground around Dhamug is hard, each of the submersible pumps is connected to a new 100mm ductile iron pipeline that runs over-ground. They are joined at a manifold situated near the booster pumphouse and connected to a rising main to Farahood.
g. Construction of foundation and dwarf piers of reinforced concrete and assembling of the water-tank on Farahood hill. An elevated pressed steel panel Braithwaite tank of 750 $m^3$ is installed on a saddle on Farahood hill.
h. Installation of a ring water main and distribution water main connecting to the existing network of 220 mm pipe, approximately 3 100 m long. From the tank on Farahood, a DN200 PVC ring main will then deliver water to a DN15O distribution main which will in turn feed the existing distribution lines. A branch pipe about 200 m long will interconnect the DN200 ring main with the 4” GI rising main to Sheikh Ali tank (Figure 4.5).
i. Construction of kiosks; the main aim of the improved system is to connect as many households as possible to the system. Fifteen kiosks are constructed in areas where the density is high, but income is low (see Figure 4.6).
j. Test water, and create awareness on quality of water and intake quantity per person. At various times, complaints have been brought against quality of water from deep wells (like Dhamug). Tests have confirmed that the quality is well within the range of WHO drinking water guidelines. Discussions were held with medical doctors and an awareness program was created through Borama TV. The public was also briefed about the need to drink enough water for health purposes.

k. Workshops on private management and community awareness, to prepare for privatization with public oversight of the Borama Water Supply System. Workshops and programs were carefully planned and implemented to enhance community awareness towards BWS and PPP.

l. Connection of the new system to the old, the whole system cleaned, disinfected and pressure-tested and put into operation. A drawing of the water supply system was also completed.

m. The New Borama water supply system was transferred to private management.

*Water Source Equipment:* The Chinese drilled eight boreholes in 1988, five of which are under the Management of Sheba Company, and four of which have been rehabilitated by UNICEF and equipped with submersible pumps. All four wells are equipped with a central power station located at the booster station. Only three of the boreholes are in operation, as the fourth one was kept inoperative to avoid well depletion. Original well depth was 45.5 m. The three operational boreholes are operated for an average of 18-20 hours/day, with average yields of 25, 25 and 20 $m^3$/hour respectively.

**Figure 4-4: Suspension bridge, part of the piping distribution network system**

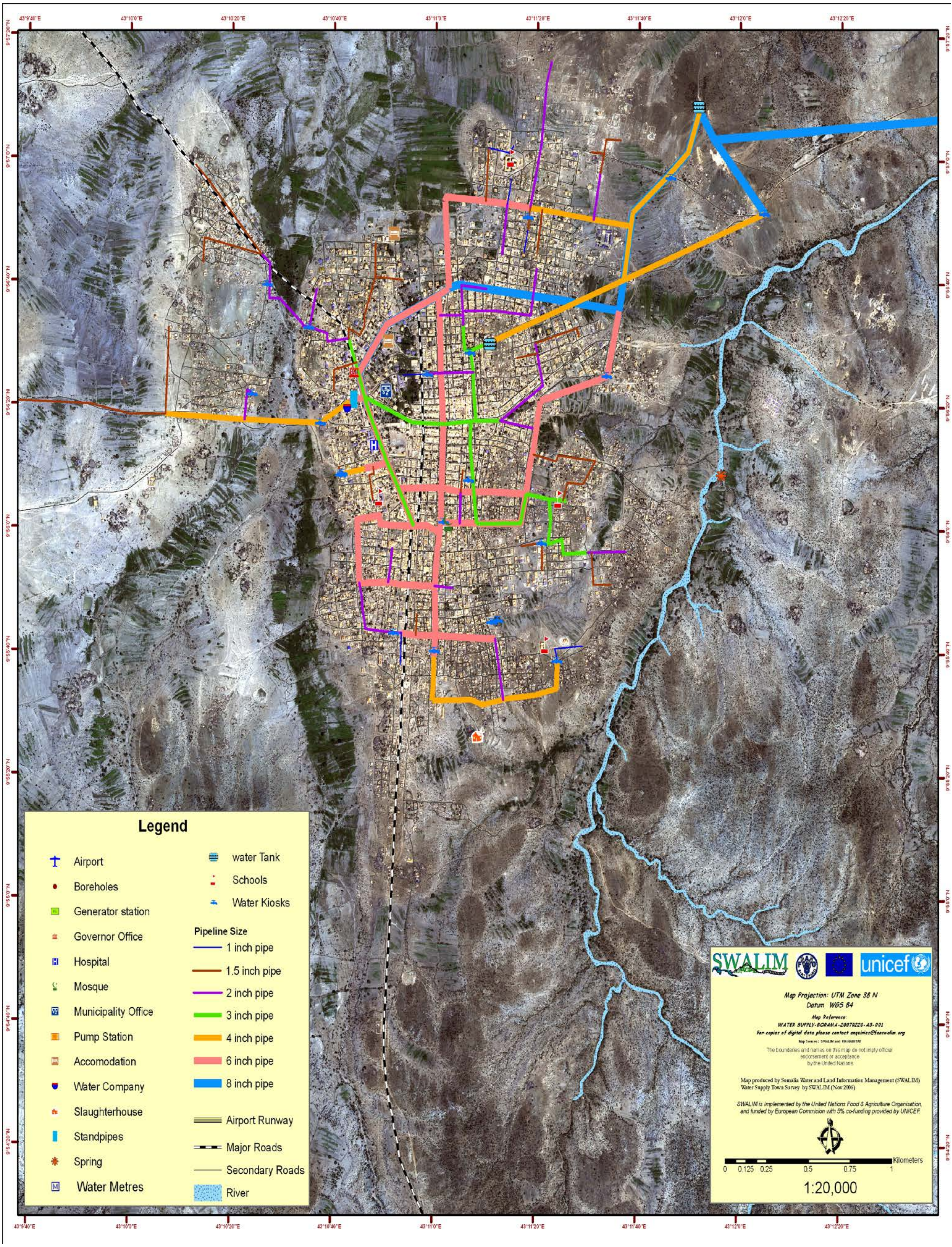


**Figure 4–5: Map of SHEBA piping distribution network in Borama**

**Figure 4-3: Example of one of fifteen Kiosks in Borama city**

### 4.4.2 Other Sources of Water

In Borama there is a natural water spring, located in the upper reaches of the Damuq River where the Jurassic limestones overly the Precambrian schist (Figure 4.7); know locally as Qorgab. Water flow is limited, the poorest people using this water, taking one hour to collect a donkey load of 80 litres. Water vendors tap the spring water and sell it relatively cheaply to poor neighbourhoods, compared to the kiosks. Water quality tests indicated that the spring water is fresher than borehole water, that is why some up to 10% of the Borama community use the spring water, and because it is free of charge.

**Figure 4-4: Borama spring in the Damuq River**

### 4.4.3 Water Distribution

Water distribution network has covered almost 95% of the residential areas of the town. The network is increasing month by month, while the numbers of kiosks are reducing every month. People fetching water were reduced to only standpipes. Water tankers almost stopped. Table 4.3 is showing the increment of households' water connections with time.

The water was extended to the town boundary, and the water kiosks (currently about 35 units of them) were extended to all parts of the town. The biggest concentrations of kiosks are in the south-east, east, west and south-west of the town. There are hundreds of house connections used as commercial water points. In areas where house connections are limited, the community purchases water from neighbouring houses with water connections.

**Table 4-1: The increment of households' water connections**

| Date | Number of household connections |
|---|---|
| 01/01/05 | 768 |
| 01/02/05 | 851 |
| 01/03/05 | 934 |
| 01/04/05 | 975 |
| 01/05/05 | 1069 |
| 01/06/05 | 1169 |
| 01/07/05 | 1255 |
| 01/08/05 | 1334 |
| 01/09/05 | 1408 |
| 01/10/05 | 1458 |
| 01/11/05 | 1768 |
| 01/12/05 | 1844 |
| 01/01/06 | 1918 |
| 01/02/06 | 2006 |
| 01/03/06 | 2072 |
| 01/04/06 | 2195 |
| 01/05/06 | 2425 |
| 01/06/06 | 2523 |
| 01/07/06 | 2579 |
| 01/08/06 | 2597 |
| 01/09/06 | 2631 |
| 01/10/06 | 2683 |

### 4.4.4 Water prices

The pricing policy of the water works should be such that it will favour persons consuming below 10 $m^3$ per month, but prices should increase sharply when more is consumed. From 10–30 $m^3$, the price should be at least 25% more, and the next level from 30–50 $m^3$ (50%) more than the previous price. The rationale of increases in pricing is to preserve water (see Table 4-4).

**Table 4-4: Pricing structure for the Borama utility - Source SHEBA**

| No | Source type | Unit of purchase | Price of water /unit of purchase | Seller |
|---|---|---|---|---|
| 1 | Household connection | $M^3$ | 5,500 | Sheba |
| 2 | Kiosks | $M^3$ | 4,300 | Sheba |
| 3 | Kiosks | 20 litre | 300 | Kiosk owner |
| 4 | House to other house | 200 litre | 2500 | House owner to other house owner. |
| 5 | Donkey carts vendors | 20 litre | 500 | Donkey cart owner- if the water from the system |
| 6 | Donkey cart vendors | 20 litre | 375 | Donkey cart owner – if the water from spring. |

Table 4-5 provides technical information on SHEBA utility in Borma as surveyed by the assessment team. In the table, *production* means the quantity of water extracted from boreholes, and *sales* is the quantity of water as it is sold and collected by Sheba Company. Water production/day is averaged by 1,100 to 1,300 $m^3$/day. An average day sales are 1,090 to 1,112 $m^3$/day. Average wastage is 12.89% in 2004 and water wastage of water is 6.93% in 2005, but average wastage of water is 7.51%. Water wastage levels indicated in the table demonstrate the efficiency of Sheba Company in reducing wastage.

