A RAPID FIELD EVALUATION OF THE PILOT ASAFO SIMPLIFIED SEWERAGE SCHEME IN KUMASI, GHANA

For

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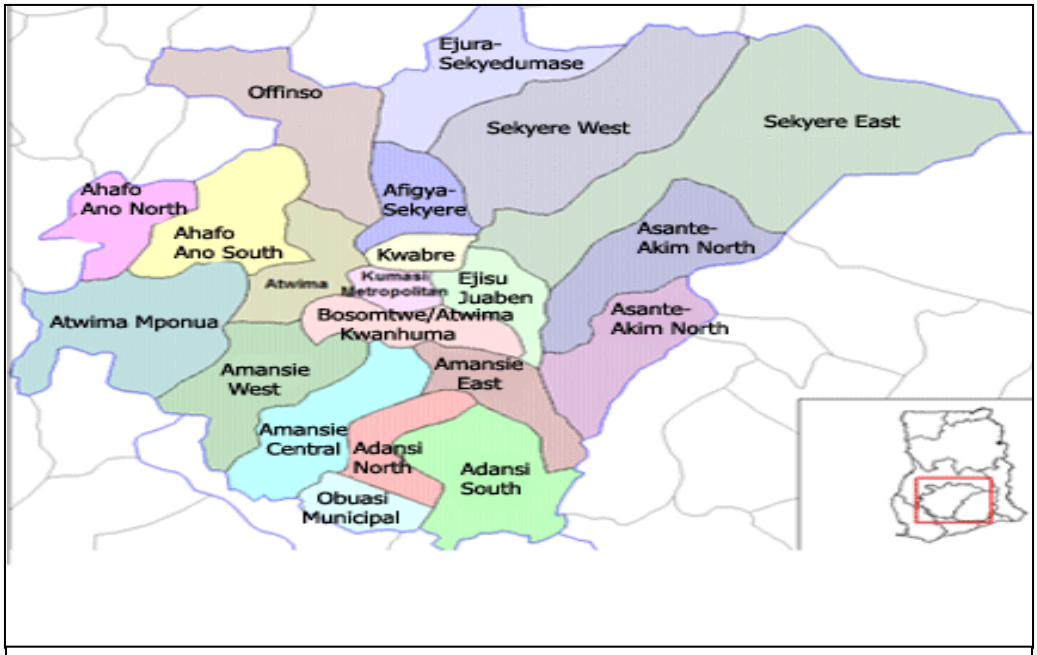
Summary

This report presents a brief overview of the Asafo Simplified Sewerage Scheme a pilot scheme now almost 20 years (start-up was in 1994) as part of UNDP/World Bank, Kumasi Sanitation Project (GHA/87/0160) which was implemented in Kumasi, Ghana's second largest city. The scheme as constructed covers an area of approximately 45 ha with 320 dwellings housing 4,000 households making up approximately 20,000 people. As part of project preparation and design, assessments of various solution options and evaluation of the existing situation in the entire city of Kumasi including baseline sanitation information and willingness-to-pay (WTP) for improved sanitation services provided adequate information for defining sanitation planning areas for the entire city. Simplified sewerage was selected for the Asafo tenement area considering a number of criteria important among them comparative costs of alternative solutions (e.g. small-bore and conventional sewerage), physical factors such hydro-geological (percolation rates in soils and level of water-table) and topography, demographic (densely populated area…/ha) and housing-type (high-rise typically 2- to 3- storeys that required "upper-floor" privy rooms. The choice of simplified sewerage was also influenced by the successful application of technology (also referred to as shallow sewerage) in the state of Rio Grande do Norte in northeast Brazil. The Asafo sewerage scheme, although a comparatively small system has shown resilience as the sewers and treatment ponds have continued to be functional since its commissioning and is currently servicing institutional category of users (e.g. Kumasi Polytechnic including Students' Hostel) with plans for linking the main regional hospital serving the Ashanti Region and northern parts of Ghana, the Komfo Anokye Teaching Hospital (KATH), the 4BN Barracks and the Golden Tulip (Kumasi City) Hotel. It is significant of note that if and when these institutions get hooked onto the Asafo system, the city of Kumasi will have restored sewerage to the pre-1984 state when the city's limited sewerage covering these areas was functional. This current overview is the result of assessments of small-bore and shallow (simplified) sewerage scheme carried out by Programme Solidarité Eau (pS-Eau) in documenting the functionality experiences of such schemes in a number of countries; Senegal, Mali, Ouagadougou, Ghana, India and Brazil. pS-Eau's study objectives are to determine the implementation context of the scheme including identifying the important processes followed in technology choice and selection; the roles, influences and challenges of stakeholders; the management arrangements adopted for the sewerage system and how this has evolved; and the economic model, if any, adopted for allocating costs and cost-recovery and based on the results of the field study the options and reasons for possible future scale-up of the particular small-bore or shallow (simplified) sewerage system and how these results are relevant for replication as feasible and affordable solutions to high-density, low-medium-high income areas of other urban areas both in-country (Ghana) and elsewhere.

1. Introduction

This paper presents a brief overview of the Asafo simplified sewerage scheme a pilot scheme now almost 20 years (start-up in 1994) as part of UNDP/World Bank, Kumasi Sanitation Project (GHA/87/0160) which was implemented in Kumasi, Ghana's second largest city. The scheme as constructed covers an area of approximately 45 ha with 320 dwellings housing 4,000 households making up approximately 20,000 people.

Asafo is located in Kumasi the second largest city in Ghana and the administrative capital of the Ashanti Region. Kumasi is located about 300 km north-west of Accra, the capital city on the Atlantic coast. Kumasi's current estimated population is 2.5 million with a daily transient population of 500,000.



Map 1: Kumasi Metropolitan Area forms the central part of Ashanti Region of Ghana

As part of project preparation and feasibility appraisal, various solution options and evaluation of the existing situation in the entire city of Kumasi including baseline sanitation information and willingness-to-pay (WTP) for improved sanitation services provided adequate information for defining sanitation planning areas for the entire city. Simplified sewerage was selected for the Asafo tenement area considering a number of criteria important among them comparative costs of alternative solutions (e.g. small-bore and conventional sewerage), physical factors such hydro-geological (percolation rates in soils and level of water-table) and topography, demographic (densely populated area…/ha) and housing-type (high-rise typically 2- to 3- storeys that required "upper-floor" privy rooms.

The choice of simplified sewerage was also influenced by the successful application of technology (also referred to as shallow sewerage) in the state of Rio Grande do Norte in northeast Brazil in mid-1980.
It is worthy of note that if and when these institutions get hooked onto the Asafo system, the city of Kumasi will have restored sewerage to the pre-1984 state when the city's limited sewerage covering the above areas was functional.

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Following on the introduction the next sections of this report is organized as a synthesis of the key questions and evaluation criteria listed in the analysis matrix made available by pS-Eau and which was used for the review of the Asafo experience (see Annex 4):

- The section on ***Sanitation Planning in Kumasi and Choice of Simplified Sewerage for Asafo*** tenement area provides the background information such as, physical factors and topography of the area, the baseline sanitation situation that led to the selection of the particular technology option, demographics and the unique features of housing pattern in the tenement areas of Kumasi; the section also covers comparative costs of alternative technology options as well as other parameters and processes that guided the recommended sanitation technologies considered as optimal for the various housing segments of Kumasi and thus for Asafo;
- ***Designing for Local Implementation*** This section presents the roles of the actors and in the selection and implementation as well as how community mobilization guided and aided the process of decision-making in the Asafo context. The section also describes the key features of the Asafo scheme and the adoption of simple systems that reduced cost;
- ***Sustaining Operation and Maintenance Management*** describes the operation and maintenance (O&M) arrangements put in place for the pilot Asafo scheme, how these have evolved over time and the challenges that remain to be overcome and proposals for sustaining O&M of the system. This section also covers capacity building initiatives that can contribute to experience sharing.

The report covers all the main points of interest from the detail items listed in the Survey Analysis Matrix of Annex 4 but not in the same chronological order as presented in the matrix.

2. Sanitation planning areas and choice of simplified (shallow) sewerage for Asafo Pilot scheme

This section describes the background information that influenced the implementation of the KSP and the proponents of the project. The reasons for choice depending on the existing situations of sanitation chain management, the status of health, hygiene and environmental risks, urban development and demographic characteristics, user demand and preferences, community participation and empowerment and above all cost.

Urban sanitation context and existing coping strategies

At the on-set of the Low-cost Human Wastes Management project (GHA/87/016) which was initiated in 1989, services and infrastructure for excreta management in Kumasi has deteriorated to levels that posed grave health risks to sanitary and conservancy labourers. Close to 75% of Kumasi's population of 600,000 had no access to improved domestic sanitation facilities: 40 % used dilapidated public toilets (mainly aqua privies built from the late 1940's up to mid-1970's and from the 1980's Kumasi-type VIPs), a quarter (25%) relied on unhygienic pan (bucket) latrines, 5% used smelly traditional pit latrines, 5% "free ranged" and the remaining 25% mostly residents of high-cost, government-housing and tenement areas such as Asafo used household water-closets connected to septic-tanks (WC-STs).

The WC-STs (which effectively served only as cesspits as there were no drain-fields) overflowed into open drains. For households who managed to have access to the municipality's old manual loading excreta collection truck or cesspit emptier the contents was collected and discharged without treatment in the nearby Subin River. Many of the public toilets of aqua-privy design were fouled with holding tanks overflowing – without water-seals these operated as anaerobic cesspits and posed grave risks as they often exploded due to build-up of gases (mainly methane) and, hence the local name *bomber latrine*.

