

# **Water management**

**ON THE UNITED NATIONS COMPOUND,  
Gigiri, Kenya**

**Assessment and Recommendations**

**Step-by-Step (SBS)  
November 2004**

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## **1. Introduction/ Mandate**

UNEP GC18/10 inter alia calls on UNEP to “*recommend strategies for the promotion of the best practices in environmental housekeeping for use by UNEP, and advise and encourage the rest of the UNEP system to develop and apply similar strategies for continually improving their own environmental performances and promoting sustainable development, with the aim of (a) reducing waste, (b) recycling, (c) conserving energy, water, paper and other natural resources*”.

Subsequently, in 2001 the Board of Auditors to the United Nations General Assembly suggested that UNEP take the initiative in bringing to the attention of the UN system Chief Executives Board (CEB) the possibility of developing a framework to implement this environmental policy in the UN system. This recommendation requests UNEP to develop a policy framework for managing its own operations in an environmentally friendly manner (recycling, reducing energy consumption, considering environmental aspects in procurement, etc.) and to share it with other agencies in the UN system.

It is in this spirit that the “Step-By-Step” (SBS) group was established in 2002 to “green” the United Nations (UN) compound in Gigiri. SBS is composed of Nairobi-based professionals from a variety of UN agencies, and its objective is to improve the corporate environmental performance of the compound. The UNEP Executive Director backed this initiative (Log 860/03) in April 2003 and the Step-by-Step group began undertaking in-depth assessments of the environmental impact of the UN compound, as endorsed by the ED (memo from B. Kante to K. Toepfer of 24 July 2003 on “*greening the United Nations compound*”).

The present report on water is one of the four element of SBS’s overall assessment of UN compound activities that also focus on waste, energy, and transport.

## **2. Water sources and consumption level**

### **2.1 Water sources**

There are three main sources of drinking water: Nairobi City Council (NCC) (with a flow rate of 25m<sup>3</sup>/hr), and two boreholes (with a flow rate of approx. 8m<sup>3</sup>/hr). The two boreholes are usually opened alternately when NCC supply is available and simultaneously when there is no water supply from NCC.

In addition, recycled water from sewage and rainwater are collected and provide some 120 m<sup>3</sup> per day that is used to water the compound.

Three storage tanks are installed: one underground (625m<sup>3</sup>), which stores water from NCC, and two overhead tanks (141m<sup>3</sup> each), which store recycled water and water from the boreholes respectively (see also Annex I on water quality).

### **2.2. Consumption**

Water is distributed from the overhead tanks. The water consumption is between 6000-8000 m<sup>3</sup>/month (see Annex II). The population in the complex is approx. 1660 UN staff members and between 450 and 600 contractors' staff.

$$\begin{aligned}\text{Consumption per capita per month} &= \frac{\text{volume of water consumed per month}}{\text{UN staff + contractors' staff}} = \frac{7000 \text{ m}^3}{2185} \\ &= 3.2\text{m}^3 \text{ or } 3,200 \text{ litres per capita per month}\end{aligned}$$

$$\text{Consumption per capita per day} = \frac{3,200 \text{ litres}}{22 \text{ days}} = 145 \text{ litres per capita per day}$$

The following activities use most of the water:

1. Sanitation (toilets and urinals)
2. Catering (cafeteria and restaurant)
3. Cleaning (offices, official vehicles and showers for staff)
4. Landscaping of the UN compound (irrigation of plants and circulation ponds for rearing fish)

## **3. Assessment of water management**

### **3.1. Methodology**

Data was collected from:

- a) Direct observations
- b) Direct measurements:
  - Counting of toilets taps urinals and showers.
  - Actual measurement of the amount of water used in a single flush (with at least one toilet being sampled in each block)
- c) Consultation with the contractors:

- The Professional Cleaners Ltd.: information on approximately how many buckets of water they use for cleaning the carpets, windows, toilets and corridors within the complex.
  - Varsani: information on the sources, distribution, quality and quantity of water, consumed within the complex.
  - Diani Flowers & Landscaping Ltd.: information on the sewage system, recycled water and watering.
- d) Review of data from previous publications.