**Table 4-5: Utility Survey Results for Borama**

| **2004** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Production 1000 $m^3$ water | 31.7 | 31.8 | 34.8 | 38.1 | 37.8 | 38.1 | 36.0 | 36.5 | 30.9 | 30.6 | 31.4 | 32.6 |
| Sales 1000 $m^3$ of water | 24.9 | 30.2 | 30.2 | 35.4 | 31.2 | 35.4 | 32.0 | 34.0 | 28.0 | 28.0 | 28.9 | 29.3 |
| Wastage % | 28.01 | 14.0 | 13.22 | 6.82 | 17.6 | 6.82 | 28 | 6.8 | 9.4 | 6.2 | 7.64 | 10.13 |
| **2005** | | | | | | | | | | | | |
| Production in thousand $m^3$ water | 34.3 | 33.9 | 36.4 | 30.8 | 27.9 | 38.3 | 43.7 | 38.9 | 34.0 | 38.3 | 34.7 | 36.0 |
| Sales in thousand $m^3$ of water | 32.0 | 32.5 | 33.7 | 30.4 | 24.7 | 35.9 | 39.9 | 39.0 | 30.1 | 34.0 | 34.2 | 32.2 |
| Wastage % | 6.41 | 4.13 | 7.42 | 1.3 | 11.11 | 6.27 | 8.70 | 2.31 | 11.18 | 11.23 | 1.46 | 10.23 |
| **2006** | | | | | | | | | | | | |
| Production in thousand $m^3$ water | 36.7 | 35.8 | 38.7 | 30.1 | 40.3 | 47.5 | | | | | | |
| Sales in thousand $m^3$ of water | 33.8 | 35.2 | 34.3 | 28.8 | 34.5 | 44.7 | | | | | | |
| Wastage % | 7.63 | 1.68 | 11.37 | 3.99 | 14.40 | 5.99 | | | | | | |

### 4.4.5 Water Quality Standards and Analysis

Collected water samples were analysed at the site for bacteriology and at the SGS laboratory in Kenya for bacteriological and chemical content, to determine compliance with the WHO standards for levels likely to give rise to consumer complaints.

According to site water samples analysed, Borama water sources are very safe because water is chlorinated, leakage is reduced (less than 7%) losses and the Sheba company has ensured continuity of the water supply system (see Table 4.5). In the case of spring water there is enough gravel and sand covered by the river, but there are no water sanitation parameters, so water can be contaminated, especially during the dry season.

**Table 4-6: On-site water quality analysis for Borama**

| Locations | EC µs/cm | P.H | °C | Colour | Odour | Test | Turbidity |
|---|---|---|---|---|---|---|---|
| Dhamuq BH-2 | 1,140 | 6.8 | 25 | No | No | No | < 5 |
| Dhamuq BH-8 | 1,380 | 6.8 | 25 | No | No | No | < 5 |
| Dhamuq BH-1 | 1,180 | 6.8 | 25 | No | No | No | < 5 |
| Qorgab Spring | 1,008 | 6.8 | 25 | No | No | No | < 5 |
| Qorgab Spring | 1,011 | 6.8 | 25 | No | No | No | < 5 |

Water samples collected from several representative sites were submitted to the SGS laboratory in Kenya for chemical analysis to determine compliance with World Health Organisation guidelines. Results of the water analysis provided baseline information/data (indicator) on possible high chemical contents that could be harmful to consumers (see Table 4.6. The chemical levels of the water samples collected from the sites have slightly elevated contents of nitrates, fluorides and zinc, but none exceeded limits that might cause consumer complaints.

**Table 4-7: Water quality analysis for Borama**

| Sample | Nitrates as $NO_3$ (mg/l) | Arsenic as As (mg/l) | s Fluorides as F(mg/l) | Iron as Fe (mg/l) | Zinc as Zn (mg/l) | Copper as Cu (mg/l) |
|---|---|---|---|---|---|---|
| **1** | 2.00 | ND (DL = 0.02) | 0.52 | ND (DL = 0.02) | 0.10 | ND (DL = 0.02) |
| **2** | 1.2 | ND (DL = 0.02) | 0.57 | ND (DL = 0.02) | 0.23 | ND (DL = 0.02) |
| **3** | 1.40 | ND (DL = 0.02) | 0.51 | ND (DL = 0.02) | ND(DL = 0.02) | ND (DL = 0.02) |
| **4** | 1.50 | ND (DL = 0.02) | ND (DL = 0.02) | ND (DL = 0.02) | ND(DL = 0.02) | ND (DL = 0.02) |
| **5** | 1.80 | ND (DL = 0.02) | 0.56 | ND (DL = 0.02) | 0.09 | ND (DL = 0.02) |
| **6** | 3.2 | ND (DL = 0.02) | 0.51 | ND (DL = 0.02) | 0.09 | ND (DL = 0.02) |
| **7** | 1.5 | ND (DL = 0.02) | 0.46 | ND (DL = 0.02) | 0.86 | ND (DL = 0.02) |
| **8** | 2.9 | ND (DL = 0.02) | 0.45 | ND (DL = 0.02) | 0.19 | ND (DL = 0.02) |
| **9** | 2.3 | ND (DL = 0.02) | 0.41 | ND (DL = 0.02) | 0.22 | ND (DL = 0.02) |
| **10** | 3.7 | ND (DL = 0.02) | 0.51 | ND (DL = 0.02) | 0.15 | ND (DL = 0.02) |
| **11** | 2.2 | ND (DL = 0.02) | 0.52 | ND (DL = 0.02) | 1.03 | ND (DL = 0.02) |
| **12** | 3.20 | ND (DL = 0.02) | 0.15 | ND (DL = 0.02) | 0.15 | ND (DL = 0.02) |
| **13** | 2.50 | ND (DL = 0.02) | 0.6 | ND (DL = 0.02) | 0.26 | ND (DL = 0.02) |
| **14** | 1.90 | ND (DL = 0.02) | 0.49 | ND (DL = 0.02) | 0.24 | ND (DL = 0.02) |
| **15** | 2.85 | ND (DL = 0.02) | 0.49 | ND (DL = 0.02) | 0.15 | ND (DL = 0.02) |

| Sample | Nitrates as $NO_3$ (mg/l) | Arsenic as As (mg/l) | s Fluorides as F(mg/l) | Iron as Fe (mg/l) | Zinc as Zn (mg/l) | Copper as Cu (mg/l) |
|---|---|---|---|---|---|---|
| **16** | 3.08 | ND (DL = 0.02) | 0.37 | ND (DL = 0.02) | ND(DL = 0.02) | ND (DL = 0.02) |
| **17** | 1.75 | ND (DL = 0.02) | 0.53 | ND (DL = 0.02) | 1.05 | ND (DL = 0.02) |
| **18** | 2.46 | ND (DL = 0.02) | 0.47 | ND (DL = 0.02) | 0.19 | ND (DL = 0.02) |
| **19** | 2.09 | ND (DL = 0.02) | 0.51 | ND (DL = 0.02) | 0.18 | ND (DL = 0.02) |
| **20** | 3.15 | ND (DL = 0.02) | 0.61 | ND (DL = 0.02) | 0.04 | ND (DL = 0.02) |
| **21** | 1.79 | ND (DL = 0.02) | 0.59 | ND (DL = 0.02) | 0.16 | ND (DL = 0.02) |
| **22** | 1.60 | ND (DL = 0.02) | 0.49 | ND (DL = 0.02) | 0.15 | ND (DL = 0.02) |
| **23** | 2.90 | ND (DL = 0.02) | 0.57 | ND(DL = 0.02) | ND (DL = 0.02) | ND (DL = 0.02) |
| **24** | 2.61 | ND (DL = 0.02) | 0.46 | ND (DL = 0.02) | ND (DL = 0.02) | ND (DL = 0.02) |
| **25** | 1.75 | ND (DL = 0.02) | 0.50 | ND (DL = 0.02) | ND (DL = 0.02) | ND (DL = 0.02) |

*Note that ND stands for Not Detected and DL stands for Detection Level*

### 4.5 Conclusion

Based on the technical assessment, there is high evidence of aquifer levels drop. There is high risk of aquifer depletion if the utility managers didn't take serious steps to develop an integrated water resources management plan for Borama and an alternative water sources to reduce the pressure on the aquifer. SHEBA demonstrated an excellent example for a public private partnership in Somaliland.

# 5. Erigabo Water Supply Assessment

## 5.1 General

The third urban assessment was made after final recommendations from the peer review group following the urban assessments of Bossaso and Borama. These recommendations were incorporated into the planned activities of the third urban assessment, i.e. the Erigabo Water Supply Assessment. As such it was hoped that lessons learned and experience gained from the previous assessments would enrich the Erigabo urban water supply assessment.

The Erigabo supply assessment covers information on quality and quantity of all water sources in the Erigabo urban area, including utilities, small private tube wells, water tanker operators and water vendors. It also covers at least a 5% representative sample of water consumers, including non-domestic ones. An analysis of survey results provided important findings on piped water network distribution coverage, the roles of small private water operators and water vendors in the water business, non-revenue water, tariffs, household consumption and cost and the plight of the urban poor.

Erigabo is the regional capital of Sanaag Region, one of the largest regions of Somaliland and which receives the highest rainfall. It is situated in the north-eastern part of Somaliland (see Figure 5.1).

Participants in the Erigabo water supply assessment were two national SWALIM consultants, Ministry of Natural and Water Resource staff from Hargeisa and Erigabo Offices, one WHO staff member and an LNGO called Training and Research Group (TRG) who carried out the socio-economic assessment. Execution of field activities were planned and completed within ten days. Those who participated in this assessment included the following people:

## 5.2 Revised Methodology of the Field Survey

The peer review meeting recommended dividing the urban supply assessment into technical and socio-economic data collection groups. The technical assessment consisted of the two SWALIM consultants, Ministry of Water and Mineral Resource's staff in Hargeisa and Erigabo offices, and WHO staff. The socio-economic aspect of the assessment was conducted by an LNGO called Training and Research Group (TRG).