Distribution of Sanitary Facilities in Asafo Tenement (Pilot) Area, 1990

Facility Type	No. of Houses
Water Closet	114
Pan Latrine	111
KVIP Latrine	6
Pit Latrine	37
No Facility in House	69

Households' sanitation coping strategies in Asafo followed the general trend of the entire municipality of Kumasi. As for other tenement areas of Kumasi the ready choice of many house-owners were *off-site* solutions mainly WC/STs and pan (bucket) latrines. It is within this context of poor urban sanitation that the Asafo simplified sewerage scheme was initiated as part of the Low-cost Human Wastes Management Project.
The critical challenges of managing off-site solutions especially pan-latrines and the associated health hazards to conservancy labourers was one of the main reasons that prompted the then mayor of Kumasi to seek intervention from the UNDP field office in Accra.

Plate 1: Many houses in Asafo relied on off-site solutions such as pan-latrines. Picture shows old out-of-use nightsoil bucket-chamber and newer sewer connecting a WC.

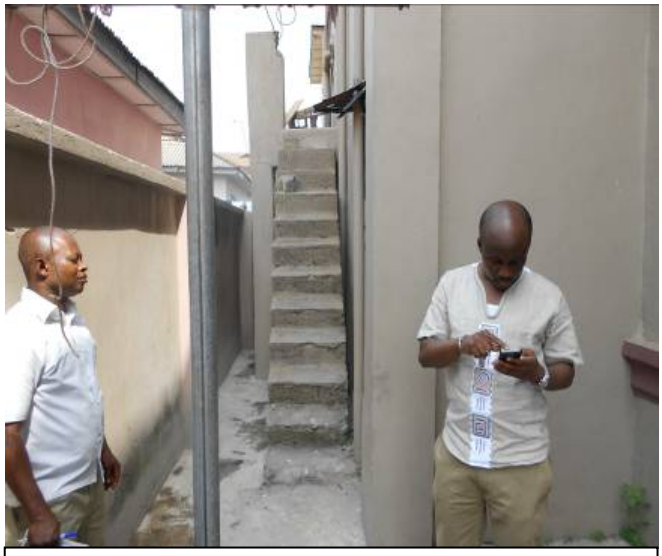


Plate 2: Well-constructed steps led to pan-latrine chambers on upper floors of tenement houses in Asafo.

Physical feature, settlement patterns and housing segments of Kumasi

Kumasi is generally undulating with gentle-hills interspersed with valleys which allow quick conveyance of storm water after rainfall. The Asafo area is of the same undulating nature and therefore allowed laying of sewers at shallow minimum gradients of 1 in 100 for house connections and 1 in 167 for block sewers.

Level of ground water table and percolation rates of sub-soils were also important physical parameters that influenced technology choice.

Although Kumasi as in other cities is made up of a blend of houses types and socio-economic status of householders, there is a unique pattern of houses in identifiable clusters according to location. These features have informed households' choice of the type of sanitation technologies depending on the location.

The Kumasi Sanitation Project (KSP) relied on this traditional knowledge in discussing and designing sanitation planning areas. Further studies were carried out to validate

Plate 3: Tenement Areas, as Asafo, are made up large storey buildings on plot sizes 30m x 30m with central courtyards.

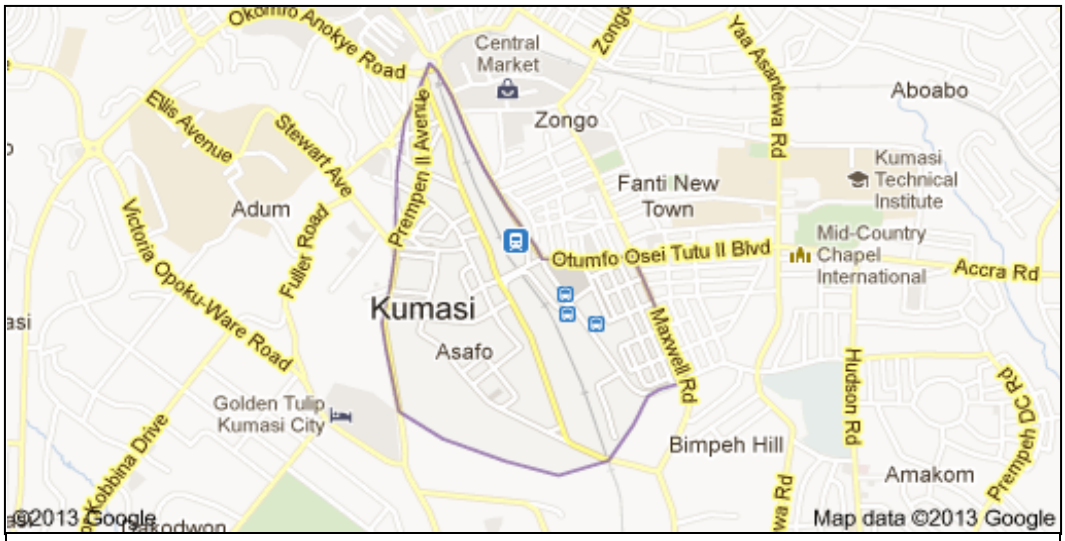
and refine these local practices. The critical studies carried out concerned *depth of water table* and *sub-soil material* characteristics including *soil percolation*. These investigations were carried out by considering main housing types, existing access to water, drainage conditions and geology (soil type). The studies also assessed potential locations for installing off-site treatment facilities. Soil permeability is an important factor that affects the performance of soil-absorption systems and therefore influences the performance of discharge by percolation into the earth (soil). The important physical features that influenced choice of technology and thus the feasible technology option that helped define the sanitation planning areas are presented in Table 2.

Table 1: Assessed Soil Percolation Rates for Selected Areas of Kumasi

Category	Percolation		Loading (liters/m2/day)	Localities
	Description	Rate (mm/hr)		
A	Very High	50	40	Kwadaso, Fanti New Town, Zongo, Akrom, Oforikrom (Part)
B	High	36-50	22-35	Oforikrom (Part), Bomso, Anloga, Dichemso, New Tafo, Ashanti Newtown
C	Moderate	21 and 35	8-22	**Asafo (part)**, Anou (Prempeh College Area), Subin Valley (Adum)
D	Low	20	8	Asokore Mampong, Nima

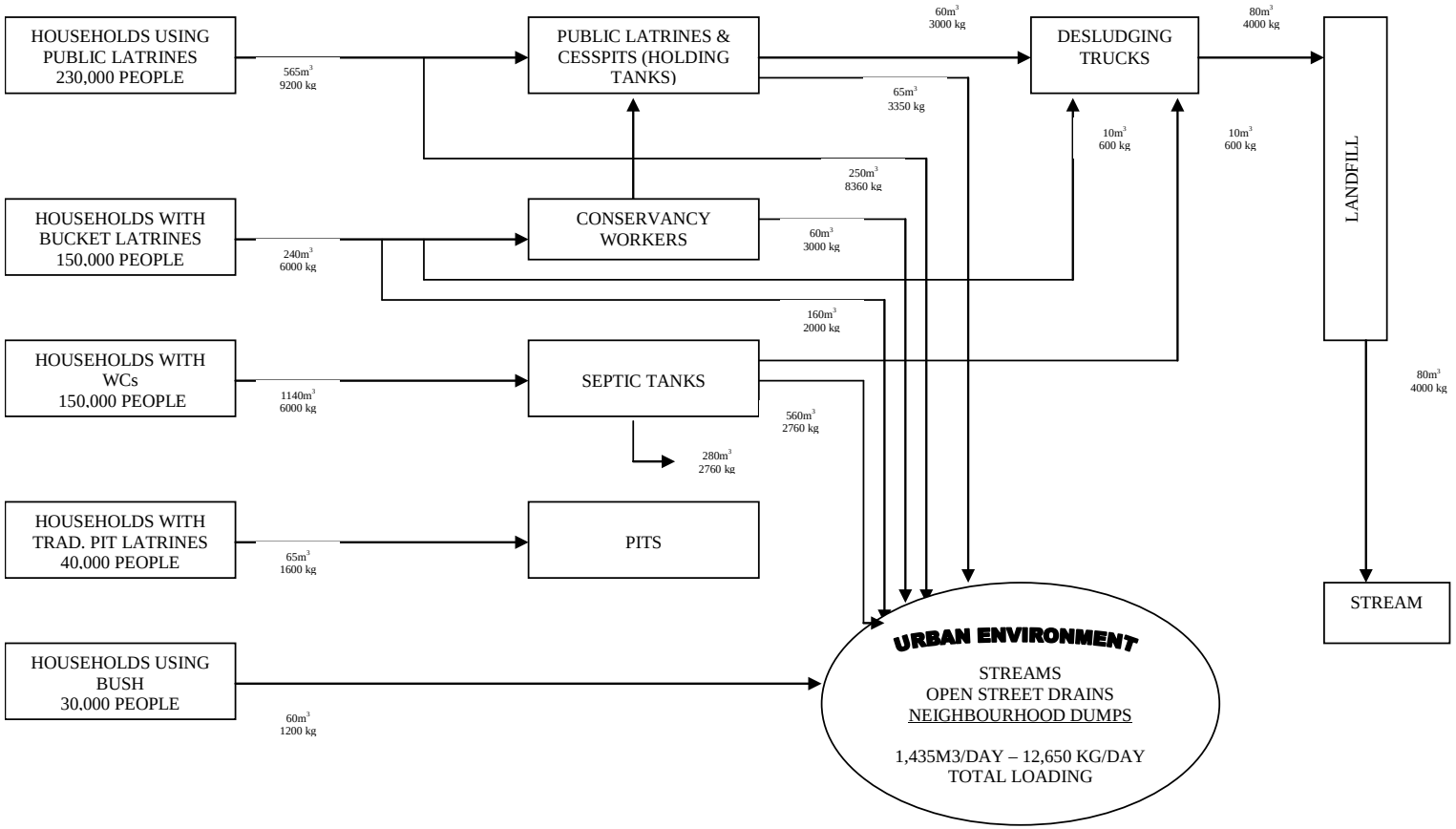
NB: The percolation rates were used to categorize (and map) housing areas and the type of feasible sanitation technologies