### **3.2. Main results/ findings**

#### **3.2.1. Fresh water**

- a) Toilets consume the lion share of the fresh water used in the complex: 93,000 litres per day – 22 days a month (~30 % of the total amount of fresh water consumed).
- b) In the toilets, the consumption of water per flush varies between 4.5 and 8.5 litres (see Annex III).
- c) The urinals consume 66,000 litres per day – 30 days a month (~28 % of the total amount of fresh water consumed). Much water is lost in the urinals as they are flushed twice a hour day and night and also during the week-end.
- d) Watering consumes approx. 20,000 to 30,000 litres a day – 22 days a month (~8 % of the total amount of fresh water consumed)
- e) Only one tap was found leaking in block D.
- f) The cleaners use approximately 10 buckets/day/block from Monday to Thursday, which they perform normal cleaning (100 litres) and approximately 150 buckets/block (1,500 litres) on Friday when they perform a general cleaning. The amount of water used also depends on the weather, on a muddy day or a dusty day more water is consumed.
- g) At the eastern car wash, the maximum number of cars that can be washed is 7 and they use an average of 3 buckets per car.
- h) Many staff members consume water from the zero B taps; a few buy mineral water from shops while very few carry drinking water from home.
- i) The rainwater from the roofs is not appropriately stored. Rainwater is stored in the swamp where it is mixed with the recycled water.

#### **3.2.2. Recycled water**

Diani Flowers and Landscaping Ltd uses 120m<sup>3</sup> of recycled water per working day for watering in the UN compound. The recycled water is pumped from the swamp. The swamp collects rainwater and recycled water from the overflow of the sewerage ponds. The swamp has an approximate capacity of 1,800m<sup>3</sup> of water.

For emergency watering, water from the old borehole can be diverted for watering purposes.

The wastewater from toilets, showers and taps is collected to the sewerage treatment ponds. There are a total of six treatment ponds within the complex. The treatment in the ponds is through natural oxidation catalyzed by the solar energy. The oxidation process is enhanced by the presence of microorganisms e.g. bacteria. The last pond stores recycled water that is used for watering the UN complex.

## **4. Recommendations**

- a) Staff members should be made to aware of the importance of water conservation measures. This can be achieved through:
  - Organizing a training section for staff members at least once a month reminding them that water is a scarce resource and there is need to conserve it. This training should focus on small issues like turning off the taps after every use, reporting to the relevant authorities i.e. the Varsani contractors all the taps sported leaking at any point in the complex. This should be put on the UN bulletin board.
  - Putting up stickers with a message like "WATER IS LIFE, CONSERVE IT!" at the entrance and inside each bathrooms.
- b) Underground tanks should be built to store rainwater; this can thereafter be used for drinking, washing hands, showers, cooking and for washing dishes. This will require the installation of additional gutters to collect water from all the roofs to the dedicated storage tank (see Annex IV).
- c) A water meters should be placed in each building. This will make it easy to tell how much water each of them consumes and appropriate measures taken incase of high consumption. Renting a water meter is 440/- per month.
- d) Daily watering of plants on the compound should only be done in the most visible areas such as around the lobby and the gate. The other remaining parts should be irrigated three times a week only (Monday, Wednesdays and Fridays).
- e) The plant and grass on the compound should be watered in the evening to reduce water losses through evaporation.
- f) Press taps should be installed in the new blocks to be constructed, and in the existing blocks in replacement of broken taps.
- g) Indigenous wetland plants should be introduced in the wastewater treatment pond to reduce evaporation and boost the treatment process by taking up organic nutrients or breaking up them through aerobic and anaerobic reactions e.g. *pistia spp.*
- h) The toilet cisterns should be adjusted to ensure that each flush uses 6 litres. However, the toilets in block H (contractors) should be fitted with larger cisterns (9 litres), to ensure that the large load from contractors' staff can be eliminated in one flush instead of two as it happens frequently according to Varsani staff members. This will lead to a saving of 3 litres of water for every flush in block H.
- i) Only blocks V, W, X are equipped with automatic urinals that reduce flushing when unnecessary. In the other blocks urinals are being flushed day and night. Automatic urinals should be installed in all blocks.
- j) Recycled water instead of drinking water should be used to flush the toilets. During the rain season, when no watering is required, all toilets and urinals could be run on recycled water. In the dry season, part of the recycled water could be used for watering and remaining being used to flush the toilets (see Annex IV).