TRG is non-governmental and non-profit professional institution established in 2004, based in Hargeisa, Somaliland where it has the authority to conduct all forms of research and training throughout Somaliland. It was established to address training, research and consultancy needs of local NGOs and other emerging local institutions, in both the private and public sectors.

The TRG assessed socio-economic factors associated with the Erigabo urban supply assessment, including water affordability to various income-groups (i.e. low, medium and high income) and by density (i.e. low density, medium density, and high-density areas) and other related issues.

Accurate sampling and sample size correlate too many intervening factors, including available budget and having an accurate estimation of population size. Planning for demographic improvement requires reliable estimates of population processes at various points in time. In Somaliland, perfect sampling frames are rarely encountered and the last census was made more than 25 years ago.

Nevertheless, in the Erigabo Water Supply Assessment, TRG divided the town into four clusters with regard to the populations being targeted. The primary focus of the assessment and specific people targeted were: low income, middle and better-off families, as well as low density, medium and high-density areas. Table 5.1 shows the four selected clusters.

**Table 5-1:The four cluster survey sample collected in Erigabo**

| Cluster | Description | Survey Collected Numbers | |
|---|---|---|---|
| | | *%* | *Total* |
| 1 | Xafadsomal/Dayacan (Domestic /Low income) | 40 | 140 |
| 2 | Daalo (Domestic/Middle class) | 35 | 122 |
| 3 | Red Sea (Domestic/better-off) | 15 | 52 |
| 4 | Commercial Areas (Non-Domestic) | 10 | 35 |
| **Total Household Surveyed** | | **100** | **350** |

Each enumerator from TRG was assigned to complete eight questionnaires (see Figures 5.2 and 5.3). The total number of questionnaires collected was 350.

The quality of data collected is the most important aspect of an assessment, therefore an editor was assigned to make spot-checks to correct any mistakes observed during the fieldwork. The reason for this was to immediately show an enumerator his/her mistake which could then be corrected or confirmed during fieldwork.

Besides the enumerator, a supervisor was nominated at the office level to ensure the quality of the assessment. He was required to monitor the methodology of the enumerators during interviews and whether the required min imum number of respondents had been interviewed.

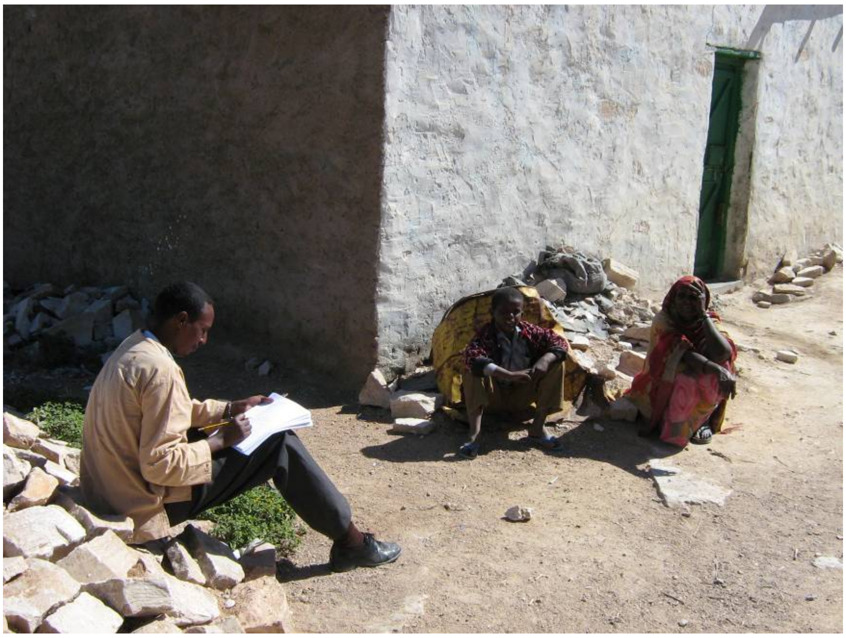

**Figure 5-1: TRG enumerator collecting data from Xafatsomal in Erigabo.**

**Figure 5-2: TRG enumerator collecting data from Daalo in Erigabo**

### 5.4 Consumer Survey Result

During the field reconnaissance to verify existing water distribution pipes in Erigabo, a consumer survey continued to facilitate the assessment of household, commercial and institutional consumers. A sample survey to facilitate assessment of domestic demand was also carried out concurrently with the field reconnaissance.

In order to achieve this, enumerators undertook a field survey involving door-to-door visits to obtain a representative sample of domestic consumers, commercial and institutional consumers. The representative sample was selected more on the basis of giving information on diverse areas and different types of consumers ,rather than being a purely random sample.

The exercise involved locating existing consumers and collecting data concerning water usage, on-site storage, types of premises, metering of various premises, details of owners and residents of the premises, water supply situation in terms of adequacy, water pressure and continuity of supply. For potential consumers, the survey sought to establish their numbers, distribution and present source/s of water.

The exercise commenced on the 22nd November 2006. By the end of November 2006 some 350 consumers had been visited. Premises visited consisted of commercial, institutional and residential premises.

For domestic premises, data was compiled to determine household sizes for each category of housing. Tabular representation and analysis of the consumer survey data obtained illustrates the findings and is appended to this report (Appendix IV). Data was analyzed and sorted into occupancy of premises. A high-income, low-density premise would have six persons, middle-income premises eight persons.

The consultant recently acquired archived digital satellite imagery from 2003 covering the whole town.

## 5.5 Population and water demand

The method of population estimation was based on the number of properties, with an assumed average of six persons per household, and an estimated growth rate of 3.5% per annum. The property count of Erigabo using July 2006 satellite imagery was approximately 1 700 properties. Assuming an average of six people per property including residential/non residential, an estimated population of 10 211 persons was arrived at. For simplicity, it was assumed in this study that an average of 10 000 persons were living in Erigabo at the end of 2006.

Daily water requirements of Erigabo town can be estimated to about 200 $m^3$/day, following the UNICEF standard of 20 litres/person/day. Hence in order to meet the MDG target, the population of Erigabo should have a water supply of 200 $m^3$/day. However, the current rate of water supply to the population is not known, as most of the wells are not equipped with meters.

With the data available, a population projection of Erigabo town is not possible and is recommended as a subject for further assessment.

## 5.6 Utility Performance

### 5.6.1 The old utility performance and piping distribution network

Erigabo town's water supply was first built in colonial times. It continued to function as a branch of local government until the civil war and the collapse of the Somali state. It comprised five boreholes, storage tanks, distribution pipes, stand pipes and kiosks. It was destroyed during the civil war. In 1992-93 Action Aid Somalia (AAS) funded its rehabilitation with significant capital investment - though this happened only after the provision function and management structure had been established. Once completed and handed over, AAS had no further involvement in the service. Water fees enabled its management to maintain service and order new pumps.

Starting between 1993-2003, the management team consisted of a Council of Elders water committee and a manager of kiosk attendants. All operational staff report to the manager on a daily basis, whilst the manager reports to the water committee every two weeks. The water committee reports to the Council of Elders on a quarterly basis. The Council of Elders is responsible for auditing and approval of unplanned costs. Monthly and quarterly financial reports are submitted to the Council of Elders, but since the election of local councils the water agency was transferred to the municipality and their elected mayor. In the early years when the system was supervised by the elders and the water system was managed by Erigabo water agency (EWA), it was one of the few agencies that purchased new pumps and generators for their boreholes.

The current water sources in Erigabo utilise two public boreholes run by EWA, know as WD1 and WD2 with original depths of 60 and 80 m respectively. The first well produce 12 $m^3$, while the second well produced 15 $m^3$. Both wells were cased by eight-inch GI pipes. Well equipment is listed in Table 5.2.

**Table 5-2: Summary of the two public boreholes in Erigabo**

| Well no | Well location | Well equipment | Pump setting | Operation time |
|---|---|---|---|---|
| B1 | N10 37.794 E47 21.757 | Mono pump with Lister Peter motor | 18m | 19 hours |
| B2 | N10 37.853 E47 21.761 | Submersible Grondfos pump, type 3.7kw and Perkin generator type WDG-6/44 and electric motor of 18KVA, 14kw. | 16m | 19 hours |

The two boreholes were drilled inside the alluvium deposited by the erosion of the anhydrite Taleh formation. The two boreholes were connected to two elevated tanks of 27 $m^3$ and 30 $m^3$ respectively, and connected to six kiosks by a six-inch PVC distribution pipes (see Figure 5.4). Every kiosk has temporary OXFAM-type storage tanks of various sizes (30-70 $m^3$). The tank exteriors protected with masonry rooms covered with iron sheets (see Figure 5.5). The system was also connected to only seven households, hotels and two vegetables gardens. Every kiosks and connection has had a water meter installed.

**Figure 5-4: Two elevated tanks of the old water system in Erigabo**

Water connection was made to nine households with various fees between US$ 130-450/month. Water production from the two boreholes estimated at 513 $m^3$/day. The water is carried from the tanks to kiosks by six-inch PVC pipes until the junction found in front of the football stadium, where the pipe is reduced to three-inch PVC, and reduced again to two-inch pipe of GI near the kiosk reservoirs.

**Figure 5-5: Old kiosk system with temporary storage in Erigabo**

The two public boreholes have received no servicing or maintenance since the demise of the Somali government in 1991. The pump locations change every year - for instance, in the previous year the pump sets were 21 and 19 m, suggesting that borehole depth is gradually decreasing. Local operators have suggested that the casings have become damaged and that residue sediments are being deposited at the bottom of the well. It seems that new boreholes will be needed in the future.

The EWA is directly managed by the mayor of Erigabo town, who appoints the manager of EWA. The total number of employees is 26 persons, engaged in various posts such as operators, plumbers, machinist, guards, sellers, cashier, clerk and account.