By superimposing the results of sub-soil investigations such as percolation rates on specific characteristics of the identifiable housing segments of Kumasi including housing-type, water use and the existing coping strategies, unique patterns emerge that define *sanitation planning in Kumasi*. From the results about 70% of Kumasi can rely on on-plot sanitation while the remainder will require off-site systems particularly, areas with very high-population density such as tenement areas including Asafo. Figure 1 presents the flow and means of handling of human excreta within Kumasi in 1990. Table 1 provides further information on the housing segments and indicates the changing trends in population and housing over time (in year 2000).



Asafo is part of the older built up area and forms part of the Central Business District with mixed (multiple) use of buildings for dwelling and business.

Figure 1: Human Waste Generation and Disposal (Kumasi, 1990)
Liquid Volume (m^3/day) and Dry Weight (kg/day)



Assumptions
Waste generations 1.6 liters/capital/day of urine, 160 g/capita/day of lace (25%dry weight), and 6 liters/capita/day of WC flush water.
Sludge trucks remove 80 m^3/day of septage: 60 m^3/day from public latrines, 10 m^3/day from septic tanks, and 10 m^3/day from bucket latrines.
Persons using public latrines dispose of their excreta by other means halt the time.
50% solids reduction and 25% infiltration in specific tanks with seepage pits.
Solids content of bucket latrine, septic tanks and public latrines is 5%

Table 2: Changing trends in housing segmentation and sanitation technology preferences (Year: 2000)

Criteria	Tenement Housing	Indigenous Housing	New Government Housing	High-cost Housing	Low density (newly developing areas)
Population (year 2000)	170,000 people. 22% of population.	470,000 people 55% of population.	60,000 people. 8% of population.	70,000 people. 10% of population.	85,000 people. 15% of population.
Housing	300-600 persons/ha. 2-3 storey buildings with 20-30 rooms and inner courtyard 10-20 families (40-100 persons). Street in front and rear alley.	80-250 persons/ha. Single storey homes with 5-10 rooms and interior courtyards. 4-10 families (20-50 persons). Street in front and rear alley.	50 persons/ha. Rows of detached single-storey homes in walled compounds with 2-3 rooms. 1-2 families. Street in front, no rear alley.	10-15 persons/ha. Detached single family homes on large lots with 5-8 rooms and servants' quarters.	5 -10 persons/ha. Detached single family homes in mixed single-double storeys on 30m x30 m lots with 5-8 rooms
Water use	Water use = 60 lcd. 90% of homes have house connections and 25% have multiple fixtures.	Water use = 40 lcd. 25% of the homes have yard taps, others buy water from neighbours	Water use = 80-100 lcd. All houses have full internal plumbing.	Water use = 100-120 lcd. All houses have full internal plumbing.	Water use = 60 - 80 lcd. All houses have full internal plumbing. Rely mostly on water vendors
Existing sanitation facilities	45% septic tanks. 40% public latrines. 10% Simplified Sewerage 5% KVIPs	60% public latrines. 25 % Traditional Pit latrines 5% KVIPs 5%???	100% septic tanks.	100% septic tanks, partial drain fields	100 % septic tanks without drain fields

Comparative financial and economic assessment of sewerage alternatives

The Asafo scheme fulfills many of the advantages for considering alternative like simplified (shallow) sewerage and other variants to the conventional sewerage option, important among them cost. Comparative financial analysis (1990 costs) of sewerage options for entire Kumasi city and pilot Asafo scheme assessed simplified sewerage as the least cost.

Table 3: Comparative cost-analysis of sewerage technology options (1990 Costs in Cedis)

Option	Entire City	Asafo Pilot
Simplified	¢7,892.692.600	¢147,709,514.00
Conventional	¢13,316,437,300	¢278,495,102.00
Small Bore	¢14,243,303,600	¢283,406,423.00

As shown in Table 3, the cost of simplified (shallow) sewerage was about half that of small-bore (or settled) sewerage mainly because of the need for septic-tanks for solids retention. Further economic analysis of the three sewer technologies assessed also indicated the simplified sewers as the one with the greatest benefits.

Table 4: Net Present Values (Asafo Pilot) (1990 costs @ 12% cost of Capital

Simplified	¢463,735,506.00
Conventional	¢622,451,066.00
Small Bore	¢889,225,397.00

It has to be pointed out that the basis for these conclusions has to be taken into consideration and analysis carried out on case-by-case basis. For example, simple to maintain waste stabilization ponds (oxidation ponds) were used as the preferred final sewage treatment technology. Currently for Kumasi there are challenges of availability of land for installation of ponds for proposed extension of shallow sewerage to other tenement areas.

Additional studies and surveys such as socio-economic profiling and willingness-to-pay[1] provided further information on householders' preferences and choices for improved sanitation as well as scenarios on how to meet such costs including subsidies.

[1] Household Demand for Improved Sanitation Services: A Case Study of Kumasi, Ghana by Dale Whittington, Donald T. Lauria, Albert M. Wright, Kyeongae Choe, Jeffrey A. Hughes, and Venkateswarlu Swama. UNDP/World Bank Water and Sanitation Program, 1992,

3. Designing for Local Implementation

This section covers briefly the roles of the various[2] actors that were involved in the Asafo pilot scheme and the processes adopted to promote community mobilization, O&M, capacity building cost recovery, system monitoring and evaluation et cetera. The layout of the Asafo simplified sewer network is compared to condominial network also in this section in order to isolate differences, if any.

Simplified sewerage meets Kumasi city's budget

The original proponent of the Kumasi Low-Cost Human Waste Management Project was the city authority, Kumasi Metropolitan Authority (KMA), now Assembly. With 25% of the population of Kumasi residing in densely populated tenement areas with drains originally meant for storm water and sullage now serving as open-sewers it was required that any proposed intervention for the city also cover this segment of the population exposed to excreta-related diseases and environment risks.

The challenge the KMA faced in equitably reaching all the vulnerable segments of the population that lacked improved sanitation was how to initiate and finance interventions that will target a modest 10% of each of these segments and still have an impact: on-site sanitation promotion in indigenous areas employing a revolving credit scheme; improvement of selected public toilets within the Central Business District (CBD) based on franchise management arrangements; and piloting of simplified sewerage in Asafo tenement area to cover close to 20,000 (approximately 10% of potential population in tenement housing, see Figure 1 and also Table 1).

The KMA as part of project cooperation agreement was required to solicit funds from Government of Ghana (GoG) sources and/or provide a matching grant of not less than forty percent (40%) of capital costs for the pilot Asafo scheme (see Box 1). The choice of simplified sewerage as the least cost evaluated technology option was therefore a strategic investment decision beneficial to the municipality. With the high population density of tenement housing, simplified sewerage "was at a lower cost than on-site sanitation" (Sinnatamby G. et al, 1986). This "least cost" notion does not implicate compromised works as the Asafo scheme was constructed adhering to high standards. For close to two decades (since commissioning in 1994), the scheme has run without major breakdown of any components.

[2] Details of the roles of various actors are presented in other studies, e.g. RWSG-WA, World Bank, Final Report, Review of the Asafo Simplified Sewerage Scheme, by Trend Group, March 2001.

An important aspect of the relatively low costs of the Asafo pilot is the very high inputs of local resources from design, construction supervision and implementation of works.

Box 1: Brief Profile of the Asafo Sewerage Scheme

Project Name:	Asafo Simplified Sewerage Scheme
Scope:	Technical/institutional studies, demand/WTP surveys, design and construction of sewerage scheme, information dissemination, community mobilisation
Project Duration	Jan 1993- April 1994
Implementing Agency	KMA
Technical Assistance	RWSG-WA
Key Partners	Local Design/Supervision Consultant Private Contractor Construction/ O&M management
Final Output	8 km of sewers (4-6 in dia), 320 junction boxes, 900 m3/day treatment via Waste Stabilization Pond (WSP)
Project Area	Asafo, (a high density tenement area in central Kumasi covering 45 ha) Density>300 persons/ha, 90% household water connection,
Key Beneficiaries	20,000 people in Asafo, No of houses-318, Population/house-63, population/household-4.6, water consumption-68 litres/person/day
Project Costs	US$ 600,000
Financing	60% from UNDP, 40% from KMA

(updated from RWSG-WA, World Bank, Final Report, Review of the Asafo Simplified Sewerage Scheme, by Trend Group, March 2001

Table 5: Financing responsibilities under the Project.

