



## Sewerage maintenance management in Ghana

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GHANA IS SITUATED in sub-Saharan Africa surrounded. About half of Ghana's total GDP is non-agricultural, in industry and services; these largely urban based sectors of the national economy has been the most dynamic in recent years. Comparative country data show that economic development and urban growth are closely linked. About one-third of Ghana's population urbanised and per capita incomes are consistently higher in urban areas, and urbanization increases with economic growth more rapidly at lower income levels than at higher ones.

Deficient urban services — water supply, sanitation, urban roads, and others — is a major constraint on urban productivity in Ghana. Mobilizing more public and private capital for investment in urban infrastructure is a major need, along with using financial and institutional resources more efficiently. The huge gap between investment requirements and actual funds likely to be available highlights the tremendous importance of **(i) cost recovery through beneficiary contributions and local taxes and (ii) use of appropriate design standards supplemented with cost-effective operation and maintenance management strategies.**

**Tema:** is Ghana's primary port, handling about three quarters of all goods shipment. Tema also houses a bulk of heavy industries including refinery, boat building, cement production, the smelting of aluminium and steel and the production of iron rods and metal fittings for the construction industry.

Tema is the only city developed from the cradle by government and thus have planned infrastructure. It is also the only city in Ghana with a comprehensive sewerage system. Inadequate provision of maintenance, however, led to the deterioration of the system with discharge of sewage into drains and water courses. The system has been rehabilitated recently under an IDA-supported Urban II project with the provision of a new treatment facility — aerated lagoons.

**Kumasi:** is located 300km northwest of Accra, the second largest city in Ghana and the capital of the Ashanti Region. The metropolitan area covers 150km<sup>2</sup>. Kumasi has been the cross-roads between the northern and southern sections of Ghana since its establishment as the heart of the Ashanti Empire around the turn of the eighteenth century. The city is now a budding industrial centre with formal industries in timber, food processing (including beer brewing) and soap manufacturing, together with informal activities in woodworking, light engineering, vehicle repair, footwear, furniture manufacture and metal fabrication.

Kumasi has a unique housing pattern with well defined contiguous sectors. This feature lends itself to dividing the city into sanitation planning areas on the basis of predominant housing characteristics and spatial continuity.

The simplified sewerage system in Asafo, Kumasi is located within a tenement area. These areas have the following basic features: (high density), most residences are in 2-3 story buildings having 20-30 rooms shared by 10-20 families (40-100 persons). Plot sizes are about 30 m by 30 m and houses tend to be built to the edge of the property and have a central courtyard. Population densities in the tenement area are between 300 to 600 persons/hectare.

### Evaluation of sewerage systems - Accra, Kumasi and Tema

Table 2 list sewerage schemes identified in the cities of Accra (capital city of Ghana), Kumasi and Tema. All the systems were constructed employing conventional principles and all, apart from the very new Asafo system, and packaged plants (Labadi Beach Hotel and Golden Tulip Hotel), are malfunctional to varying degrees.

#### Current operational practices - Tema and Kumasi

The Ghana Water and Sewerage Corporation by Act 310, 1965 is the agency with legal responsibility for sewerage in Ghana. However, with decentralisation Metropolitan and Municipal Assemblies will want to assume more and more responsibility for sewerage management ; Establishment Instruments of Metropolitan Assemblies enjoins them to construct and maintain sewerages.

**Tema:** a survey was carried out in late 1994 to ascertain the state of the Tema sewerage system and identify main problems. The system is under a very poor state of repair mainly due to lack of programmed maintenance. Currently the Tema Metropolitan Assembly (TMA), operates and maintains the sewerage system, after rehabilitation works.

Three distinct catchments drain to different pumping stations which have emergency overflows from their wetwells into local water courses. Two of the pumping stations work sporadically due to pump maintenance difficulties and the emergency overflows become the main outlet from the pump stations. The third pumping station, which mainly serves the industrial area catchment is non-operational due to theft and vandalism and

the sewage flow is discharged directly into a surface stream. In practice around 95 per cent of the sewers suffer from sand depositions. Approximately 40 per cent of these pipes suffer a loss of cross-sectional area greater than 50 per cent. Thus at least half of the original flow capacity has been lost in these pipes; and consequently the so called “ self-cleansing velocity” or “minimum tractive force” is not achieved and further deposition occurs.