The EWA provide a poor service, as they did not plan to increase the number of household connections, despite the large number of requests from the communities of Erigabo. They argue that available water is insufficient to meet public demand. The four operational kiosks are covering almost two-thirds of the town population, while the remaining one third are supplied by trucks. The EWA have no accumulated stocks to draw on if breakdowns occur. Recently, there was a water crisis when one of the submersible pumps stopped functioning. The mayor tried to increase the water price, but a mass uprising and outcry by the public and the central government changed the mayor's decision. From that day however, water prices have changed between the different kiosks of the city.

The water problems in Erigabo are summarized below:

a. Shortage of water supply to meet demands of the current population, particularly among poor, internal displaced and IDPs. Limited water connection to houses.
b. No water sanitation practiced among the community and EWA.
c. Inadequate sanitary facilities for the poor and IDP, who cannot afford the digging expenses due to the nature of the terrain.

d. Lack of experienced technicians and EWA personnel to carry out maintenance and management of WES facilities.

### 5.6.2 The new utility performance and piping distribution network

UNICEF recently rehabilitated the GTZ Well No 3, which has the highest yield of 180 $m^3$/hr (see Figure 5.6). A new 147 $m^3$ capacity water tank was constructed and new six- and four-inch PVC piping installed (see Figure 5.7). Five new kiosks, a generator and watchman rooms were also constructed (see Figure 5.8). The borehole was equipped with a Grundfos submersible Sp k-45 pump and a Perkins PEP03 generator with and a 40KVA electric motor. The pump and generator were tested by EWA who reported that pumped water filled the tank after 18hrs. Water quality is good due to the geological formation of the area, which is Aurado limestone with zero salinity. The borehole static level is 7 m. the aquifer is artesian.

**Figure 5-6: Recently-rehabilitated GTZ well No. 3 in Erigabo**

Rehabilitation and establishment of the new network of distribution pipes was financed by UNICEF and implemented by an Italian NGO named CEFA. Rehabilitation started on 24$^{th}$ Sep 2004. The main distribution pipeline which will carry water from the new 147 $m^3$ tank is six-inch PVC, 3 000 m in length. Water distribution will be done by 19 000 m of four-inch diameter pipe. The system is not operational yet, as it needs improvements.

The location and mapping of the water distribution network was established in order to produce an actual pumping regime using GPS. The available 1:12.000 maps of Erigabo town were produced by SWALIM based on data acquired on 05 March 2003. The aim was to superimpose the water distribution network map onto 2003 digital photomap/satellite imagery of the town and to produce maps to be used in the Erigabo water supply assessment (see Figure 5.9).

The system has not yet been tested, but during the assessment the team carried out mapping of the new system, and it was found that the pipeline has no junction boxes or saddle boxes or protected main halls. The system is not yet operational. The mayor of Erigabo pointed out that CEFA is trying to hand over the new water supply system to the municipality and that he, the mayor, refuses to accept it, arguing that the project plan and activities were not participatory and that the borehole is equipped with incorrect equipment (i.e. the pump and gen set).

The location of wells, kiosks, water storage and transportation systems studied are shown in Appendix IV, all located in the urban area of Erigabo. Each source is identified by an ID number referenced to the database. Each well can also be identified by location and by the owner/s in the database. Other parameters may be used in case of doubt, such as total depth (which in principle does not change, unless some deepening is carried out). The type of protection of each well can also be used and, altogether; these parameters provide a fingerprint and will avoid possible confusion. The original datasheets also provide a simple sketch of the location of each well in the compounds.

**Figure 5-7: New water tank in Erigabo**

### 5.6.3 Other water sources

Two pubic boreholes drilled by the water development agency of Somalia are used for the irrigation of some farms, and three private borehole used for farm irrigation. The owners of the private well have their own tankers and are allowed to collect water from their borehole to sell it to private consumers in the town. Each borehole supplies an average of 12 $m^3$ of water/day to the public. Detailed information on those boreholes is recorded in the SWALIM data sheets. There is one shallow cavern well know locally as Afweyne, which is a natural depression created by water erosion of sulphurous limestone (gypsum). This water source is used for watering livestock, and pastoralists also collect water for domestic use. The well is not protected from contamination, and the water is hard due to dissolved sulphates and carbonates.

**Figure 5-8: New kiosks in Erigabo**

### 5.6.4 Tanker water distribution

Numerous water tankers operate in Erigabo city, serving almost one-third of the population and are an important element of the water sector in Erigabo (see Figure 5.10).

### 5.6.5 Water prices

Whether supplied from public tank, stand-pipe or kiosk, one $m^3$ costs US$1 (15 000 SOS). One 20 litre container costs 500 SOS and 200 litres cost 3 000 SOS. At Kiosk No 1, one $m^3$ costs 18 000 SOS while at other kiosks located within the town one $m^3$ costs 20 000 SOS. The water tanks buy 200 litre drums for 3 000 SOS each, and sell them for 12 000 SOS. The daily revenue collection of the water agency from the six kiosks averages 3 500 000 SOS which is equivalent to 200 $m^3$ of water. Water consumption by the nine connected households varies from 35 $m^3$ to nine $m^3$ /month.

Waters consumed with no charge are:

- Five irrigation farms owned by the borehole operators and guards with an average size of 0.7 ha.
- Hospital
- Municipality offices
- Public garden or park
- Prison and military personnel
- Certain tankers, by order of the mayor

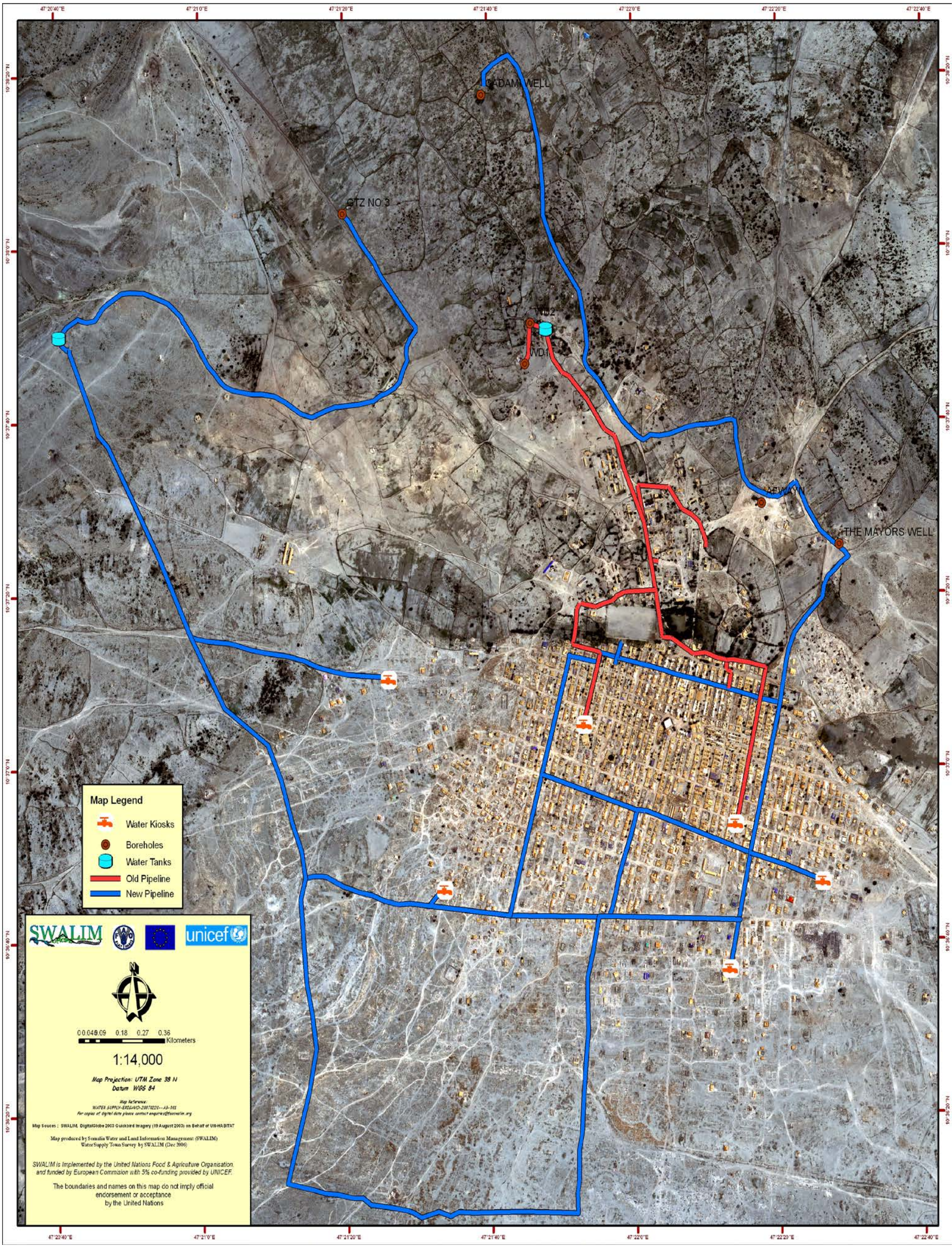


**Figure 5-9: Map of the new EWS piping distribution network in Erigabo**

**Figure 5-10: Water tanker filling water from public borehole wells in Erigabo**

### 5.6.6 Sustainability

Technical backup, lack of transparent management within EWS and lack of funds for spare parts and O&M services are identified as major constraints. Ministry of Water and other agencies are encouraging the transfer of EWS management and operations into a private company (public private partnership), but the current staff (with the support of the mayor) feel that this will not serve their interests.

### 5.6.7 Affordability

The 1990 draft Water Law stipulated that “a water pricing and subsidy system shall be employed, along with other means, to encourage specific uses of water and to discourage its less beneficial uses, and thereby reduce or eliminate the divergence between the social and market benefits and costs” (Chapter 1, article 4.4). The Somaliland Water Strategy is the only document that stipulates that "poverty abatement considerations may require that subsidies be given to the most vulnerable in society”.