Project Component	Responsibility	Estimated Costs per house	General Comments
Capital costs of sewers and treatment facilities	KSP/KMA/GoG	US$ 1875	Based on total cost of Project was $600,000 for 320 households
Operation and maintenance of sewers	Households	US$ 62.5	Annual cost was $20,000 in 1996-1999 (for 320 houses). Current O&M expenditure level is about U$ 7000. Project plan was for this cost component to be covered with a sanitation tariff (35% of water bills) but this is yet to take off. All costs presently borne by KMA.
HH Plumbing and connection to sewer	Households	US 120 average US$ 50 minimum US$ 1800 max.	Based on cost analysis carried out by KMA in 1994. Estimates do not include cost of overhead tank. Figures do not include cost of over head tank
Household level Operation and Maintenance	Households	US$ 40 per month (excluding water bills)	Based on 63 people per house; Toilet roll at $0.4/person/month, toilet cleaning material, disinfectant at $0.15/person/month and house plumbing maintenance at $ 0.03 per person/month .
Replacement costs of sewer components	Households/KMA		Project planning projected substantial savings from sanitation tariffs (35% of water bills) to go into a special fund for replacement of system. Fund was to be supplemented with annual grants from KMA. This scheme has not is yet to take off.

Source: The RWSG-WA, World Bank, Abidjan- Cote D'Ivoire Final Report, Review of the Asafo Simplified Sewerage Scheme, by Trend Group, March 2001

Roles of Frontline Actors

The tables that follow provide a summary of what is termed "analysis of successful and not-so successful aspects of the Asafo Project" from the March 2001 review of the Asafo scheme by the then RWSG-WA (now WSP) of the World Bank. The information presents the roles of the various institutions and the results of implementation of these roles at the time of the assessment.

Table 6: Summary of Analysis of Successful Aspects

ITEM	KEY ISSUE UNDER CONSIDERATION	RESPONSIBLE INSTITUTIONS	REASONS FOR SUCCESS
1.0	Innovative Project Design	KMA, RWSG, Consultant (ABP)	• Simplified Sewerage adopted is simple and cost-effective • Superior consultancy support services from Consultant (ABP)
2.0	Design and construction of the system to a very high standard	KMA, RWSG, Consultant (ABP), Contractor (EEL)	• Good Design in accordance with established principles • Effective Supervision of construction • Strict bidding procedure ensured that highly qualified and professional contractor was chosen for works execution.
3.0	Capacity building of Private sector	KMA, RWSG	• Project planning and implementation was encouraged a policy of active Participation of Private Sector in all aspects. • KMA's commitment to private sector involvement and good facilitative role ensured a conducive environment for the private sector to operate.
4.0	Emphasis on capacity building of the KMA	KMA, RWSG	• Project design envisaged the KMA as the key implementation agency • All key extension activities were directly provided by seconded multidisciplinary staff of KMA • Most of the Contract staff who worked with the KSP Project continued to work with the KMA even after the end of the Project .
5.0	Decentralization of management of operation and maintenance services.	KMA,RWSG, MOH	• Privatization of operation and maintenance activities • Strict adherence to the conditions of the contract by the KMA.

Table 7: Summary of Analysis of Not-So-Successful Aspects (2001 Assessment by Trend)

ITEM	DESCRIPTION OF ACTIVITY	RESPONSIBLE INSTITUTION	REASONS FOR FAILURE OR ONLY LIMITED SUCCESS.
1.0	Low level of connection to the sewerage system. Less than 35% of potential beneficiaries had connected after 2 years and only 50% after 5 years. 50% are still unconnected. Major institutions like the hospital and army barracks still unconnected.	KMA, Households	• High internal plumbing and connection costs • Inability of KMA to mobilize demand • Inability of KMA to provide and maintain the required regulatory environment • Lack of financing/credit facilities to support or assist poor households • Discussions on the issue and KMA facilitation still not completed
2.0	No Arrangement/System in place for Recovery of O&M Costs	KMA	• Inability of KMA to conclude discussions with GWCL with regard to billing of users. • Inadequate User Education
3.0	Compared to condominial systems planning the level of community mobilisation was inadequate.	KMA	• Level of extension support and information dissemination was not adequate • Scope of key messages disseminated was not comprehensive • No brochures or supportive literature were provided.
4.0	Inadequate monitoring and Evaluation of the project, and also poor documentation of system performance and related experiences	KMA, TNC, RWSG-YWCA	• Inadequate efforts by KMA coupled with non-implementation of M & E arrangements • Key partners in M&E- TNC and RWSG were no longer available (TNC folded up in 1994, RWSG closed its Ghana Office closed in 1995) • Resource constraints within KMA.
5.0	Inadequate in-house capacity of KMA to update and refine the Strategize Sanitation Plan	KMA	• Weak internal/Institutional structures • Poor and inadequate M&E • Resource constraints within KMA
6.0	Inadequate Sewerage System Maintenance Since 1999	KMA	• Contract of maintenance Contractor not renewed since December 1999 • Inability of KMA to generate any revenues from operation of the system to cover O & M costs
7.0	Weak financial and Cost recovery arrangements.	KMA	• There was no contribution • No system in place for filling and collection of user fees • Low connection Ratio

Source: The RWSG-WA, World Bank, Abidjan- Cote D'Ivoire Final Report, Review of the Asafo Simplified Sewerage Scheme, by Trend Group, March 2001.

Laying sewers along natural slopes and in alleys

The various design and mode of construction of simplified (shallow) sewers that lead to the often-listed advantages of this technology option were largely realized in the Asafo scheme (Salifu, 1997). Important amongst these was the laying of sewers along flat natural gradients in back-alleys of tenement buildings: 1 in 100 for house connections and 1/167 for block collections. In Asafo tenement area, alleys to the rear of dwellings were used for laying house connector and block sewers while trunk sewers were laid, generally, under paved walk-ways in-front of the properties and thus away from high vehicular loads. The minimum depth of sewer pipes in alleys and pavement not subjected to vehicular traffic was 0.5 m and areas subjected to traffic 0.8 m and protected with concrete sleeving.

The network arrangement in Asafo sewer area is typical of planned settlements as is the case for all tenement areas of Kumasi which fall within the older planned sections of t the city.

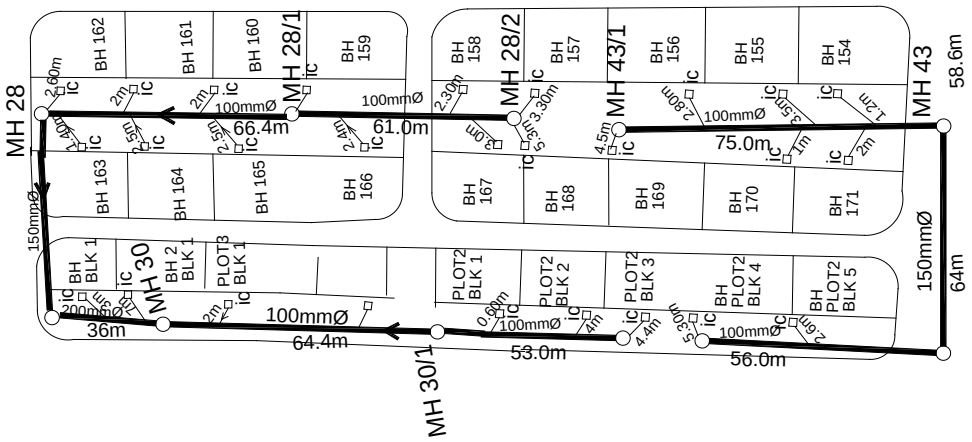


Figure 2: Asafo simplified sewerage scheme: house connection chambers and block sewers.

Sewers were laid along natural slopes and manholes (chambers) used for any change in direction and gradient. According to the design report sewer pipe diameter ranges from 100mm to 300mm while depth of excavation ranges from 0.5m for block sewers, 0.9 m along trafficked areas, to a maximum of 2.38m at the lowest point of the main sewage transmission trunk leading to the treatment facility. These shallow excavations have significant cost reductions and also make the cost of block connection and inspection chambers cheaper.

A schematic of the whole Asafo scheme is shown in Annex 4..

4. Sustaining Operation and Maintenance Management

An essential consideration for the successful operation and maintenance (O&M) management of simplified sewerage is need for "extensive community involvement, acceptance and participation" (UNCHS-Habitat, 1986). Involving communities in the whole process of intervention from conception, planning through construction to operation and maintenance enhances the continued operation of the sewerage system and its expansion.

The Asafo scheme has been evaluated as poor as far as community involvement during planning and instituting arrangements for O&M management are concerned (see Table 7). In spite of the relatively deficient community-involvement processes, the Asafo scheme has functioned robustly without breakdown for close to 2 decades. Perhaps the education and allocation of households' responsibilities for O&M at the stage of *applying-for* and *paying-for* house-connections as well as the O&M management arrangements initiated by the KMA partly explain why the Asafo scheme continues to function as an odd example out of several failed schemes in Ghana and across the sub-region.

The following sections of the report summarizes the key arrangements for O&M management that has evolved for the scheme and is a synthesis of the rapid field survey carried out as part of the current study and from previous assessment reports especially those by Salifu, L.Y (1997) and the Trend Group (2001).