Blockages (caused by use of bulky anal cleansing material) can take between 8 and 20 weeks to clear from the moment they are identified and backflows or emergence of sewage from inspection chambers either into surface water drains has become conveyance units of the sewerage system. Due to a large backlog of work, complaints to the TMA are not attended to systematically.

A recent rehabilitation included the repair and retrofitting of the three pumping stations, sections of sewers and the construction of aerated lagoons and new outfall. The TMA is in the process of procuring of private operators for operation and maintenance management.

**Asafo simplified sewerage :**

Simplified (or shallow) sewerage was identified as the least cost option for the Asafo tenement area — the initial capital outlay were lower compared to conventional and small-bore sewerage. The system has a waste stabilisation pond for sewage treatment.

Simplified (shallow) sewerage is appropriate for high population density areas. In Asafo shallow sewers work because:

- the location of kitchens, bathrooms, privy rooms and yard taps ensure that all household wastewater - excreta, toilet flush water and sullage are intercepted easily;
- facilities for ablution are generally laid at the back of the tenement buildings and hence sewer pipe lengths for house connections are shortened;
- smaller diameter pipes are used (100mm - house connections; 150mm Block sewers, 300mm-trunk sewers to waste stabilization ponds).
- transport of deposited solids by tractive force is enhanced;

- the tenement houses are re positioned rear-to-rear in a block and allow only pedestrian and light-weight vehicular traffic (eg. motorcycles) hence sewers were laid in shallow trenches since imposed loads are low - a minimum level of cover of 0.5 m in non-trafficked areas and 1.0 m below trafficked areas were used;
- as few of the sewer lines traversed under heavily trafficked streets within Asafo proper, the above depths of cover were sufficient in conjunction with PVC pipes. PVC pipes offer the advantage of longer lengths, and so few joints and thus avoid poorly made joints to initiate blocking;
- the high population per dwelling in Asafo (average 63 persons) induce high frequency of flush volumes and achieve the successive waves of wastewater which provide adequate traction along the length of the sewers;
- the gently sloping nature of the Asafo area plus the high frequency of generation of waves of wastewater allowed the laying of small diameter sewers at flat gradients without pumping to the waste stabilization pond system;
- the provision of simple grit/grease traps behind kitchens eliminates bulky materials and ensure that households provide the first-step routine maintenance by removing trapped grit ;
- expensive manholes which contribute up to a third of conventional sewerage costs are replaced with shallow “ simplified” inspection chambers (boxes).

**Proposed responsive operation and maintenance management strategy**

Maintenance management procedures for sewerage systems and its attendant allocation of costs have been identified as one of the factors which has influenced unsustained use of such systems in Ghana. As shown in Table 2 the dependence on central government agencies and institutions has contributed to the current state of most sewerage systems. The Asafo simplified sewerage system require little maintenance; routine removal of grit and grease from traps and rare removal of blockages from house connection chambers are passed on to households. However, the long term sustained performance of the whole sewerage system require that a responsive operation and maintenance management scheme be put in place.

The following propositions seek to ensure this:

- responsibility of operating and maintaining of the system will be vested in the Kumasi Metropolitan Assembly-Waste Management Department (KMA-WMD);
- the Asafo Community will be entrusted with the maintenance of house connections and block sewers;
- the KMA-WMD will be responsible for external street sewers and the waste stabilization pond system;

<p><b>Table 1. Comparative initial investment costs for the Asafo Tenement Area, Kumasi Ghana</b></p>
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- the KMA with powers conferred on it by the Local Government Act 462, 1993 and Establishment Instrument LI 1614, will pass bye-laws reinforcing the declaration of the Asafo Tenement Sewerage Connection Area;
- the KMA-WMD will depend on GWSC's capability to apply sanctions (service disconnection for non-payment of tariffs) and seek a water-consumption-indexed sewerage fee (lower than GWSC's 30 per cent of water bill) to be applied in the Connection Area;
- a private contractor will be employed to offer sewerage operation and maintenance (including the treatment facility) and also for collection of a single Water/Sewerage Bill.