### 5.6.8 Reliability

The new schemes for domestic water supply in Erigabo should ensure the availability of untreated water 100% of the time. The service should not fail due to drought.

### 5.6.9 Safety

The Somaliland Water Policy states “given that groundwater is the safest resource that can be used for human consumption, the policy is to focus on groundwater resources for the development of water supply for human consumption. This will be achieved through different technologies including boreholes and shallow or deep wells”.

In Somaliland, water policies stipulate that water quality should respect minimum standards and be acceptable to the consumers in terms of portability (taste, odour and appearance)

## 5.7 Water quality standards and analysis

Different water quality guidelines and standards have been proposed, such as those of Faillace (1986), WHO (1997) and SPHERE, (2000). Somaliland has adopted WHO guidelines. Table 5.3 illustrates the different standards for Maximum Total Dissolved Salts and Tolerated Faecal Coliforms.

**Table 5-3: Example water quality standards**

*Maximum Total Dissolved Salts concentration tolerated by humans and livestock (TDS in mg/l, EC in uS/cm)*

| Consumer | Faillace (1986) | WHO | | Sphere (2000) | |
|---|---|---|---|---|---|
| | ***EC*** | ***TSD*** | ***EC*** | ***TDS*** | ***EC*** |
| Humans | 3,500 | | 1,500-2,000 | 1,000 | 2,000 |
| Cattle, sheep, goat | 7,500 | | | | |
| Camels | 10,000 | | | | |

Source: Brinkerhoof, 2004, Annex 8

*Maximum Tolerated Faecal Coli forms (FC/100 ml)*

| Consumer | WHO | Sphere (2000) |
|---|---|---|
| Humans | 0 | 10 |

Source: Brinkerhoof, 2004, Annex 8

Collected water samples were both analysed at the site for bacteriology and STG laboratory for bacteriology and chemical contents, to determine compliance with WHO standards for levels likely to give rise to consumer complaints.

*Water quality analysis at the site*

Conductivity values were recorded with the use of an electroconductivity meter equipped with temperature correction and calibrated with standard solution. Electroconductivity is a simple way to measure the total effect of dissolved ions and therefore allows for an estimation of salinity, expressed as milliSiemens/cm (at a given temperature) or of the total dissolved solution in mg/l, calculating using a constant from the conductivity of the solution. The limits normally considered as acceptable for human consumption are the following.

*EC Directive (EEC 80/778) = 1500 micro Siemens/cm at 20º C.*

Appendix V shows the electroconductivity values of the water sources surveyed between December 22nd and 28th 2006, expressed in mS/cm. Values significantly higher than 1 500 mS/cm can be observed in two drilled wells (GTZ Well No.1 of 2 970 mS/cm and Ismail H. Nur well of 3 225 mS/cm). The third sample that exceeds the limit is an Afwayne shallow well which shows EC 2 400 mS/cm. The shallow well is unimproved and does not have any cover at all (see Figure 11).

*Water Quality Analysis at SGS Laboratory*
Water samples collected at several representative sites were submitted to the SGS laboratory for chemical analysis to determine compliances with the standards of WHO guidelines. The results provided baseline information/data (indicators) on possible high chemical contents of harm to consumers (see Table 5.4 and Appendix VII).

Chemical levels of water samples collected on site have slightly higher levels of nitrates, fluorides and zinc, but none exceeded levels that could cause consumer complaints.

**Table 5.1 - SGS water quality analysis for Erigabo**

| **Sample** | **Nitrates as $NO_3$ (mg/l)** | **[s] Fluorides as F(mg/l)** | **Arsenic as As (mg/l)** | **Iron as Fe (mg/l)** | **Zinc as Zn (mg/l)** | **Copper as Cu (mg/l)** |
|---|---|---|---|---|---|---|
| **Borehole 1 & 2** | 9.8 | 1.50 | ND(DL = 0.02) | ND(DL = 0.02) | ND(DL = 0.02) | ND(DL = 0.02) |
| **Borehole 2** | 10 | 1.4 | ND(DL = 0.02) | 0.13 | 0.08 | ND(DL = 0.02) |
| **Borehole 1** | 9.2 | 1.30 | ND(DL = 0.02) | ND(DL = 0.02) | ND(DL = 0.02) | ND(DL = 0.02) |
| **GTZ 2** | 10.4 | 1.30 | ND(DL = 0.02) | ND(DL = 0.02) | 0.06 | ND(DL = 0.02) |
| **FAI 1** | 10.8 | 1.40 | ND(DL = 0.02) | 0.11 | 0.30 | ND(DL = 0.02) |
| **Main Receiver** | 11 | 1.60 | ND(DL = 0.02) | 0.15 | 0.07 | ND(DL = 0.02) |
| **Afwayne** | 11.1 | 1.70 | ND(DL = 0.02) | ND(DL = 0.02) | 0.68 | ND(DL = 0.02) |
| **GTZ 1** | 9.20 | 1.30 | ND(DL = 0.02) | ND(DL = 0.02) | 0.04 | ND(DL = 0.02) |
| **Ismail.Borehole** | 6.80 | 1.30 | ND(DL = 0.02) | ND(DL = 0.02) | 0.30 | ND(DL = 0.02) |
| **Seeraha 1** | 10.6 | 1.30 | ND(DL = 0.02) | ND(DL = 0.02) | 0.32 | ND(DL = 0.02) |
| **Seeraha 2** | 8.80 | 1.20 | ND(DL = 0.02) | ND(DL = 0.02) | 0.07 | ND(DL = 0.02) |
| **Dhuhul Well** | 9.80 | 1.50 | ND(DL = 0.02) | ND(DL = 0.02) | ND(DL = 0.02) | ND(DL = 0.02) |
| **Adam Well** | 8.90 | 1.20 | ND(DL = 0.02) | ND(DL = 0.02) | 0.39 | ND(DL = 0.02) |
| **Buhoodle Well** | 9.0 | 1.40 | ND(DL = 0.02) | ND(DL = 0.02) | 0.34 | ND(DL = 0.02) |
| **Sanag Hotel** | 8.40 | 1.20 | ND(DL = 0.02) | ND(DL = 0.02) | 0.29 | ND(DL = 0.02) |
| **Centre of town** | 7.90 | 1.40 | ND(DL = 0.02) | ND(DL = 0.02) | 0.20 | ND(DL = 0.02) |
| **Jano Restaurant** | 8.20 | 1.40 | ND(DL = 0.02) | ND(DL = 0.02) | 0.05 | ND(DL = 0.02) |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Teashop** | 8.0 | 1.20 | ND(DL = 0.02) | ND(DL = 0.02) | ND(DL = 0.02) | ND(DL = 0.02) |
| **Sha'ab Area** | 8.40 | 1.40 | ND(DL = 0.02) | ND(DL = 0.02) | 0.04 | ND(DL = 0.02) |
| **Wheel Borrow** | 8.30 | 1.20 | ND(DL = 0.02) | ND(DL = 0.02) | ND(DL = 0.02) | ND(DL = 0.02) |
| **Teashop** | 8.60 | 1.50 | ND(DL = 0.02) | ND(DL = 0.02) | 0.97 | ND(DL = 0.02) |
| **Hotel H. Nuur** | 8.40 | 1.30 | ND(DL = 0.02) | ND(DL = 0.02) | 0.04 | ND(DL = 0.02) |
| **Kiosk No. 4** | 8.0 | 1.40 | ND(DL = 0.02) | ND(DL = 0.02) | 0.03 | ND(DL = 0.02) |
| **Household** | 8.10 | 1.40 | ND(DL = 0.02) | ND(DL = 0.02) | ND(DL = 0.02) | ND(DL = 0.02) |
| **Kiosk No. 2** | 8.20 | 1.40 | ND(DL = 0.02) | ND(DL = 0.02) | 0.78 | ND(DL = 0.02) |

**Figure 5-11: Afwayn shallow well, an unimproved source of water**

## 5.8 Conclusion

Water problems include a shortage of water to meet demand of the current population of the town, particularly among the poor, internal displaced and IDPs. There are limited connections to houses. Also:

- No hygiene practice among the community and EWA,
- No adequate sanitary facilities for the poor and IDP, who cannot afford digging of latrines,
- Lack of experienced technicians and EWA personnel to maintain and manage WES facilities,

# 6. Summary of Methodology and Assessment Conclusions
## 6.1 Methodology Summary

The methodology presented here based on various consultations and discussions between FAO SWALIM and UNICEF and later with UN-HABITAT and WHO. These interagency discussions have yielded a conceptual framework to assess Somalia urban supply systems and their contribution to the MDG's.

MDGs target 10 states: "*halve by 2015 the proportion of people without sustainable access to safe drinking water"*. Access to safe drinking water is the percentage of the population using improved drinking water sources, as recommended by the JMP and that are described below.

**Improved drinking water sources**
Household connection
Public standpipe
Borehole
Protected dug well
Protected spring
Rainwater collection

**Unimproved drinking water sources**
Unprotected well
Unprotected spring
Rivers or ponds
Vendor-provided water
Bottled water[1]
Tanker truck water

To achieve this target in urban supplies for Somalia, several criteria had to be considered with regard to availability, sustainability, accessibility and safety of water. This required a combination of information. These were technical and socioeconomic information. The technical information determined the appropriate technologies in use, water quality and their availability and sustainability, while socioeconomic information determined access/affordability by the different groups surveyed.

Municipalities and/or utility mangers should also consider trade-off between available water sources, their distance and value of water for customers.

### 6.1.1 Household surveys

The first step in urban supplies assessment is the identification of water sources in use by communities. Representative samples of all income groups should be considered when conducting household surveys (HHS). In many cases this information can be obtained from town plans if exists, otherwise they can be obtained from utility managers or using an appropriate technology, e.g. from remote sensing as was the case during this assessment. Town plans developed from high-resolution satellite images and population estimates were based on an average HH of 6 persons. Separation of areas of low, medium and high-

[1]According to WHO and UNICEF (2004), bottled water is not considered improved due to limitations in the potential quantity, not quality, of the water.

income groups needed for assessing accessibility by these groups compared to their incomes.