Municipal oversight of municipality-owned sewerage system offers responsive O&M Management

As reported (Salifu, 1997) the originally proposed franchise O&M maintenance framework for Asafo will have involved the Kumasi Metropolitan Assembly (KMA) as owners of the scheme relying on the then Ghana Water and Sewerage Corporation (GWSC) for managing of a water-consumption indexed sewerage fee to be *negotiated* with GWSC. The collection of the sewerage-fees will have been carried out by a private contractor under the supervision of KMA and the GWSC. The issue of negotiating for a lower fee than the 35% sewerage fee in practice at the time was necessitated by the large increase in cost of water to those houses which had connected to the Asafo scheme: close to 105 houses (a third of the 320 total tenement houses) have connected by early 1997 some two-and-half years after the scheme has been commissioned.

With GWSC facing huge solvency challenges of its own, maintaining and managing an additional sewerage accounts of a traditionally "difficult" to deal with municipal-authority client such as a KMA was not attractive. That sewerage was divested from GWSC in the creation of Ghana Water Company Limited (GWCL) in 1999 as part of sweeping sector reforms is telling of how much restructuring GWSC was undergoing as part of improving its operations characterized by very high non-revenue water of up to 40%.

That the municipality's Waste Management Department (KMA-WMD) which was in charge of sewerage maintenance took responsibility to investigate the effect of increasing cost of water due to the water-tariff regime employed by the GWSC and subsequently contracted the sewerage scheme works-contractor to provide O&M management beyond the defects liability period is indicative of owners' responsiveness.

Service Contracting for sewerage maintenance in Asafo

As reported (Trend, 2000) the KMA-WMD has borne 100% of O&M management costs (approximately US$1,500 equivalent per month) since the inception of a first contract for the period 1st January 1996 to 31st December 1999. Beyond that period and up until 2009 a similar arrangement has been maintained with householders responsible for maintenance of in-house plumbing (including grease traps) and block sewers while KMA-WMD catered for trunk sewers and maintenance of the treatment ponds including periodic desludging of the anaerobic ponds.

The final treatment facility for the Asafo scheme comprises 1 anaerobic, 1 facultative and 2 maturation (polishing) ponds. The routine maintenance required for the ponds includes weeding of the embankments, removal of weeds from the corners of the ponds where stagnation often occurs and cleaning the final screening chamber to the ponds of debris.

The major periodic maintenance requirements include the changing of metal screens and desludging of the anaerobic ponds. The latter is a serious undertaking as KMA requires heavy-duty machinery with long-boom scoopers or a crawler-tracked dragline to be able to scoop out the very viscous stabilized sludge; this has to be carried out every five years as reported by the O&M contractor.

A sample of the Service Contract applied to the O&M management tasks is provided in Annex 2.

Franchised Sewerage Operation and Maintenance Management Scheme

Since September 2010, KMA-WMD has implemented a slightly modified version of the originally proposed franchise scheme (Salifu, 1997). Under the current scheme the service provider (franchisee/ "contractor") collects fees directly from users and provides the required routine maintenance services. Households continue to pay for in-house plumbing and block sewer repairs and maintenance while the KMA supports the repair of street sewer blockages and damages to trunk sewer lines and man-holes as well as desludging of anaerobic ponds.

Plate 4: Sewerage Maintenance Fee collection and House-Connection Kiosk, Asafo

The payment of the O&M service provider costs under the current scheme is based on the fees schedule of Table 8 below. An analysis of the schedule of fees and charges, set in 2009, indicates that the total revenue barely covers O&M service provider's labour costs. With the additional payments by the municipality for street trunks and periodic maintenance of the ponds there is need for a review of the fees by the KMA.

Table 8: Proposed User Fee Schedule for Connections to Asafo Simplified Sewerage Scheme (Sept. 2009)[3]

Item	Description	No. of Properties Connected	Monthly User Fee per property (GH¢)	Amount (GH¢)	Amount (US$)
1.	Private Hostels	6	25.00	150.00	76.92
2.	Transport Association (Terminals)	5	15.00 – 40.00	135.00	69.23
3.	Public Toilets	6	30,00 – 40.00	180.00	92.31
4.	Educational Institutions	4	30.00 – 50.00	185.00	94.87
5.	Hotels	6	15.00 – 50.00	115.00	58.97
	Sub-Total Institutional and Public Facilities			**762.00**	390.77
6.	Domestic Premises (Dwellings)	300	3.00	900.00	461.54
	Sub-Total Domestic Premises			**900.00**	
	Total Revenue (Collection)			1,662.00	852,31
	Operation and Maintenance Cost per month			1,300.00	666.67
	Revenue collection cost per month			362.00	185.64
	Total Cost			1,662.00	852.31

Source: Personal Communication, Mr. Anthony Mensah, Director KMA-WMD

[3] The fee schedule is captured in the Fee-Fixing Resolution of the KMA and gazzeted in the Government Bulletin (See Appendix 3)

According to the managers of the Asafo scheme (KMA-WMD), the above payment schedule was negotiated with the service provider to cushion against delays (often more than 6 months) in payment of service contract charges due the contractor.

During the field survey for this study it was reported that the fee of GH¢3.00 per month per domestic premises set by the KMA Fee Fixing Resolution is taken only as a minimum and a graded fee is actually applied in Asafo as follows; single-storey - GH¢3.00, two-storey - GH¢5.00, three storey - GH¢7.00 (about US$1.5, US$2.5 and US$3.5 per month)

Applying these actual rates and taking the distribution of houses in Asafo into account shows that the potentially revenue to be realized from domestic premises is slightly higher than that based on the official fee schedule. Given that the service provider complained of default in payment of about 40% and the fact that there is lack of effective monitoring from KMA it is difficult to ascertain whether the current fee regime adequately caters for the costs of routine maintenance.

Housing and Population Characteristics - Asafo Tenement Pilot Area (1990)			Applied Fee Schedule for Sewerage Services (2010)	
House Type	No. of Houses	Percentage (%)	Applied Fee (GH¢)	Total Revenue (GH¢)
Single Storey	139	43.7	3.00	417
Two Storey	152	47.8	5.00	760
Three Storey	23	7.2	7.00	161
Four Storey	4	1.3	7.00	28
Total	318	100		1,366.00

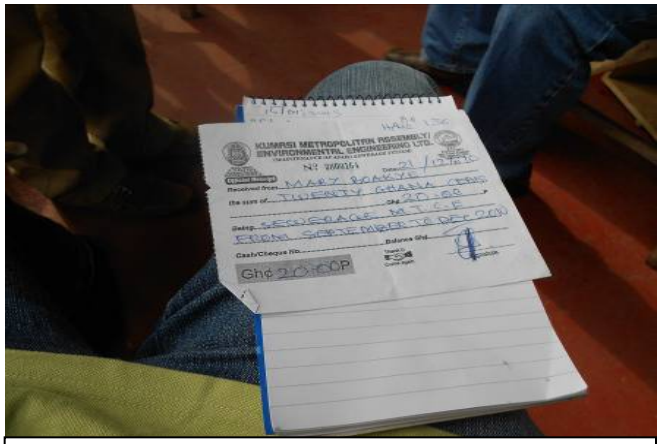


Plate 5: Sample Receipt (2-Storey Premises, BH 152) for quarterly payment inspected during field survey

There is need for further detailed assessment of the O&M management arrangements and as previously suggested (Salifu, 1997) how KMA-WMD can create a fund from any surplus revenues over-and-above routine maintenance costs particularly as the scheme nears two decades of operation and rehabilitation of appurtenances could rear up soon.

5. Institutional Strengthening and Capacity Building for Improving Sewerage Operation and Maintenance Management

This section of the report revisits the issue of sustaining operation and maintenance management which has been a subject of previous assessments of the Asafo Pilot Sewerage Scheme. The section also brings on board discussions of the needed skills enhancement for the managers and operatives of the Asafo scheme to sustain O&M management as well as exchange visits to learn from other experiences and contribute to sharing lessons of the modest gains of the Asafo pilot scheme.

Community participation and contributions to maintenance

The general conclusion from the assessment of community participation (Trend, 2001) in the whole project cycle of the Asafo scheme suggests that community involvement at the planning stage was inadequate. In the Asafo Asafo scheme households bore full costs (100%) for house-connections. During the period of installation of house-connections the KMA-WMD held a number of community meetings and consultations with landlords regarding the costs of laying pipes, plumbing fittings as well as households' responsibility for operation and maintenance.

A survey by KMA-WMD and the Contractor (Messrs.' EEL) in 1995/1996 for updating the costs of house-connections and in-house plumbing generated a lot of interactions with householders. This resulted in householders purchasing required items on installments basis upon the advice and in close consultation with the works contractor and KMA-WMD community-liaison unit which was responsible for registration for house connections. The awareness and readiness of households to pay the sewer fees currently in place and managed by the service contractor is another proof of community responsiveness which can only be borne out of close interactions and engagement.

Plate 6: Householders are responsible cleaning of grease-traps.

Many older residents within Asafo are aware of the need to routinely clean grease-traps at the back of kitchens and bathrooms and thus also endorse efforts made to create awareness of the obligations of households in this regard.

Multi-tenanted dwellings have challenges of duty of care by individual households, a phenomenon not attributable to simplified sewerages per se. In some instances disagreements and hence non-payment of water tariffs compel individual households to fetch water outside the premises and resort to use of public toilets.

The concern of water-for-flushing costs as an additional "burden" to premises that already fall within higher tariff bands has previously been mentioned (Salifu, 1997). An innovative Output Based Aid (OBA) scheme for resolving this challenge will be the installation of multiple meters on specific floors of tenement buildings to assist households pay lower domestic water tariffs as against the current practice of paying higher owing to sheer high numbers of residents per dwelling.

