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Pollution profile of Thika River

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1. INTRODUCTION

Water resources planning and management, the world over, is increasingly concerned with water quality and hence control of pollution levels in the major and minor water bodies. Kenya is not blessed with many large rivers that would support industrial development, hence it is pertinent to focus attention on monitoring the status of the few major rivers that are potential water sources and also carriers of waste discharges. Among such major rivers are the Thika, Tana, Kuja, Migori, Nzoia, Yala and Nyando. The Water Pollution Control Division of the Ministry of Water Development has set up a water quality monitoring network for these main rivers, however, very often, efforts are only intensified when a particular river is identified for a specific water supply project. In this respect the Chania-Thika River system has been a candidate of increased monitoring activity because the system supplies water to both Nairobi and Thika towns which are major industrial centres.

2. RIVER QUALITY STANDARDS

Although river quality standards vary a great deal depending on the stream in question they are basically set up as an attempt to either save already polluted rivers or/and as a precaution to safeguard pollution free rivers. The two main approaches that have been used in setting up the standards are specification of either the effluent standards to be met before discharging into a stream or grading of streams in terms of their existing status depending on their beneficial use.

Effluent standards have tended to be less generalized than stream standards, instead they have been more related to the nature of the specific industry seeking authority to discharge into a given stream. The WHO Report No.5 of 1973 has set out the preliminary stream standards to be applied under the Water Act, for adoption in Kenya until more specific standards are set for each of Kenya's rivers and streams. The general preliminary standards broadly cover aspects such as settleable materials that emanate from industrial or community activities, floating matter, oil, etc that may give rise to colour, odour, limiting the human or other legitimate uses of water. The specific standards deal with bacteriological, chemical and radioactive aspects of pollution.

3. THIKA RIVER

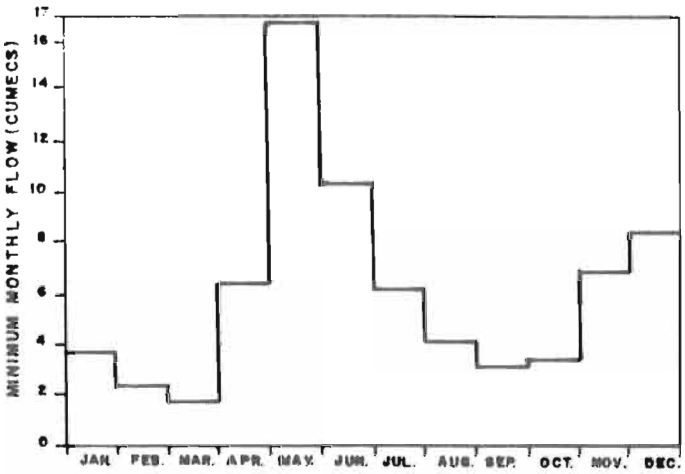
The catchment area under consideration is defined by the Thika River at RGS 4CB4 and Chania river at RGS 4CA2, the Thika river basin extending for 518km^2. Both rivers originate from the Aberdare Mountains and flow in a south east direction towards Thika town. The length of the main streams from the rainfall gauging stations are about 59km and 70km for the Thika and Chania rivers respectively.

The Thika and Chania rivers provide water for domestic as well as for irrigation purposes. Nairobi draws 80% of its water from the Chania catchment where most of this water is abstracted directly from Sasumua reservoir in the Chania headwaters. Thika Municipality draws its water from the Chania river above its confluence with the Thika river. As the rivers approach Thika town, they pass through coffee plantations which use their waters for irrigation. Pollution signs of the rivers at this phase are primarily due to coffee wastes emanating from discharges by the several coffee processing factories associated with the extensive coffee plantations.

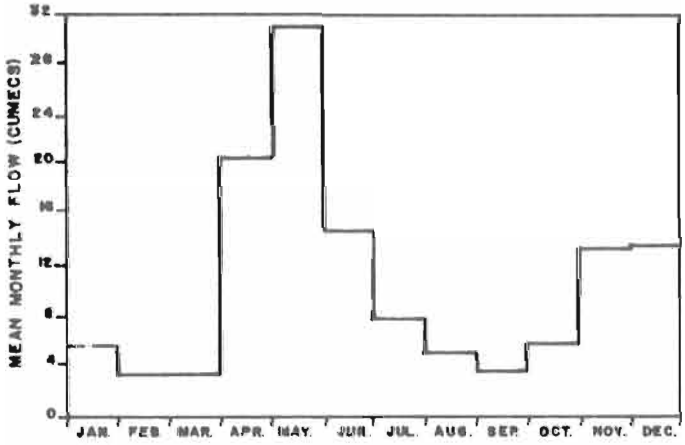
As the Thika river flows through the town it receives a large amount of wastewater discharges from the many industries which have been established within the past 15-20 years (see fig. 2 for location of industries).