The information obtained through households surveys (HHS) is useful for identifying different factors and parameters. List the following form each HHS using a questionnaire:

1) List all sources of water in use by the HH, e.g. household connection, vendor, rainwater, etc.
2) Distance is a limiting factor in collecting water supply; attention must be given to time taken and distance of source (improved), number of trips per day, means of collecting the water, time taken, etc.
3) Amount of water used per day for each HH or per person, sources, purpose for use (domestic, farming, etc.)
4) Cost of water as a proportion to the monthly income of the HH as either payment to water provides (utility) or as direct purchase from vendors or public standpipes, etc.
5) Survey all classes of water consumers and all types of water providers, list tariffs from various suppliers, etc.
6) Obtain data on access (population coverage).

These are examples, but the list can be exhaustive depending on the purpose of the HH survey. The data collected from consumers can provide accurate coverage information.

### 6.1.1 Utility/Technical surveys

Water utilities managing each of the urban centres surveyed were assessed for their capacity to meet MDGs target ten. Inventory of the main water sources in each city and their water quality should be recorded. Identify available other sources of water distribution (tankers, their capacity and ownership). This is a potential area for use of SWIMS software.

Record the following: 1) make inventory list of all water resources and their types capacity of each water source in the inventory list and the number of beneficiaries of each main source, 2) storage facilities at city level and their types and capacity, 3) distribution pipe network. Map water supply system using the information obtained from the inventory (during the assessment under discussion maps were produced for each urban centre showing the sources, storages and pipe network, see chapters 3, 4 and 5). Only critical parameters should be tested for water quality of the main water/representative water sources. Table 6-1 provides the necessary parameters needed for test in water supplies.

**Table 6-1: Critical Parameters in Water Quality**

| **Microbial and related** | **Inspections** | **Physical and chemical**[1] |
|---|---|---|
| Thermotolerant coliform, Escherichia coli | Sanitary inspection | Appearance |
| Feacal streptococci[2] | | Nitrate |
| Turbidity | | Arsenic |
| pH | | Fluoride |
| Chlorine Residuals | | Iron; Zinc, Copper |

[1] Only area-specific known health related elements
[2] Preferable for shallow wells

Define functional criteria at which the system is operational in order to be considered as a suitable source to meet MDG's. Breaks in the system are determined by the time between restoring the utility supply and another break. According to JMP, less than 50% on daily basis not considered functioning.

**Sustainability**
Water supply sustainability is useful in monitoring MDG target 10. This can be monitored through comparison of cost and consumption - piped water versus non-piped water, tinkered water, donkey-pulled carts, etc. Population growth is a limiting factor in sustainability. Assess whether the system will accommodate more consumers for the long run.

**Affordability**
Affordability is a function of both the price of water service and the ability of households (and other water users) to pay for the service. Thus, drinking water can be made more affordable by reducing the cost of service, increasing the ability of users to pay, or both. This can be achieved through the HHS.

From the survey results, calculate the percentage of the population in each city with improved water source according to the definitions given in section 6.1 above & Table 1-1. Verify the true coverage with piped water on 24-hour supply and find out the seasonal variation.

Find the main conclusions and suggestions to improve coverage. Undertaking stakeholder consultations based on the survey findings and organizing; if possible, the civil society/NGO (consumer groups) to monitor policy implementation.


**Figure 6.1: Example trade-off curves for socioeconomic information needed for monitoring progress in target 10 of the MDGs**

The currently implemented approach in the three urban centres aimed to take a more accurate account of the actual use of facilities, and of initiatives to improve facilities taken by individuals and communities, which in some cases might not be included in official water supply statistics. By using household surveys, this approach also provided more information on breakdowns and service deficiencies, which might render the facilities unusable after they had been installed and on service technologies. A prerequisite for this approach is that, household surveys need to be conducted recurrently. Another problem is the lack of standard indicators and methodologies, which makes it difficult to compare information obtained from different surveys.

## 6.1 Summary

SWALIM and UNICEF commissioned this study to develop a methodology for monitoring progress of urban Somalia towards MDG target: *to halve by 2015 the proportion of people without sustainable access to safe drinking water.* The indicator of progress towards this target is proportion of urban population with sustainable access to an improved drinking water source.

The proportion of the urban population with access to safe drinking water is an indicator expressed as the percentage of people using improved drinking water sources or delivery points (listed in Table 1-1). Improved drinking water technologies are more likely to provide safe drinking water than those characterized as unimproved.

Classification of water sources (technologies) required extensive surveys for collection of necessary data. Two types of data collected: 1) technical information on water sources and 2) socioeconomic information. The two datasets used to assess progress towards meeting the target required.

It is assumed that if the user has access to an "improved source" then such source would be likely to provide 20 litres per capita per day at a distance no further than 1,000 metres. The price of water should also be affordable by the different income groups in any one urban centre.

There are no estimates made since the eruption of the civil war in 1990, this assessment provided estimates of the current drinking water coverage in the three urban centers. It showed how many people have access to improved sources and identified the challenges to meet the urban MDG drinking water target for Somalia over the coming decade.

The statistics presented here were obtained from users of services rather than providers of services, and thus are not affected by differences in definitions of access or political influence in presenting coverage data.

## Conclusions and Way Forward

The study concluded the following:

11) Detailed baseline information that did not exist before are gathered during this assessment. This can form the baseline and basis for any future monitoring programs.
12) Only one third of the population served by house connections in Bossaso while less than a quarter served by house connections in Boroma and Cerigabo.

13) Apart from the piped connections in each town (35% in Bossaso, 23% in Boroma and 0.02% in Erigabo)[1], few of the sources identified meet the criteria for an improved water source as required by the JMP.
14) Although in all towns surveyed, all the populations have access to water supply in one-way or another, this does not mean, these centres are meeting the MDG targets. This is mainly due in part to un-improved waters sources in use, and completely to the quality of water they use. For example, apart from the boreholes water served by the utilities; which is very safe according to the bacteriological and chemical analyses, most of the other unprotected sources tested positive for bacteriological contamination, e.g. Berkado, other rainwater collection storages and public shallow wells. On the other hand, some of the sources are quite far to achieve sustainable water supply given the time spent in search for water (distance more than 1-kilometre).
15) In some cases, we classified water source as improved, but water handling, delivery and storage are likely to contaminate it, e.g. donkey carts, water tankers, etc. People do not boil, disinfect with chemicals, filter or take any other preventive measures for their drinking water. This is mainly attributed to the lack of hygiene practice by the communities.
16) Water prices compared to the income groups selected are high, with the poor paying more compared to the middle and better off groups, however, when comparing the current utilities' service to the previous instalments, water prices have dropped by 50%. For example in Boroma, the price for 1-$m^3$ was equivalent to $1-US, while now it is sold at 60 cents for piped connections and 50 cents for kiosks and water tankers.
17) Some water sources have elevated levels of Nitrates, Fluorides and Zinc, however none exceeded the recommended limits levels that can lead to consumer complains. High salinity levels and that are beyond the WHO recommended standards for electrical conductivity (EC) of 1,500 mS/cm or for the Sphere standards of 2,000 mS/cm were also noted in some of the wells.
18) Despite the huge investment by UNICEF and others, the level of service in all towns is very poor. This is mainly attributed to: i) the small/limited coverage of the reticulated networks despite willingness to pay for piped water supply connections, ii) the utilities' management didn't take any efforts to extend the systems to other areas, iii) high return of IDPS and Diaspora to these towns increased the pressure on the installed system and, iii) the pipes leak excessively due to poor operation and maintenance by the utility managers reducing significantly the amount of water supplied by the system.
19) There are weak/non-existent sound water resources management plans. For example, in Borama, the ground water table has dropped substantially in the past few years leading to drop down of the water levels, placing the town population at high risk due to un-guaranteed sustainability to meet their future demands.
20) There are no studies and information on groundwater recharge patterns, no equipments for measuring the groundwater levels and carrying pumping tests, there are few/no-trained technicians to carry routine checks on the groundwater resources, maintenance, etc.

[1] The reason for the low values in Erigabo is being the system still new and not yet functional during this assessment. It was found that, UNICEF through CEFA rehabilitated the wells and distribution network. More than 50% of the town demand will be met by the rehabilitated system.

In summary, this assessment formed the basis for future work and monitoring of any progress achieved since the time it was conducted. We recommend similar assessments be carried out to monitor progress towards MDG target 10 in urban supplies every 3 years.

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# Annexes

## Annex - 1: Water Supply Assessment Questionnaire

### Section 1: Socio-Economic Information

1. i) Name of respondent……………………………………………

   ii) Age ………………………………………………………………...

   iii) Level of Education

   - ▢ University
   - ▢ College
   - ▢ Secondary
   - ▢ Primary
   - ▢ None

2. Position in household

   - ▢ Husband
   - ▢ Wife
   - ▢ Son/Daughter
   - ▢ Household
   - ▢ Others

3. What is the total number of occupants living in your house (*including respondent*)

   ………………

4. i) How many members of the household are over 18? ………………………………

   ii) How many are under 18?

   ………………………………………………………………….

5. i) What is the main occupation of the household head? (*may be more than one)*

   - ▢ Livestock farming
   - ▢ Employed
   - ▢ Businessman
   - ▢ Others (*specify e.g. casual worker*)

     …………………………………………….

   ii) If a farmer, what are your main activities? (*Tick in appropriate boxes)*

   - ▢ Cash crops
   - ▢ Subsistence crops
   - ▢ Livestock
   - ▢ Beekeeping

- ▢ Others (*specify*)

  ………………………………………………………………………

iii) If employed, what type of employment?

- ▢ Teacher
- ▢ Clerical work
- ▢ Doctor/Nurse
- ▢ Machine Operator
- ▢ Priest
- ▢ Others (*specify*)

  ………………………………………………………………………

iv) If businessman, what type of business?