## Annex1: Physical / chemical water analysis report

**Table1: physical/ chemical water analysis report**

PARAMETERS	UNIT				
		New borehole	Old borehole	NCC	Irrigation
PH	pH scale	6.7	7.1	6.5	6.9
Colour	mgPt/l	<5	< 5	<5	125
Turbidity	N.T.U	20	7	9	4
Mno <sub>4</sub> (20 <sup>0</sup> c)	Mgo <sub>2</sub> /l	<0.4	< 0.4	3.16	-
Conductivity (25 <sup>0</sup> c)	μS/cm	225	289	84	421
Iron	mgFe/l	1.06	0.24	0.47	-
Manganese	mgMn/l	0.02	<0.01	0.05	-
Calcium	mgCa/l	3.2	6.4	6.4	8
Magnesium	mgMg/l	1.5	0.97	0.97	7.3
Sodium	mgNa/l	50	65	11	46
Potassium	mgK/l	6.4	7.2	3	15
Total hardness	mgCaCO <sub>3</sub> /l	14	16	20	50
Total Alkalinity	mgCaCO <sub>3</sub> /l	88	110	20	146
Chloride	mgCl/l	15	15	5	31
Fluoride	mgF/l	1.8	13	0.15	3.6
Nitrate	mgN/l	4.5	1.4	2.1	-
Nitrite	mg/l	<.001	<0.01	<0.1	<0.01
Ammonia	mgN/l	-	-	-	-
Total nitrogen	mgN/l	-	-	-	-
Sulphate	mgSO <sub>4</sub> /l	0.6	3.71	10	12
Orthophosphate	mgP/l	-	-	-	-
Total suspended solids	mg/l	-	-	-	-
Free CO <sub>2</sub>	mgCO <sub>2</sub> /l	30	10	4	6
Dissolved oxygen	mgO <sub>2</sub> /l	-	-	-	-
TDS		154	200	58	266
Silica		-	-	-	2.8
Others		-	-	-	-

*Source: Information received from Varsani. Analysis done at the Water-Testing Laboratory, Ministry of Environment and Natural Resources*

### Comments:

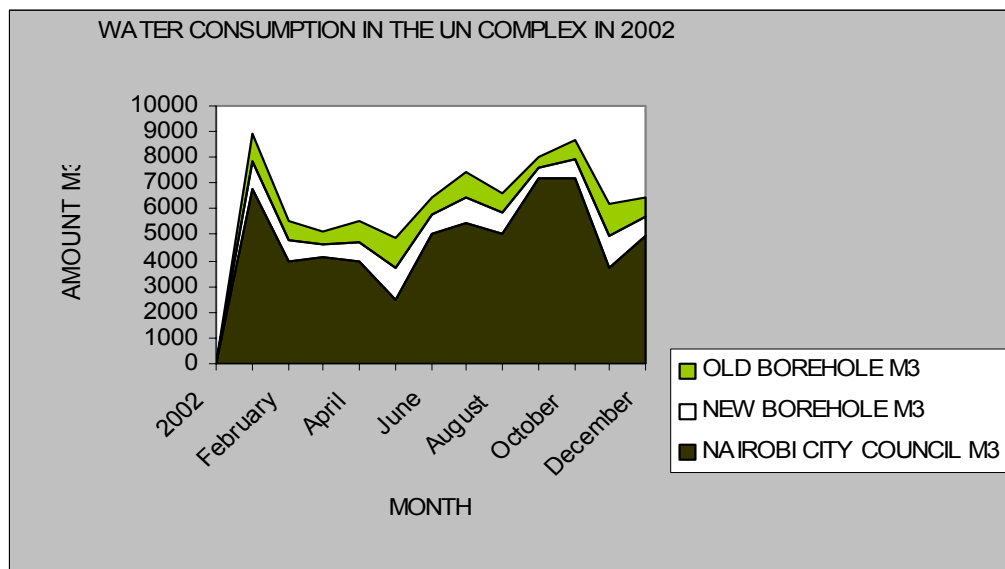
- The water from the two boreholes is fresh, soft with high chloride content. As such, to respect drinking water standards (1.5mgF/l ), it is necessary to mix it with water.
- The water from the new borehole is slightly turbid; it requires effective filtration system so as to obtain a turbidity less than 5 N.T.U.