4. RIVER FLOW PATTERNS

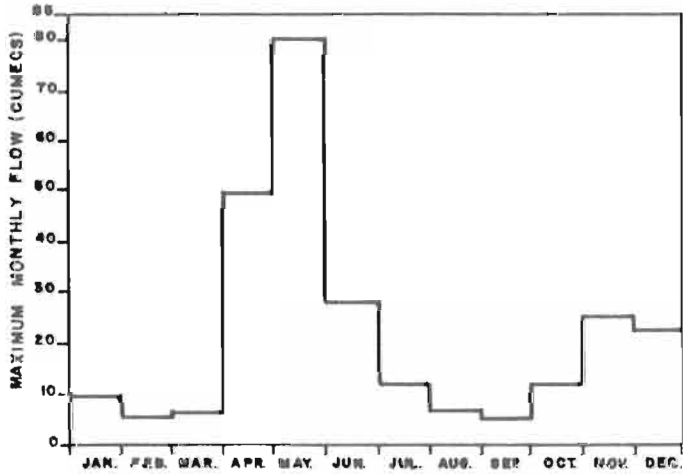
To establish the river's capacity to cope with the pollution load at different times of the year it was important to assess its seasonal flow variations. The flow patterns for minimum, mean and maximum flows over the period 1950-1990 are shown in figure 1. Since there is no gauging station at the confluence of the Thika and Chania rivers data was taken for Chania river at RGS 4CA2 and Thika river at RGS 4CB4 and



(a) VARIATION OF MINIMUM MONTHLY FLOW OVER THE PERIOD 1950--1990



(b) VARIATION OF MEAN MONTHLY FLOW OVER THE PERIOD 1950 – 1990



(c) VARIATION OF MAXIMUM MONTHLY FLOW OVER THE PERIOD 1950 – 1990

FIG. 1: THIKA RIVER - MEAN FLOWS

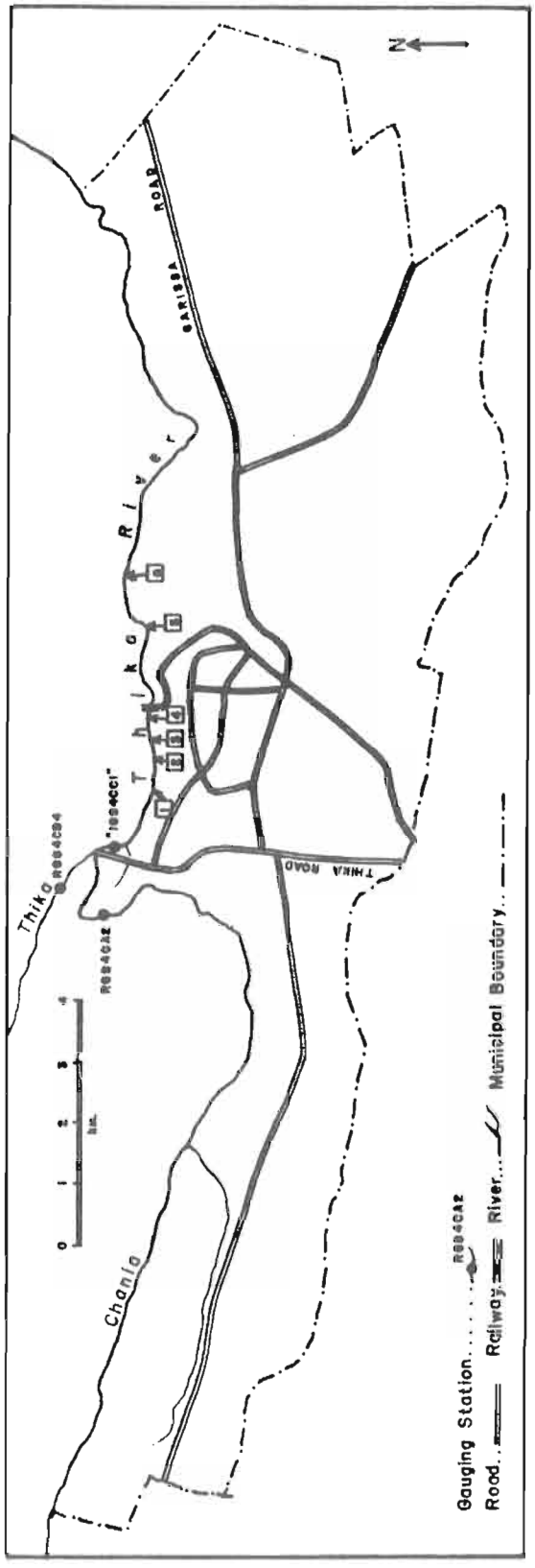


FIG. 2: LOCATION PLAN OF THIKA MUNICIPALITY

1. BULLEYS TANNERY
2. SYNTHETIC FIBRES OF KENYA
3. KENYA PAPER MILLS (LTD)
4. THIKA COTTON MILLS
5. DELMONTE (K) LTD. (CANNERY)
6. LEATHER INDUSTRIES OF KENYA