Houses in proximity of public toilets also resort to use of these as "preferred choice" in some cases because of WCs are used solely by landlords, their immediate families and/or "room-lords" with tenants left to fend for themselves. While Water and Sewerage Regulation 1979 (LI 1233) stipulates 10 persons to one WC toilet and bathroom, results of the house connection surveys indicated that modifications was required and so 20 person per toilet/bathroom was adopted for Asafo pilot area. This relaxation of the standard mean that on the average five (5) households instead of the maximum of two (2) per toilet/bathroom is what pertains. The issues of non-comfort and risks of unhygienic use and exposure still prevail.

Routine, Preventive and Corrective Maintenance

The current arrangements for O&M management need to be streamlined. While the service provider under franchise is supposed to provide routine maintenance this has to be specified. With KMA-WMD assisting with the flushing of sewers, responsible for paying for repair of street trunk sewers and man-holes as well as period (5-yearly) desludging of anaerobic ponds, there should be a dedicated source of funding to cover these aspects.

Plate 7: Contractor resources are stretched! - burning of overgrown embankments of anaerobic ponds is resorted to during dry season.

Plate 8: Additional anaerobic pond constructed to cater for institutional connections (Kumasi Polytechnic). Available land around ponds should be preserved against encroachment and for future expansions.

The elements that make up the total cost of O&M and rehabilitation need to be re-worked especially for institutional connectors including hostels (e.g. Kumasi Polytechnic), the Komfo Anokye Teaching Hospital (KATH) and the Golden Tulip Kumasi City. A comparative analysis of the costs to hotels in Accra that operate and maintain in-house sewerage treatment plants (e.g. Golden Tulip, Accra) will give indicative charges and also savings for these establishments in hooking up to an existing city sewerage system.

Regulation and Enforcement Management

As reported from previous studies regulation and enforcement management has been and remains unimproved at this point in time. Currently there is no proper register of defaulters and although a few defaulters have been prosecuted (after serving of Demand Notices and in default of 6 months or more) with penalties imposed there are some who continue to be defiant and ignore orders of the court, without any follow-up sanctions.
There is need for upgrading of skills in modern regulatory and enforcement mechanisms for the staff of the Public Health Department of the KMA which is supposed to be the local authority's enforcer of environmental sanitation bye-laws.

Skills and capacity building for design, implementation and O&M Management

The design, construction and supervision and implementation of the Asafo Pilot Simplified Sewerage have been achieved almost entirely by national professionals rooted in local institutions. That the scheme continues to function well close to two decades is a manifestation of real ownership by the KMA and the municipality's readiness to invest modestly to maintain the works contractor in Asafo beyond the defects liability period.

As the scheme has proven *technically* successful and indications are that next stage community upgrading schemes will be adopting simplified or small-bore sewerage technologies depending on final treatment options to be applied. There is the need for skill enhancement for many more local engineers, contractors, environmental health officers, community development officers, sociologists and financial managers on the various aspects of sewerage design, works construction and supervision, as well as critically community participation, financial monitoring and evaluation and enforcement management and regulation.

Specifically the following will be required:

Community mobilization: training of local staff (KMA-WMD/Public Health Department) in surveys and environmental sanitation assessment and audits; field visits to good practice projects on community participation and management (e.g. in Brazil and Pakistan)

Design and O&M Management: Training Workshops on sewer design, O&M management procedures and development and implementation of a manual on sewerage O&M management; field/exchange visits of city technical, financial and administrative personnel to other cities with successful implementation of "best practice" and "working" options in management and financing models e.g. Brazil, Ghana.

Implementation of Output-Based Aid (OBA) and Micro-Credit Schemes: the delays in connectivity of many premises was due to the upfront payment of the 100% cost for house-connections. In the Asafo case after the initial wave of house-connections (30% in the first three

years, 1997), it took several years, 2004/2005 to reach 50% connection and up to 2008/2009 to reach 100% connection. For a technology that relies on full block-connections to ensure adequate flow by tractive force in sewers, low connection and low flows are counter-productive. While a number of important financial studies[4] were carried out prior to project execution the suggested financing models for the Asafo scheme were not implemented. Training on as well as delivery of innovative means of financing house-connections through OBA and micro-credit schemes need to be implemented for new schemes.

[4] UNDP/World Bank-RWSG-KSP (GHA/97/0160), Financial Arrangements for Home Latrine Delivery and Sewerage Management under the SSP-Kumasi. G. Akosa and J. Owusu Akyaw, 1991.

Annexes

Annex 1: Field Evaluation Process and Persons Met

Survey on the use of simplified (shallow) sewerage in Asafo, Kumasi, Ghana

PROPOSED SCHEDULE OF CONSULTATIONS

Monday 14, – Thursday 17, January 2013

Schedule of activities and outputs for Jean-Marie Ily (pS-Eau, Paris) and Lukman Y. Salifu (WasteCare, Accra).

Key Objective of the proposed consultations and interviews *is to conduct an in-depth analysis of*:

The implementation context of the Kumasi small-bore sewer experience and the factors of sustainability for this solution and the challenges that remain.

Expected results from Consultations and field Interviews, including evaluated responses on:

- process followed in technology choice/selection and the roles, influences and challenges of stakeholders;
- management arrangements adopted for sewerage systems and how this has evolved, including the roles of KMA, contractor, type of contract, households, GWCL and means of regulation;
- the economic model of the service: costs, resources and means of cost recovery;
- options and reasons for possible replication/future scale-up of the simplified sewerage system.

Work & Meeting Schedule

Activity/Task	Details	Date	Proposed Location/ Participants
• Initial briefing, 1st meeting	• Meeting with Head KMA-WMD and Technical Staff	• Monday, 14 January 10:30 am - 12:00	KMA-WMD Offices • Anthony Mensah • Prosper Kotoka • Charles Mensah • Ossei Asibey Bonsu • Jean Marie Ily • LY Salifu
• Initial Field visit/Sewer Walk	• reconnaissance visit to Asafo sewer network area and treatment facility • Quick overview of catchment basins of Kumasi (Aboabo, Subin etc) and visit to Tenement Areas Dichemso, Aboabo No.1 etc	• Monday, 14 January 2 -3 PM	Asafo Sewer Network/Waste Stabillisation Pond • Jean Marie Ily • LY Salifu • Charles Mensah • Management Contractor

			(EEL) •
• Meeting with Metropolitan Engineers Department	o Review of Kumasi City projects' profile and planned interventions on wastewater treatment	• Monday, 14 January 3:00 – 4:30 PM	Engineer's Department • Mr. Alexander Boateng (Metropolitan Engineer) • Frank Fosuhene • Justice Simmons (Development Planning Officer) • Charles Mensah • Jean Marie Ily, • LY Salifu •
• Detailed field visit and interviews	• Semi-structured interviews of selected households in tenement houses (15 No.) in Asafo sewer network area	• Tuesday, 15 January AM/PM	Asafo Sewer Network • Charles Mensah • Jean Marie Ily • LY Salifu • Private contractor's reps • Abu–Zeid Suleman, Technician Plumber (in charge of Asafo O&M Management) • Kofi Thompson
• Initial completion of analysis matrix	• Evaluation of responses and completing of analytic matrix/initial drafting of outline of report	• Wednesday, 16 January 8:00 am – 10:00 am	• Jean Marie Ily • LY Salifu
Review of Urban planning and sanitation services	• Consultation with Regional Planning/TCPD	• Wednesday, 16 January 10:00 am – 12:30	Town and Country Planning Department/Regional Director • Rosemond Edusei • Jean-Marie Ily • LY Salifu
• Wrap up briefings	• Conclusion consultation and briefing with KMA-WMD/Metropolitan Engineers Department	• Wednesday 16 January, 3:00 – 4:00	• Alexander Boateng • Tony Mensah • Prosper Kotoka • Charles Mensah • Frank Fosuhene • Osei Asibey Bonsu
• Depature of Team	• Thursday 17 January		
• Follow-up Visit to Kumasi	• Further discussions on evolution of O&M management arrangements	• Wednesday 23, January, 09:00 – 4:30	• Tony Mensah • Abu-Zeid Suleman • LY Salifu

Annex 2: Schedule of KMA Fee-Fixing Resolution, 2011 for Sewerage Fees

No.	Item Description	Approved Fee for 2012 GH¢ Gp
16.	**KMA City Guards Parade, etc. Funerals**	200.00 per day
17.	**Registration and Calibration of Noise emission**	
	Category "A" (Permanent)	100.00
	Category "B" (Temporary)	50.00
18.	**Kumasi Abattoire Fees**	5,000.00 per annum
	H - WASTE MANAGEMENT FEES	
1.	**Dislodging/Bucket Collection**	
	Dislodging of Septic Tank	
	Category "A" (Large Size)	100.00 per trip
	Category "A" (Medium Size)	90.00 per trip
	Category "A" (Small Size)	80.00 per trip
	Manual Evacuation	100.00 per trip
	Dislodging of Septic Tank (Commercial Properties)	
	Category "A" (Large Size)	150.00 per trip
	Category "A" (Medium Size)	120.00 per trip
	Category "A" (Small Size)	100.00 per trip
2.	**Tipping Charges/Dump Fees**	
	Tipping of Liquid Waste at the Faecal Sludge Treatent plant	
	Category A	20.00 per trip
	Category B	15.00 per trip
	Category C	10.00 per trip
	Tipping of Liquid Waste at Landfill Site	10.00 per trip
3.	**Solid Waste Collection Services**	
	Communal Collection Service	
	Pay-as-you-dump	
	Commercial/Industrial/Institution	0.20 per head load
	Door to Door Collection Service	20.00 per ton
	1st Class Residential Area	10.00 per bin/pm
	2nd Class Residential Area	8.00 per bin/pm
	3rd Class Residential Area	6.00 per bin/pm
	Commercial Rate (Hotels, Restaurants, Factories)	15.00 per ton
	Hiring of refuse Container	
	23m³ Container	200.00 per bin
	23m³ to 15m³ Container	100.00 per month
	120ltre to 24ltre Bin	5.00 per month
4.	**Public Toilet User Fee**	
	KVIP/Aqua Privy/Enviro-Loo	0.10 per visit
	W/C	0.20 per visit
	Public Urinal	0.5 per visit
5.	**Sewerage**	
	Public Toilets (Maintenance Fees)	0.3 per drop hole/m
	Domestic (Maintenance Fees)	0.3 per house/m
	Institutions (Maintenance Fees)	
	K' POLY	100.00 per month
	KATH	300.00 per month
	CITY HOTEL	300 per month
6.	**Bath Houses (Showers): Franchise**	
	Category "A" (10 or more Cubicles)	50.00 per month
	Category "B" (1 – 9 Cubicles)	25.00 per month