### **Water tariff policy, incident household costs and house connections**

A number of significant issues concerning the Asafo system have come to the fore in the recent past. The Pilot Asafo Sewerage Scheme which was commissioned barely 2½ years ago received media attention due to slopes and embankments being overgrown with wild grass and the facultative and maturation ponds engulfed with macrophytic plants. Apparently, the problem or lack of any "maintenance culture" to provide for sustainable O&M management seem not to have changed since the construction of the oxidation ponds to serve KATH in 1966. However, the ownership and maintenance management of the system by the city authority (KMA) has changed and the response of the city seem to support government's direction of devolution of irresponsibilities to centres of immediate impact.

The KMA responded to the foregoing by signing a Maintenance Services Contract with a contractor in since October 1996. At this stage, that only a third of the projected 320 houses in Asafo have connected to the system, the city authority may have to pay for maintenance of the system for the next two years or so. Obviously, a more responsive and sustainable Operation and maintenance arrangement should involve beneficiaries paying for O&M costs.

A careful appraisal of the Asafo area seem to suggest that water tariffing policy may influence households' willingness to connect to sewerage systems, and their ability to pay for additional sewer tariffs especially where a "let's wait and see whether it would work" attitude is adopted. Households connected to the system have noticed a jump in water bills in the order of magnitudes not expected.

The example of Asafo, Kumasi may not be a unique case and serves to illustrate problems of water tariff structure and the implications regarding management of sewerage systems.

### **The Pilot Asafo Franchise Water and Sewerage Management Scheme**

As the first of its kind in the sub-region (indeed in Africa) and the typical conditions of low-income high density areas of developing countries, the Asafo sewerage scheme has to be studied carefully to provide dissemination material for practitioners in the field. To achieve this, the following issues have come up on field interviews, interactions with public officials and study of sample water bills by the author:

- the KMA-WMD and GWSC should jointly institute the above pilot project for sewerage maintenance and water tariff collection;
- a private contractor will be employed to offer sewerage operation and maintenance and also for collection of a single Water/Sewerage Bill for the Connection Area. The GWSC shall receive its full fee on water plus a portion of the sewerage tariff in lieu of administration charges;
- the contractor shall be paid by the KMA-WMD on a negotiated contract fee plus a commission for above 85 per cent collection; the KMA-WMD shall retain the surplus from the sewerage tariff in an Asafo Sewerage Improvement Fund for trunk sewer and waste stabilization pond maintenance including periodic desludging of anaerobic ponds.

### **The effects of water and sewer pricing on user costs**

The Asafo tenement area of Kumasi depicts inequity in the rate form applied by the Ghana Water and Sewerage Corporation (GWSC). The GWSC employs the **Increasing Block** rate structure in which case - the price per unit increases by steps with the amount purchased. There is an incentive to conserve water as use increases and the GWSC offers "Lifeline" rates for minimum consumption (less than 3,000 litres per month at ₵2,431.00). BUT this particular kind of rate form indicates how "the poor in their great numbers pay more for the rich in their less numbers who pay less".

The number of households per dwelling is so high in Asafo that metered premises fall in ranges higher than normal for residential properties. A water-tariff-indexed Sewerage Fee of 35 per cent (proposed by GWSC) will add more to the cost per household in places like Asafo. Indeed, households who have connected are in effect paying about 4 - 6 times more than those in high cost areas of Kumasi.

One solution to this inequity is the demarcation of tenement buildings into metered sections so as reduce total consumption and hence reduce rates. However, the monthly rent for metres may not bring about any meaningful savings.

It may be necessary to investigate the effects of different rate structures as part of the proposed pilot project. The economies of scale offered by larger water usage tenement households make such premises candidates for lower rates. In effect the implementation of a **Declining Block** rate structure (with a cut-off point) which is opposite to current GWSC rate policy is what may be equitable for residents in Tenement Areas like Asafo.

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Figure 1.