## Annex2: Water consumption at the UN complex

Table2: Water consumption at UN complex in 2002

MONTH	NAIROBI CITY COUNCIL	NEW BOREHOLE	OLD BOREHOLE
	M3	M3	M3
<b>2002</b>			
January	6810	1061	1061
February	3983	792	792
March	4122	499	499
April	3997	753	753
May	2503	1201	1201
June	5068	701	701
July	5479	967	967
August	5060	782	782
September	7178	402	402
October	7160	754	754
November	3727	1223	1223
December	4947	740	740

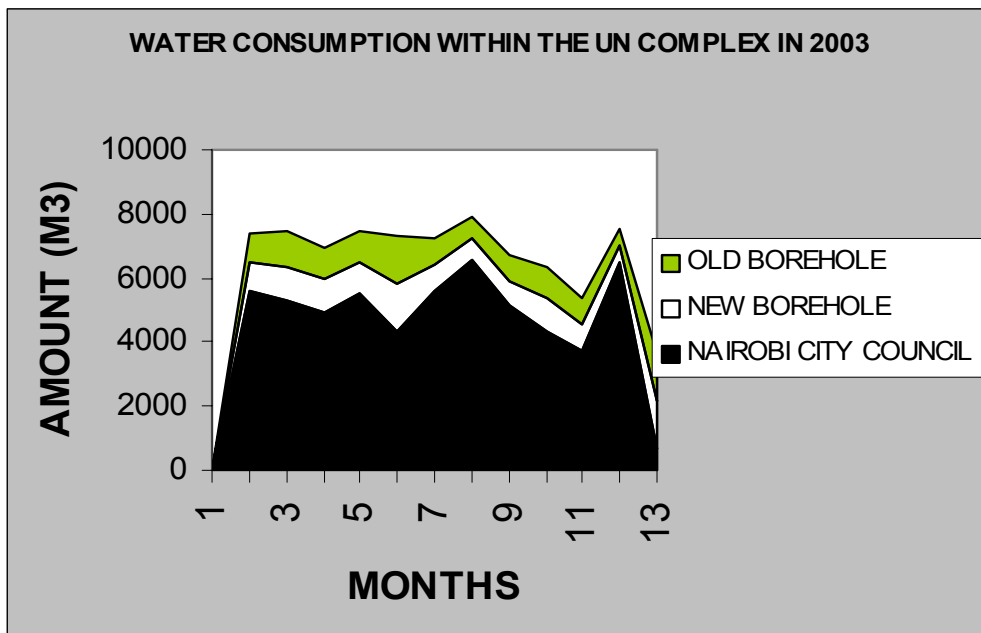
Graph 1: Water consumption at the UN complex in 2002



**Table3: Water consumption at the UN complex in 2003**

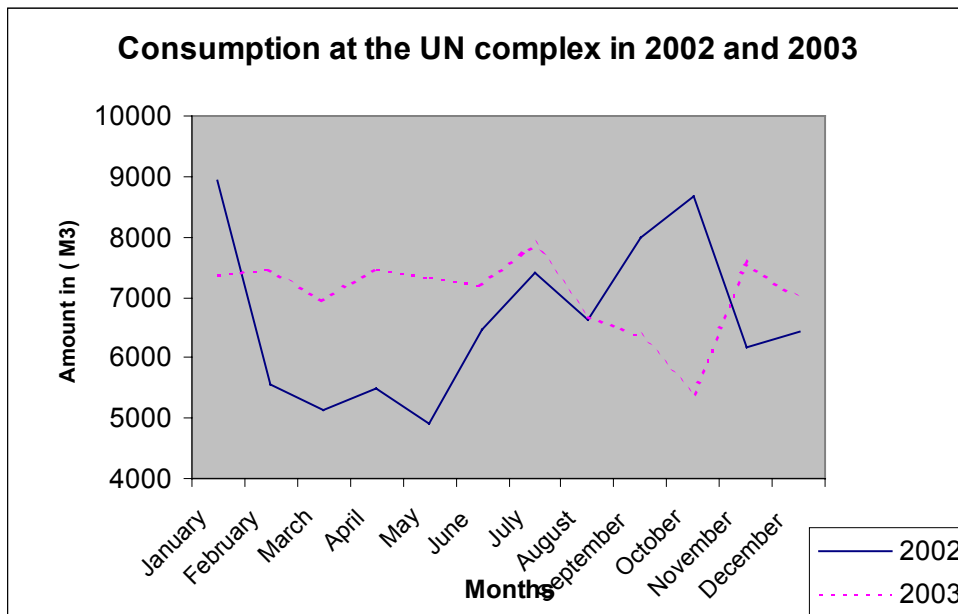
MONTH	NAIROBI CITY COUNCIL	NEW BOREHOLE	OLD BOREHOLE
	M <sup>3</sup>	M <sup>3</sup>	M <sup>3</sup>
January	5597	895	895
February	5297	1080	1080
March	4943	1003	1003
April	5550	962	962
May	4328	1500	1500
June	5601	810	810
July	6595	655	655
August	5149	777	777
September	4363	997	997
October	3706	848	848
November	6515	520	520
December	672	1482	1482