Annex 3: Schematic Drawing of the Asafo Simplified Sewer Network

Annex 4 : Results of Field Survey Analysis

Field analysis matrix for Asafo Simplified Sewerage System, Kumasi, Ghana

Part I. When to choose small-bore sewers?			
Question	**Determining Factor**	**Criteria**	**Summary of evaluated responses/findings**
Why were small-bore sewers chosen?	Sanitation chain management		Review of technology options, Willingness to Pay (WTP) studies, Affordability studies; financing option studies evaluated various sanitation options (both on-site and off-site) and therefore allowed a hierarchy of options. Simplified sewerage selected as preferred choice for tenement segment of houses in Kumasi with housing/population density.
	Hygiene, health risks		The three main existing toilet/latrine technology options been used by households included *traditional pit, pan (bucket) latrines, WC/Septic Tanks and public toilets* of variety of designs (mainly aqua privies from late 40 – 70's and from the 1980's K-VIPs. Many of the storied dwellings adopted the pan-latrine option because of ease of installation for use of residents on upper floors (see picture showing staircase to out-of-use bucket chambers on upper floors). WC/STs overflowed into drains and gutters and fouled the air in the immediate vicinity of houses; traditional pit latrines often got filled up, were smelly and attracted flies and vermin (cockroaches); pan-latrines were smelly and posed health risks to conservancy labourers.
	Physical context and environmental risks		Determination of percolation characteristics of the sub-soils in selected locations of Kumasi led to the zoning of Kumasi on based percolation qualities to help determine where on site sanitation systems can be/cannot be implemented easily. Sewerage was recommended for areas of poor sub-soil percolation and on-site systems for areas of good percolation (what are the percolation rates?) Many aqua-privies were fouled with holding tanks overflowing – without water-seals these operated as cesspits and posed grave risks as they often exploded due to build-up of gases (mainly methane and hydrogen sulphide hence the local name *bomber latrine*.
	Urban morphology		Sanitation planning areas under the Strategic Sanitation Plan for Kumasi (1990, Revised 1996?) identified four (4) such areas: Indegenous, *Tenement*, High cost and Government Areas (Estates). Simplified sewerage has been evaluated as suitable for Tenement areas. As the city of Kumasi has grown new developing areas, generally in the preiphery, have sprung up with house owners installing WC/STs as the preferred "modern" option.
	Comfort		Sewerage was evaluated to provide "comfort" to users as many houses were

<table>
<tr><td></td><td></td><td></td><td colspan="3">gradually upgrading to WC/STs. Connection of sewers by those outside the Asafo sewerage network area is indicative of the need by some householders of improved “comfort”.</td></tr>
<tr><td></td><td rowspan="5">Cost</td><td rowspan="5">Comparative analysis (1990 costs) of sewerage options for entire Kumasi city and Pilot Asafo Simplified Project; further analysis are provided from WTP study</td><td colspan="3">Cost (per sewerage technology option)</td></tr>
<tr><td>Option</td><td>Entire City</td><td>Asafo Pilot</td></tr>
<tr><td>Simplified</td><td>¢7,892.692.600</td><td>¢147,709,514.00</td></tr>
<tr><td>Conventional</td><td>¢13,316,437,300</td><td>¢278,495,102.00</td></tr>
<tr><td>Small Bore</td><td>¢14,243,303,600</td><td>¢283,406,423.00</td></tr>
<tr><td></td><td>Community empowerment</td><td></td><td colspan="3">No observed project design characteristics to augment community empowerment. Capacity building of municipal technical departments pursued with visits to Brazil of City Engineer (co-manager of Kumasi Sanitation Project).</td></tr>
<tr><td></td><td>Modernity</td><td></td><td colspan="3">The choice of simplified sewerage followed emerging trends (”modern”?) for adopting the technology.</td></tr>
<tr><td></td><td>Simplicity</td><td></td><td colspan="3">The choice of treatment system (waste stabilization ponds) dictated by simple operation and maintenance management requirements; elimination of pumping stations and elaborate manholes with simple grease traps (for removal of detritus from sullage flows from kitchens) to be handled by householders.</td></tr>
<tr><td rowspan="10">How were small-bore sewers chosen?</td><td rowspan="4">Process that led to the system being selected</td><td>Part of a Sanitation Master Plan</td><td colspan="3"></td></tr>
<tr><td>Part of a concerted planning approach</td><td colspan="3">Strategic Sanitation Plan-Kumasi (1993)</td></tr>
<tr><td>Part of a project approach</td><td colspan="3">UNDP-KMA Kumasi Low-Cost Human Waste Project focused mainly on resolving excreta management crisis.</td></tr>
<tr><td>Are small-bore sewers included in national standards?</td><td colspan="3">Simplified sewerage not part of standard options of the then Ghana Water and Sewerage Corporation. Currently simplified sewerage is recommended, as option in National Environmental Sanitation Strategy and Action Plan (MLGRD, 2010)</td></tr>
<tr><td rowspan="5">Actor behind the choice</td><td>Contracting authority</td><td colspan="3">City authority adopted simplified options based on WTP, technology review and financing options studies. Provision of matching grant of up to 40% of capital costs prompted Kumasi Metropolitan Assembly (KMA) in choice of lowest evaluated technology’s cost option.</td></tr>
<tr><td>Local NGO</td><td colspan="3"></td></tr>
<tr><td>Development partner</td><td colspan="3">UNDP/World Bank Regional Water and Sanitation Group provided technical assistance in analysis and recommendations of options</td></tr>
<tr><td>Users</td><td colspan="3"></td></tr>
<tr><td>Private promoter</td><td colspan="3"></td></tr>
<tr><td>Preliminary studies that guided the choice</td><td>Topographic and hydro-geological analysis</td><td colspan="3">City wide sub-soil investigations for determining percolation rates and mapping of percolation zones (locate percolation zones map?)</td></tr>
</table>

		Technical diagnostic of existing equipment and facilities	Technology Review Report (Asafo Boakye and Partners, WB-RWSG, 1990), Feasibility Report on Kumasi Sanitation Project.		
		'Stakeholder' diagnostic and institutional analysis (capacities)	WTP for Imprpoved Household Sanitation in Kumasi (Dale Whittington, Donal Lauria et al, 1991). Institutional Analysis of KMA Technical Departments led to creation of Waste Management Department with Metropolitan Engineers Department responsible for implementation of project.		
		Demand assessment	WTP and demand assessment		
		Economic and financial assessment	Technology review and Cost-Benefit analysis of technology options (1990 costs); *to be converted to US$ and current costs*)	NPVs (Asafo Pilot)	
				Simplified	¢463,735,506.00
				Conventional	¢622,451,066.00
				Small Bore	¢889,225,397.00
		Territorial diagnostic and urban planning and population outlook	Housing and Population Census (1984) data analysis projections carried out as part of studies; mapping of sub-metropolitan areas and sanitation planning areas		
		For how long? And what is the scalability of the solution?	Planning horizon of 15 – 20 years adopted; simplified sewerage targeted at tenement areas of Kumasi, land requirements is challenging (possible constraint) for installation of waste stabilization ponds as simplest treatment option in extending to other proposed tenement areas (Aboabo No.1 & 2, Dichemso, Ashanti Newton, Fanti Newtown)		
In what context has the small-bore sewer system been implemented?	Physical context	Gradient	General undulating nature of Kumasi (rapid run-off of storm water) amenable to gravity flow of sewers; Pilot Asafo area is well draining with good gradients (average slopes of…%)		
		Soil type	Percolation studies identified areas of poor percolation for sewerage		
		Proximity to a water table	Low water table in high areas; flood plain areas of high water table employed for waste stabilization ponds.		
		Proximity to a river or the coast	Waste stabilization ponds located along Subin river (channel)		
		Other?			
	Urban morphology and land tenure context	Density of buildings (on-site solutions / pipe-laying possible or not?)	High housing and population density; well laid out alleys and pavement allow laying of sewers at shallow depths and in "condominial" fashion. (*check sheet on housing characteristics and population for sanitation planning areas*)		
		Road network (straight or winding, major road links or narrow streets, etc.)	Straight paved major roads and arterial streets abutting properties		
		Presence of public institutions or similar	Land tenure management in Kumasi is uniquely managed by the Asantehene's Land Administration Office (Asantehene is the King of Ashanti who owns all lands apart from government designated lands?)		
		Multi-storey housing	Sanitation Planning areas categorized areas with mostly multi-story buildings as *tenement* areas		
		Land tenure status of the area to be covered: planned / unplanned	Asafo is planned old section of the city of Kumasi		

