Anthropogenic Impacts on Flow Regime and Water Quality of Ngong River in Nairobi

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ABSTRACT

Water resource management involves the monitoring and management of water quality and water quantity. This research project was designed after several extensive case studies that revealed lack of adequate information on interaction between water quantity and quality of Ngong River. Many of those research investigations indicate that the river is highly polluted and almost no information about water quantity is presented.

This report is compiled based on water quality and water level data collected from five flow measuring stations set up along the Ngong River and four sewer stations for a period of 5 months (July to December, 2006). The stations namely: Kibera, Nairobi Dam Outlet, Mombasa Road crossing, Outering Road crossing and Njiru Bridge. The sewer stations were located at Kibera, Enterprise road, Imara Daima and Outering Road. Water levels were determined daily for a period of five months and the data was converted into discharge by use of Manning's equation. Daily rainfall data was collected and the SCS Curve number method was used to estimate direct runoff depths within Ngong river basin.Water quality assessment was done for a wide range of physical and chemical water quality parameters. Microsoft Excel and SPSS version 10 software were used for statistical analysis. Results were screened against NEMA, FAO and WHO standards, and were compared across the five sampling stations in the dry and wet seasons to assess suitability for domestic and irrigation use.

Flow in the Ngong River increases downstream with the lowest average flow rates experienced at the Kibera ($0.090 m^3/s$) and Nairobi Dam outlet ($0.856\ m^3/s$) stations.

Mombasa Road station had an average flow of 5.452 m^3/s. Higher flows were recorded downstream at Outering Road (6.283 m^3/s) and Njiru (7.003 m^3/s) stations.

Direct runoff contribution from areas above Kibera and Nairobi Dam Outlet station was 7% and 78%, of the measured water yields, respectively. Water yields at the downstream stations is contributed by other sources other than direct runoff which

were identified as extra water from wastewater discharges of overflowing manholes and open drains, and stormwater runoff.

The highest pollutant concentrations found in Ngong river water were heavy metals (lead and cadmium), nitrate and residues (suspended and dissolved solids). There were reduced levels of EC, Nitrates, TSS and TDS during the wet weather whilst increasing levels of lead and cadmium reported. Lead values increased in the wet season ranging from 0.39-0.46mg/l. The heavy metal levels recorded at all stations were below the FAO guidelines for irrigation water - 5mg/l for lead and 0.5mg/l for Cadmium. Sewer water contaminant loading of TSS and TDS were found to be decreasing during the wet weather. BOD_5 values of these sewers waters were high ranging from 103-500mg/l. These high values are above the NEMA effluent discharge standard which allows for only treated wastewaters to be discharged in water courses. Heavy metal levels increased during the wet season with lead values ranging from 0.39-0.44mg/l and cadmium values ranging from 0.08-0.12mg/l.

Downstream river stations recorded increased levels of water quality parameters against constant discharge rates implying that Ngong River cannot sustain its assimilative capacity as it is heavily polluted. Ngong River at Kibera station can be described as

adequate since water sampled complied with WHO and NEMA standards for most parameters except for Nitrates. According to FAO irrigation water standards, Ngong River is fit for irrigation however this should be cautioned due to the long-term effects on the soils and crops. Frequent water quality monitoring programs combined with the enforcement of NEMA criteria and guidelines on effluent discharges, improvement of sewer infrastructure, protection of riparian areas, control of direct waste discharges, decreasing surface run-off distances and, the creation of pervious areas for increased infiltration, can be adopted to restore the hydrological system of the Ngong River.