- ▢ Wholesale shop
- ▢ Retail shop
- ▢ Butchery
- ▢ Tailoring shop
- ▢ Rental houses
- ▢ Vendor
- ▢ Hawking
- ▢ Others (*specify*)

  ………………………………………………………………………

v) How much do you earn from each activity per annum (you may also calculate per month/season)? (**Note**: *Calculate for all activities e.g. for farming, use income for the number of animals he sells per season or year to get a monthly figure*)

i) Livestock farming Ssh…………………

per………………………………

ii) Employment Ssh…………………

per………………………………

iii) Business Ssh…………………

per………………………………

iv) Other Ssh…………………

per………………………………

vi) Other sources of income;

i) Family members Ssh…………………

per………………………

ii) Share/stocks Ssh…………………
per………………………
iii) People living in the diaspora Ssh…………………
per………………………
iv) Others Ssh…………………
per………………………

6. What is the estimated family income per month? Ssh…………….…….. per month. This corresponds to:
(i) 0 – 200,000 ……………………
(ii) 200,001 – 500,000 ……………………
(iii) 500,001 – 1,000,000 ……………………
(iv) 1,000,001 – 1,500,000 ……………………
(v) 1,500,000 - 2,000,000 ……………………
(vi) Over 2,000,000 ……………………

7. Please list the major household expenditure items in order of importance (*per month/per year, etc*)
i) Household e.g. food, paraffin, etc Ssh…………………….
per……………..
ii) School fees Ssh…………………….
per……………..
iii) Uniform Ssh…………………….
per……………..
iv) Clothes Ssh…………………….
per……………..
v) Medical Ssh…………………….
per……………..
vi) Transport Ssh…………………….
per……………..
vii) Water Ssh…………………….
per……………..
viii) Other Ssh…………………….
per……………..

8. What is the estimated family expenditure per month? Ssh………………. per month? (**Note**: *To be calculated by the person administering the questionnaire*)

9. Please list the type of numbers of assets that are owned by your household e.g. vehicles, bicycles, animals, plots, equipment, land, commercial buildings, company shares.

| | Item | No. | Access | | | Control | | |
|---|---|---|---|---|---|---|---|---|
| | | | Man | Woman | Children | Man | Woman | Children |
| i) | | | | | | | | |
| ii) | | | | | | | | |
| iii) | | | | | | | | |
| iv) | | | | | | | | |
| v) | | | | | | | | |

10. What items (*assets*) would you say you now have, that you did not have two or three years ago (*e.g. bicycle, vehicle, land, number of animals, etc*)?

i) …………………………………….

ii) …………………………………….

iii) …………………………………….

iv) …………………………………….

v) …………………………………….

11. Type of House (observation)

☐ Permanent (solid structure)

☐ Semi-permanent (solid foundation)

☐ Temporary

12. Do you have electricity in your house? ☐ Yes ☐ No

13. Do you have a telephone/mobile phone? ☐ Yes ☐ No

***Section 2: Water Supply***

14. a) i) What is the source of your water supply?

☐ Piped water

☐ River/stream

- Flowing
- Scoop hole

☐ Shallow well

☐ Rainwater

☐ Borehole

- ☐ Rock catchment
- ☐ Dam
- ☐ Pan
- ☐ Vendors
- ☐ Others

(*specify*)…………………………………………………………………….

ii) What is your most preferred source of water?

………………………………………

b) i) If your source is piped water, how are you connected to the water supply?

- ☐ Stand pipe
- ☐ Communal water point
- ☐ Own connection (*unmetered*)
- ☐ Water kiosk
- ☐ Own connection (*metered*)
- ☐ Neighbour's pipe

| | | |
|---|---|---|
| (ii) Has metering been done? | ☐ Yes | ☐ No |
| iii) If metered, is meter working properly | ☐ Yes | ☐ No |
| iv) Is it read regularly? | ☐ Yes | ☐ No |
| v) If not, metered would you like to be metered? | ☐ Yes | ☐ No |

vi) If no to question 14 (v) why not?

Reasons……………………………………………………………………………
…………

…………………………………………………………………………………
……………

15. a) If not connected to piped water, how many times do you collect water per day?

- ☐ Twice a day or less
- ☐ Three times a day
- ☐ More than four times a day

b) Who collects the water?

…………………………………………………………………….

c) Means of collecting water

- ☐ By back/self
- ☐ By donkey
- ☐ By animal cart

☐ By bicycle

☐ Other (Specify)

…………………………………………………………………………….

16. How far is your main water source/water supply? ………………………………. Kms.

17. Time taken to collect water (*estimate the minutes or hours used in a day)*

………………………………. Minutes

……………………………….. Hours

18. i) How much water do you use per day? ………………. 20litre jerricans

ii) How much water would you use in a day if water was made available? ……… 20litre jerricans

19. Apart from cooking and drinking, how else do you use the water?

☐ Washing clothes

☐ Watering the animals

☐ Growing crops

☐ Others (*specify*)………………………..

20. i) Is the water from the supply sufficient throughout the year? ☐ Yes ☐ No

ii) If "No", how many times in a month do you miss water from water source?

☐ Less than 7 days

☐ Between 7 and 14 days

☐ Between 14 and 21 days

☐ Over 21 days

iii) Which are the critical months when you have no water?

…………………………..

iv) During this time, what are the alternative sources of water?

……………………..

21. (i) Do you pay for the water you consume? ☐ Yes ☐ No

(ii) If "Yes", how do you pay for water, and how much do you pay?

☐ Every time water is fetched Ssh………………. per…………………

☐ Monthly Ssh……………….

☐ Daily Ssh……………….

☐ Others (*specify*) Ssh……………….

(iii) If "No" why not? …………………………………..

(iv) If "No", are you willing to pay for it if the supply is improved? ☐ Yes ☐ No

(v) How much would you be willing to pay? Ssh. ……………….. per ………………….

22. (i) Do you have storage facilities? ☐ Yes ☐ No

(ii) If "Yes" what type? …………………….Volume …………… (*in litres or number of jerricans*)

23. (i) Do you use the project water for farming? ☐ Yes ☐ No

24. (i) Are you satisfied with your present water supply source? ☐ Yes ☐ No

(ii) If "No", are you willing to contribute towards the improvement of the present source?

☐ Yes ☐ No

25. Are you satisfied with present leadership of your water management group?

☐ Yes ☐ No

26. What are the most serious problems in the present water supply services?

☐ Poor financial management

☐ Long distance to the source

☐ Poor water quality

☐ Poor operation and maintenance

☐ Low water pressure/less water available

☐ High water tariffs

☐ Frequent water shortages

☐ Lack of people's participation

☐ Others (*specify*) ……………………………………………………….

**Annex – 2: Bacteriological water analysis Borama and Erigabo**
**Borama Water Quality for Bacteriological analysis**

| S. No. | Type of source | Locations | No/E-Coli/100ml | Evaluation |
|---|---|---|---|---|
| 1 | Tap-connected plastic tube 200m to neighbour (west corner | Airport road West | 8 | Low-risk |
| 2 | Kiosk | Near to main reservoir | 2 | “” |
| 3 | Ex-reservoir | Sh-Ali Jawhar | 1 | “” |
| 4 | Kiosk | Dheg-dher | 2 | “” |
| 5 | Tap | House hold | 1 | ”“ |
| 6 | Tap | Airport road house ,west | 2 | ”“ |
| 7 | Tap connected with plastic tube 100m | Tea-shop shacab area | 5 | “” |
| 8 | Stand pipe | Close to the Sheba-shacab area | 3 | ”“ |
| 9 | Tank | House very corner of Djibouti, road | 3 | “” |
| 10 | Tank | Center of city, house | 2 | “” |
| 11 | Stand pipe | Isha-cobosha borehole No5 | 1 | Low-risk |
| 12 | Elbow-pipe | Dhamug borehole No2 | 0 | safe |
| 13 | Pipe | Dhamug borehole No 8 | 0 | safe |
| 14 | Pipe | Dhamug borehole No 1 | 0 | safe |
| 15 | Kiosk | Faraxyoy | 1 | Low-risk |
| 16 | Tank | School Sh Abdurrahman | 2 | “” |
| 17 | Tap | T.B Hospital | 1 | ”“ |
| 18 | Tap | Restaurant central town | 3 | ““ |
| 19 | Tank | Borama guest house | 1 | ““ |
| 20 | Container | Kuwait village East H.H | 3 | ““ |
| 21 | Tap | Kuwait village East H.H | 2 | ““ |
| 22 | Spring water | Qor-gab | 10 | Inter risk |
| 23 | Spring water | Qor-gab | 11 | Inter risk |
| 24 | Inlet-pipe reservoir | Main reservoir | 0 | Safe |
| 25 | Donkey trucking container | Kiosk north of the town | 5 | Low risk |
| | | | | |