**Graph 2: Water consumption at the UN complex in 2003**



**Table4: Total consumption in the UN Complex**

<b>Water consumption in cubic meter in the UN complex</b>		
	<b>2002</b>	<b>2003</b>
January	8932	7387
February	5567	7457
March	5120	6949
April	5503	7474
May	4905	7328
June	6470	7221
July	7413	7905
August	6624	6703
September	7982	6357
October	8668	5402
November	6173	7555
December	6427	6978
<b>Total</b>	<b>81,786</b>	<b>86,716</b>



The big difference in water consumption in 2003 at the UN complex between February and June and between August and December 2002 can be attributed to:

1. Increased number of conferences leading to increased water consumption.
2. Water shortage, which calls for the Varsani contractors to control the supply of water to the minimal in the complex hence low consumption.
3. When there is an acute water shortage within the city, staff members come fetching water in the complex, which increases the consumption in the complex,
4. Leaking taps could lead to high consumption.

## Annex3: Tabs, showers and urinal

Table 5: location and number of tabs, showers and urinals

Location	Wash and taps	Kitchen taps	Drinking H <sub>2</sub> O taps	Shower	Urinals
<b>Block A</b>	8	2			2
<b>J</b>	12	-			1
<b>C</b>	8	2			2
<b>D</b>	8	2			2
<b>E</b>	8	2			2
<b>F</b>	12	-			12
<b>Staff clinic</b>	7			1	
<b>G</b>	10	1			1
<b>H</b>	23	1		14	1
<b>I</b>	8	2			
<b>J</b>	6	1			1
<b>M-N</b>	19	4			
<b>P-Q</b>	18	2	1		
<b>R-S</b>	19	4	1		
<b>T-U</b>	18	2	1		
<b>V</b>	7				3
<b>W</b>	7		1		3
<b>X</b>	7				3
<b>Main kitchen</b>	16	16		5	1
<b>Delegates coffee lounge</b>	34	3	2		22
<b>Staff coffee lounge</b>		3			
<b>Document publication</b>	6	1			
<b>Old cafeteria</b>	4	3			1
<b>Gardening workshop</b>	2			2	
<b>Car wash, eastern</b>	5				
	(1 main tap)				
<b>Staff recreation</b>	2			6	
<b>Visitors</b>	2		1		1
<b>Petrol station</b>	2				
	(1 main tap)				
<b>Nature trail</b>					
<b>Conference, west &amp; east</b>	9		1	4	10
	(1 main tap)				
<b>Chat room</b>	8				4
<b>Total</b>	295	51	8	32	74

**Table 6: Litres of water used to flush in the sampled toilets**

Location	Total no of toilets/block	No toilets checked	Measure	Measure	> 7 litres	Mean (litres)
<b>Block A</b>	8	1	6		0	6.00
<b>B</b>	12	1	7		0	7.00
<b>C</b>	8	1	6.5		0	6.50
<b>D</b>	8	1	5.8		0	5.80
<b>E</b>	8	1	5.75		0	5.75
<b>F</b>	12	1	7		0	7.00
<b>Staff clinic</b>						
<b>G</b>	10	1	6		0	6.00
<b>H</b>	2					
<b>I</b>	8	1	8		1	8.00
<b>J</b>	4					
<b>M-N</b>	18	2	7	6.33	0	6.67
<b>P-Q</b>	18	2	6.33	7.5	1	6.92
<b>R-S</b>	18	2	5.6	4.5	0	5.05
<b>T-U</b>	18	2	7.5	6.5	1	7.00
<b>V</b>	11	1	4.5		0	4.50
<b>W</b>	11	1	5.5		0	5.50
<b>X</b>	11	1	7.5		1	7.50
<b>Main kitchen</b>	5					
<b>Delegates coffee lounge</b>	36					5,7
<b>Staff coffee lounge</b>						
<b>Document publication</b>	6	1	8.5		1	8.50
<b>Old cafeteria</b>	4	1	6		0	6.00
<b>Gardening workshop</b>	4					
<b>Car wash, eastern</b>	2	1	6		0	6.00
<b>Staff recreation</b>	4					
<b>Visitors</b>	2					
<b>Petrol station</b>	1					
<b>Nature trail</b>			249			
<b>Conference, west &amp; east</b>		1	6.5		0	6.50
<b>Chat room</b>						
<b>Total</b>	249	23	122.98	24.83	5	<b>6.43</b>
<b>8 percent not adapted</b>						

## Annex4: Cost – benefit analysis

### **Use of recycled water for the toilets and urinals**

Toilets consume 92m<sup>3</sup> per normal day and 108m<sup>3</sup> per conference day. If only recycled water is used, the amount of money that could be saved would be Kshs 2,869 on a normal day and Kshs 3,421 on a conference day. In one month (22 working days), Kshs 63,118 could be saved.