		settlements, in the process of being regularized	
	Urban and demographic processes	Urban development, expansion and urban structure projections	Provide figures from SSP-Kumasi
		Coherence with on-going urban planning processes (land, real estate, other basic services, etc.)	Tenement areas within old sections of city. Laid sewers across newly developed bus terminals caused problems and required rectification.
	User demand	Users' level of income	WTP
		Capacity-to-pay	Check financing options study
		Status of occupants: owners or tenants	Tenants (85%); *refer to studies*
		Existing sanitation solutions	Public toilets; connection rate > 85%
		Water consumption/day/inhabitant	60 liters per caput
		Discharge/day/household	45 lcp
		Future water consumption and wastewater discharge projections	
		Demand for a service requiring regular in-home maintenance	Grease-trap maintenance by householders
		Demand for a service requiring user involvement in its management	
		Demand for a service where the costs are not controlled by the user	What are the rates applied? Are these determined by users or city? The rates are determined by the city authority through annual fee-fixing resolutions. *Check for current gazzeted fees and rates*
		Willingness-to-pay	
	Demand from the authority responsible	Sanitation comes under its remit, in accordance with the regulatory framework in force	KMA-WMD; LI1962
		Integrated into a sanitation planning approach	KMA-WMD outcome of major institutional restructuring
		Aware of the inherent constraints of small-bore sewers and of its responsibilities	
	Financial resources	Small-bore sewer investment costs	
		Local capacities for financing the investment	
		Operating costs	
		Local capacities for financing operations	KMA capable

Part II. How to design, implement and sustainably manage small-bore sewers?			
How was the small-bore sewer system designed?	Technical choices and facilities' design	Option chosen for the network	Simplified sewer with collector lines in back-alleys and pavements
		Definition of the area to the covered and the route	Sanitation planning areas and
		Technical choices	Technology review and feasibility studies
		Others (to be defined)	Economic analysis to determine net present value ad per capita costs to enable comparison to affordability and WTP
	Investment costs and funding sources	Investment costs	Technology review including financing options study (see above)
		Funding sources mobilized	UNDP (60%), GoG/KMA (40%)
		What does the user pay and what tools are used to finance the connection?	Connection fees estimated for each dwelling. Outright full payment by households for connection.
	Service operating costs	The different items to be financed, renewals, management cost estimates and the allocation of operating costs	Estimated in the Contract with Management Contractor
	Cost recovery and pricing		Fixing of fees implemented by KMA annual fee-fixing resolution which is not based on detailed analysis of items of operation and maintenance specified in contract. Contractor's personnel indicated high default rates of between 40-50% and untimely payment by households. Almost all households interviewed on-spot indicated knowledge of fees and were not aversive.

How was it implemented?	User-targeted activities	Demand stimulation (=social marketing)	WTP
		Good practices for using and maintaining household facilities	Education of households on maintenance of grease traps and point of receiving complaints – previously at offices of KMA-WMD currently at Contractor's Kiosk in Asafo,
		What the sanitation tax is used for and why it is necessary to pay this regularly	No sanitation tax. Households pay tiered tariff – single storey GH¢3 per month; 2-storey GH 5¢.00; 3-Story – GH¢7.00, paid quarterly.
		Good hygiene practices	
	Construction works	Works monitoring schedule	Contracted Consultant and Construction Company responsible for works and project overight by KMA with technical assistance from UNDP-WB- RWSG
		Pipe construction	
		Pipe-laying	
		Construction of the treatment plant	
		Quality control	
		User involvement	Household surveys and education on construction and use of "way-leaves" for laying of sewer pipes
		Other (to be defined)	
How is it managed?	Care and maintenance	Risks	Multi-tenanted dwellings have challenges of duty of care by individual households a phenomenon not attributable to simplified sewerage alone. In some instances non-agreement in paying of water tariffs compel individual households to fetch water outside the premises and resort to use of public toilets. Houses in proximity of public toilets also resort to use of these as "preferred choice" in some cases because of non-sharing of privy rooms by landlords and "room-lords"; Generally collector sewers that have experienced rampant blockages have been identified to receive flows from hostels used by students. A case was reported of blockage within in-house plumbing owing to use of sanitary pads. Main risk of maintenance of anaerobic ponds requiring the use of drag-line (or long-arm excavator) for scooping of very viscous sludge every 5 years.
		Maintenance of household solutions	Households generally aware of need for maintenance of grease traps, particularly older residents of Asafo. New (less than 4 years) residents generally not aware of

			location of grease traps. Major blockages of collector sewers in alleys carried out by contractor
		Preventive network maintenance	Preventive maintenance (e.g. flushing of sewers) carried out by contractor with assistance from KMA-WMD
		Corrective network maintenance	Remedial collector and trunk sewer maintenance carried out by contractor and paid by KMA. Contractor submits works estimates for payment by KMA
		Plant maintenance	NIL
	Monitoring & control mechanism	Technical controls	Not observed controls of technical norms
		Financial monitoring	Financial monitoring is poorly managed currently with no indicative benchmarking of costs of O&M items; default levels of households are as high as 40%; reported default after court sanctions and imposed penalties have been defiantly ignored by a number of prosecuted property “owners”=”caretakers”
		User satisfaction	On-the-spot interviews of householders indicated general “satisfactory” use of facilities
		What post-project monitoring is undertaken by the organization in charge of supporting the activity?	
	Regulation	Dialogue between actors/conflict resolution	Public Health Department
		Capacity of the contracting authority to enforce corrective measures (control)	Use of Demand Notices and legal sanctioning at KMA Sanitation Court after 6-months default in payment; poor performance monitoring by KMA of Contractor operation and maintenance schedule

By which actors and with which skills?	Organizational choices and roles and responsibilities of each actor	Contracting authority for the service	KMA-WMD; Overall monitoring and payment of major O&M costs: desludging of Anaerobic ponds carried out at approximately 5-year intervals; repair of blockages of collector and trunk sewers; replacement of manhole covers in general areas (out-of-premises)
		Technical supervision	KMA-WMD
		Operations	Contractor (technicians with plumbing skills)
		Monitoring	KMA-WMD/Contractor
		Outsourced services	Contractor has out-sourced collection of fees from households
		Contract agreements	Prepared by KMA-WMD; last reviewed in 2005?
	Capacities	Technical capacities (design and sizing)	Local Consultants
		Capacities for carrying out the work	Local contractors
		Social engineering capacities	KMA-WMD community mobilization, Public Health Department, Local consultants, NGOs
		Monitoring capacities	KMA-WMD
		Financial management and cost recovery capacities	Local consultants for detailed financial analysis and modeling
		Care and maintenance capacities	Contractor (techicians with plumbing skills)
	Skills/capacity-building for the actors responsible for system design, implementation and management	What capacity-building approach is required?	*Design and O&M* :Training Workshops on sewer design, O&M management and development of manual of sewerage O&M management; field/exchange visits of city technical, financial and administrative personnel to other cities with successful implementation to study best practice options in management and financial models applied e.g. Brazil *Community mobilization*: Training of local staff (KMA-WMD/Public Health Department) in surveys and environmental sanitation assessment and audits; field visits to good practice projects on community participation and management.
		Who can provide this?	Sewer design and O&M by local consultants and international consultants (e.g. Brazil)
		At what cost?	Variable cost depending on module (aspects of training), duration and location

List of Background Documents Reviewed

1. Financial Arrangements for home latrine delivery and sewerage management under the SSP-Kumasi George Akosa and J. Owusu-Akyaw, August 1991.

2. Kumasi Sanitation Financing Options Study J. Owusu-Akyaw and Mbanefo, October 1989

3. Kumasi Sanitation Project, Technology Review, Final Report, Volume I (Draft Final) and Appendices and Drawings by Asafo Boakye and Partners. October 1990

4. Kumasi Metropolitan Assembly, Kumasi Sanitation Project (GHA/87/016) Detailed Design of Simplified Sewerage System for Asafo Area of Kumasi, ABP, May 1991.

5. Kumasi Sanitation Project, Asafo Pilot Sewerage Scheme. Supplementary Information: Soil Profile and Site Investigations Report for Waste Stabilization Ponds, Operation and Maintenance Requirements for the Pilot Sewerage Scheme, Redesign Calculation and Cost Estimates for Waste Stabilization Ponds. UNDP/World Bank RWSG, ABP. July 1991.

6. Workshop on the Dissemination of Lessons Learned from the Kumasi Sanitation Project. Review of Sanitation Technologies for the Project. Presentation by E.A. Kuma, ABP. January 1992.

7. Household Demand for Improved Sanitation Services: A Case Study of Kumasi, Ghana by Dale Whittington, Donald T. Lauria, Albert M. Wright, Kyeongae Choe, Jeffrey A. Hughes, and Venkateswarlu Swama. UNDP/World Bank Water and Sanitation Program, 1992

8. Kumasi Metropolitan Assembly: Draft Strategic Sanitation Plan for Kumasi, January 1993

9. GHA/87/016 Terminal Report, Low Cost Human Wastes Management Project. Project Findings and Recommendations, Draft Report by UNDP and UNDP/World Bank Water and Sanitation Programme, Abidjan, 1994.