**Table-10:Borama bacteriological water quality analysis carried 13-14 November 2006**

| S. No. | Type source | Locations | EC µs/cm | P.H | ºC | Colour | Odour | test | Turbidity |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Plastic tube | Neighbor connection supply | 1424 | 7.3 | 25 | No | No | No | <5 |
| 2 | Kiosk | Eastern corner of city | 1227 | 7.2 | 25 | “” | ”” | ”” | ”” |
| 3 | ex-reservoir | Sh.ali reservoir | 1318 | 7 | 25 | ”” | ”” | ”” | ”” |
| 4 | Kiosk | Dheg-dher | 1227 | 7 | 25 | ””””” | ”” | ”” | ”” |
| 5 | Tap | Eastern corner house | 1450 | 7.2 | 25 | ”” | ”” | ”” | ”” |
| 6 | Tap | Airport road house | 1350 | 7.20 | 25 | ““ | ”” | ““ | ““ |
| 7 | Plastic tube 100m | Tea shop shacab area | 1354 | 7.2 | 25 | ““ | ““ | ““ | ““ |
| 8 | Stand pipe | Close to Sheba shacab area | 1245 | 7.52 | 25 | ““ | ““ | ““ | ““ |
| 9 | Tank | House corner Djibouti road | 1341 | 7.4 | 25 | ““ | ““ | ““ | ““ |
| 10 | Tank | House centre of city | 1424 | 7.4 | 25 | ““ | ““ | ““ | ““ |
| 11 | Stand pipe | Isha-cobosha borehole 5 | 1221 | 6.85 | 25 | ““ | ““ | ““ | ““ |
| 12 | Borehole elbow | Dhamug borehole 2 | 1140 | 6.8 | 25 | ““ | ““ | ““ | ““ |
| 13 | Borehole elbow | Dhamug borehole 8 | 1380 | 6.85 | 25 | ““ | ““ | ““ | ““ |
| 14 | Borehole elbow | Dhamug borehole 1 | 1180 | 6.86 | 25 | ““ | ““ | ““ | ““ |
| 15 | Kiosk | Faraxyod | 1215 | 7 | 25 | ““ | ““ | ““ | ““ |
| 16 | Tank | School sh. Abdirahman | 1344 | 7.2 | 25 | ““ | ““ | ““ | ““ |
| 17 | Tap | T.B hospital | 1340 | 7.2 | 25 | ““ | ““ | ““ | ““ |
| 18 | Tap | Restaurant of centre | 1340 | 7.2 | 25 | ““ | ““ | ““ | ““ |
| 19 | Tank | Borama guest house | 1310 | 7 | 25 | ”” | ““ | ““ | ““ |
| 20 | Container | Kuwait village East side | 1320 | 7 | 25 | ““ | ““ | ““ | ““ |
| 21 | Tap | Kuwait village East side | 1292 | 7 | 25 | ““ | ““ | ““ | ““ |
| 22 | Spring water | Qor-gab | 1008 | 6.84 | 25 | ““ | ““ | ““ | ““ |
| 23 | Spring water | Qor-gab | 1011 | 6.94 | 25 | ““ | ““ | ““ | ““ |
| 24 | In-let reservoir | Main reservoir | 1239 | 7 | 25 | ““ | ““ | ““ | ““ |
| 25 | Container donkey | Kiosk | 1420 | 7.2 | 25 | ““ | ““ | ““ | ““ |

**Erigabo Water Source for Bacteriological analysis**
**Table 11. Erigabo water quality analysis between 22-27 December 2006.**

| # | Co-ordinates | Location | Type of sources | EC ms/cm | PH | Temp C$^{o}$ | Tub | color | Test | Odour |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 38p 0758488 UTM1178154 | Kiosk for bore-hole 1 Bore-hole 2 | Kiosk | 963 | 7.20 | 21.5 | <5 | No | No | No |
| 2 | 38p 0758402 UTM11760541 | Borehole 2 | Tank | 1098 | 7.13 | 21 | <5 | No | No | No |
| 3 | 38p 0758488 UTM1178154 | Borehole 1 | Tank | 925 | 7.21 | 22 | <5 | No | No | No |
| 4 | 38p 0757803 UTM1178541 | GTZ2 | Tap | 1176 | 7.3 | 21.6 | <5 | No | No | No |
| 5 | 38p 0757267 UTM1176535 | FAI 1 | Elbow Pipe | 1545 | 7.4 | 21 | <5 | No | No | No |
| 6 | 38p 0767260 UTM1176521 | Main receiver | Main receiver | 1560 | 7.34 | 20 | <5 | No | No | No |
| 7 | 38p 0759467 UTM11755371 | Afweyne well | Sh. Well | 2400 | 6.8 | 21 | >40 | Exist | Exist | Exist |
| 8 | N:10$^{o}$38:182" E:47$^{o}$:21: 857" | GTZ1 | Tap | 2970 | 7.5 | 21 | <5 | No | No | No |
| 9 | 38p 0759467 UTM1175515 | Ismail H. nur's well | Tap | 3225 | 6.95 | 21 | >15 | Exist | Exist | Exist |
| 10 | N:10$^{o}$38:110" E:47$^{o}$:21: 964" | Seeraha 1 Well | Container | 901 | 7.3 | 22 | <5 | No | No | No |
| 11 | N:10$^{o}$38:120" E:47$^{o}$:21: 960" | Seraha 2 well | Tap | 1146 | 7 | 21 | <5 | No | No | No |
| 12 | N:10$^{o}$38:405" E:47$^{o}$:21: 651" | Ina Dhuxul's sh. Well | Tap | 1850 | 7.2 | 21 | <5 | No | No | No |
| 13 | N:10$^{o}$38: 284" E:47$^{o}$:21: 651" | Adam's Well | Tap | 875 | 7.32 | 21 | <5 | No | No | No |
| 14 | N:10$^{o}$62: 585" E:47$^{o}$:35: 820" | Buhoodle sh. Well | Tap | 1530 | 7.3 | 21 | <5 | No | No | No |
| 15 | N:10$^{o}$62: 580" E:47$^{o}$:35: 820" | Sanaag Hotel | Tap | 986 | 7.3 | 21 | <5 | No | No | No |
| 16 | N:10$^{o}$62: 580" E:47$^{o}$:35: 760" | Water truck at centre | Truck Tap | 996 | 7.4 | 21 | <5 | No | No | No |
| 17 | N:10$^{o}$63: 420" E:47$^{o}$:35: 740" | Restaurant Jano gaban | Open Container | 1002 | 7.5 | 21 | <5 | No | No | No |
| 18 | N:10$^{o}$62: 940" E:47$^{o}$:35: 300" | Teashop | Container | 1012 | 7.4 | 21 | <5 | No | No | No |
| 19 | N:10$^{o}$62: 570" E:47$^{o}$:35: 820" | Kiosk sha'ab area | Kiosk | 995 | 7.16 | 21 | <5 | No | No | No |
| 20 | N:10$^{o}$62: 640" E:47$^{o}$:35: 420" | Wheel barrow | Container | 999 | 7.14 | 21 | <5 | No | No | No |
| 21 | N:10$^{o}$63: 640" E:47$^{o}$:35: 420" | Teashop | Open container | 1011 | 7.6 | 20 | <5 | No | No | No |
| 22 | N:10$^{o}$62: 125" E:47$^{o}$:35: 600" | Hotel H. Nur center | Tank | 1013 | 7.7 | 20 | <5 | No | No | No |
| 23 | N:10$^{o}$62: 450" E:47$^{o}$:35: 480" | Kiosk No.4 | Kiosk | 1013 | 7.7 | 20 | <5 | No | No | No |
| 24 | N:10$^{o}$62: 455" E:47$^{o}$:35: 475" | House hold | Container | 1000 | 7 | 20 | <5 | No | No | No |
| 25 | N:10$^{o}$62: 925" E:47$^{o}$:35: 625" | Kiosk No.2 | Kiosk | 1020 | 7.3 | 21 | <5 | No | No | No |

## Table 11. Erigabo bacteriological water quality analysis between 22-27 December 2006.

| Sampling No | Co-ordinates | Location | Type of sources | No. of E.Coli/50ml | Evolution |
|---|---|---|---|---|---|
| 1 | 38p 0758488 UTM1178154 | Kiosk for bore-hole 1 Bore-hole 2 | Kiosk | 0 | Safe |
| 2 | 38p 0758402 UTM11760541 | Borehole 2 | Tank | 0 | Safe |
| 3 | 38p 0758488 UTM1178154 | Borehole 1 | Tank | 0 | Safe |
| 4 | 38p 0757803 UTM1178541 | GTZ2 | Tap | 0 | Safe |
| 5 | 38p 0757267 UTM1176535 | FAI 1 | Elbow Pipe | 0 | Safe |
| 6 | 38p 0767260 UTM1176521 | Main receiver | Main receiver | 0 | Safe |
| 7 | 38p 0759467 UTM11755371 | Afweyne well | Sh. Well | 11 | Inter-risk |
| 8 | N:10°38:182” E:47°:21: 857” | GTZ1 | Tap | 0 | Safe |
| 9 | 38p 0759467 UTM1175515 | Ismail H. nur’s well | Tap | 0 | Safe |
| 10 | N:10°38:110” E:47°:21: 964” | Seeraha 1 Well | Container | 3 | Low-risk |
| 11 | N:10°38:120” E:47°:21: 960” | Seraha 2 well | Tap | 0 | Safe |
| 12 | N:10°38:405” E:47°:21: 651” | Ina Dhuxul’s sh. Well | Tap | 0 | Safe |
| 13 | N:10°38: 284” E:47°:21: 651” | Adam’s Well | Tap | 0 | Safe |
| 14 | N:10°62: 585” E:47°:35: 820” | Buhoodle sh. Well | Tap | 0 | Safe |
| 15 | N:10°62: 580” E:47°:35: 820” | Sanaag Hotel | Tap | 0 | Safe |
| 16 | N:10°62: 580” E:47°:35: 760” | Water truck at centre | Truck Tap | 4 | Low-risk |
| 17 | N:10°63: 420” E:47°:35: 740” | Restaurant Jano gaban | Open Container | 2 | Low-risk |
| 18 | N:10°62: 940” E:47°:35: 300” | Teashop | Container | 3 | Low-risk |
| 19 | N:10°62: 570” E:47°:35: 820” | Kiosk sha’ab area | Kiosk | 0 | Safe |
| 20 | N:10°62: 640” E:47°:35: 420” | Wheel barrow | Container | 5 | Low-risk |
| 21 | N:10°63: 640” E:47°:35: 420” | Teashop | Open container | 0 | Safe |
| 22 | N:10°62: 125” E:47°:35: 600” | Hotel H. Nur center | Tank | 0 | Safe |
| 23 | N:10°62: 450” E:47°:35: 480” | Kiosk No.4 | Kiosk | 0 | Safe |
| 24 | N:10°62: 455” E:47°:35: 475” | House hold | Container | 4 | Low-risk |
| 25 | N:10°62: 925” E:47°:35: 625” | Kiosk No.2 | Kiosk | 0 | Safe |