Urinals consume averagely 66m<sup>3</sup> per day. If only recycled water is used for the urinals, there could be a saving of Kshs 2,090 per day. In one month (30 days) Kshs 62,718 could be saved.

As a start, the toilets and urinals from blocks V, W and X – which are the closest to the recycled water ponds – could be supplied with recycled water. There are a total of 249 toilets in the complex and a total of 74 urinals, in one day 0.48m<sup>3</sup> of water is used in each toilet and 0.89m<sup>3</sup> is used in the urinals. In these blocks, there are 33 toilets and 9 urinals. The daily water consumption is approximately 15.84m<sup>3</sup> (33 \* 0.48m<sup>3</sup>) for the toilets and 8.01m<sup>3</sup> for the urinals (9 \* 0.89m<sup>3</sup>). The total monthly water consumption amounts to 588.78 m<sup>3</sup> (22 working days \* 15.84m<sup>3</sup> + 30 days \* 8.01m<sup>3</sup>). The average daily consumption is 19.62m<sup>3</sup>. This amount of recycled water could easily be subtracted from the 120m<sup>3</sup> of recycled water used daily to water the compound. The resulting annual saving is estimated to be around Kshs 219,000.

### **Rainwater harvesting**

For rainwater to be collected, a water tank preferably an underground water tank has to be constructed.

The amount of rainwater that could be potentially harvested in each rain season is:

$$\begin{aligned} & \text{Area of the roof m}^2 * 0.5\text{m of rainfall per rain season} \\ & (1000\text{mm-average amount of rainfall per annum in Nairobi} / 2 \text{ rainy seasons}) \end{aligned}$$

The roof area for each block is approx 600 m<sup>2</sup> (60m \* 10m) and 450 m<sup>2</sup> for the main cafeteria (30m \* 15m). The potential amount of rainwater that could be harvested in one rain season is then:

$$\begin{aligned} 600 * 0.5 &= 30\text{m}^3 \text{ by block} \\ 450 * 0.5 &= 22.5\text{m}^3 \text{ by cafeteria} \end{aligned}$$

The total amount of rainfall that could be harvested by rain season would then be:

$$\begin{aligned} 30\text{m}^3 * 21 \text{ blocks} &= 630 \text{ m}^3 \\ 22.5\text{m}^3 * 3 \text{ cafeterias} &= \underline{67.5 \text{ m}^3} \\ & 697.5 \text{ m}^3 \end{aligned}$$

If a tank of such capacity is constructed the amount of money that will be saved annually would be approx.: Kshs 43,245

## **Annex5: Water management contact list**

<b>Institution</b>	<b>Name</b>	<b>Room</b>	<b>Tel</b>
UNON, Facilities Management and Transport Section	Barnaby Jones		20-62-3901
UNON, Building and Grounds Management Unit	Jack Howard	G-204	20-62-1075
UNON, Chief of the Office of the Director General	Paul Akiwumi	R-205	20-62-3177
UN-Habitat Human Settlement Officer Infrastructure	Graham Alabaster	M-134	20-62-3054
UNDP Sanitation Programme (Sustainability/ Energy and Environment Unit)	Dr. Chris Gakahu, Ass Res. Rep	Q-332	20-62-4458
UNEP, DEWA Ste-by-Step water assessment	Christian Lambrechts	X-107	20-62-3470

<b>Contractors</b>	<b>Name</b>	<b>Room</b>	<b>Tel</b>
Diani Flowers	Urs Ringler	Gardeners Shed	20-62-2640
Versani			

<b>Other stakeholders</b>	<b>Name</b>	<b>Address</b>
ZOOLOGY DEPARTMENT, EGERTON UNIVERSITY. P.O BOX 536,NJORO.	Adhiambo, Suzan	Tel. 0721305411 or 0733729396 Email dasu_bar@yahoo.com

More information about Step By Step (temporary website location):  
<http://www.ulrikwestman.net/sb>