Table I : Monitoring results at peak flow

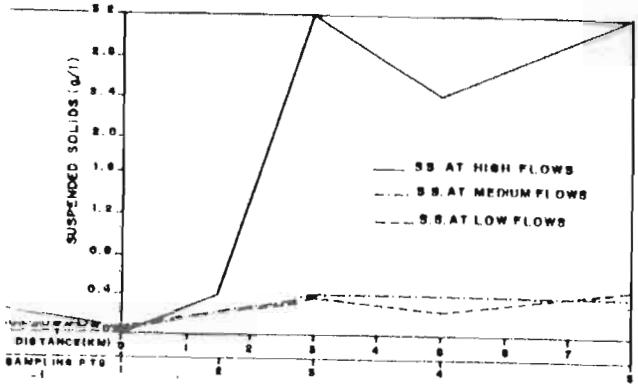
Parameter	Value obtained at sampling point				
	1	2	3	4	5
pH	7.6	7.6	7.4	7.4	7.4
Turbidy	50	50	60	55	50
Colour °	5	5	5	5	5
Suspended solids mg/l	20	400	3200	2400	3200
BOD5 mg/1	3	7	14	9	15
COD mg/1	12	16	24	16	34

Table II : Monitoring results at medium flow

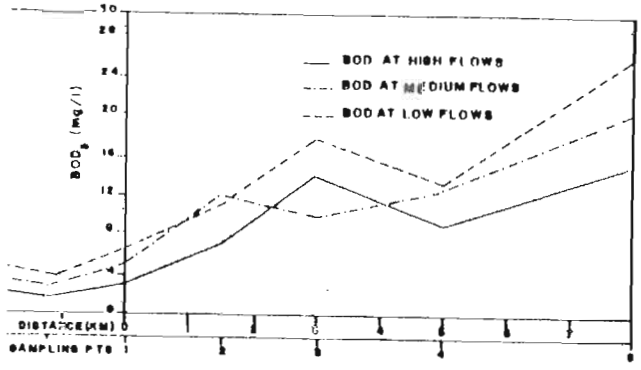
Parameter	Value obtained at sampling point				
	1	2	3	4	5
pH	7.3	7.2	7.2	7.2	7.2
Turbidy	50	50	55	50	60
Colour °	6	5	5	5	6
Suspended solids mg/l	40	200	400	400	400
BOD5 mg/1	5	12	10	12.6	20
COD mg/1	14	18	16	16	48

Table III: Monitoring results at low flow

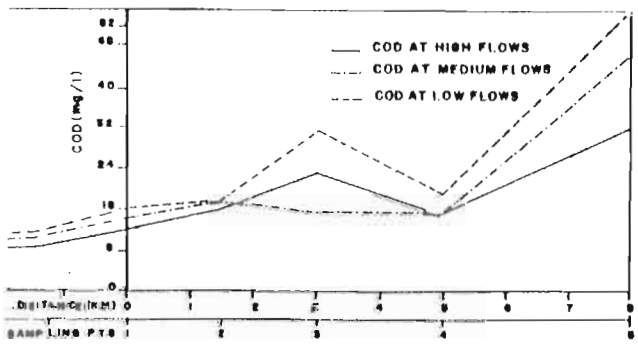
Parameter	Value obtained at sampling point				
	1	2	3	4	5
pH	7.1	7.1	7.1	7.1	7.1
Turbidy	45	45	45	45	50
Colour °	5	6	6	6	6
Suspended solids mg/l	80	200	360	240	480
BOD5 mg/1	6.5	11	17.7	13.3	27.7
COD mg/1	16	18	32	20	56



(a) SUSPENDED SOLIDS PROFILE



(b) BOD_5 PROFILE



(c) COD PROFILE

FIG. 3: RIVER POLLUTION PROFILE

combined into an imaginary gauging station IGS 4CCI established on the Thika river just above Thika town.

5. EFFLUENT LOADING PATTERN

A survey of the industrial establishments within the town shows a tremendous upsurge of activity within the past two decades perhaps because of its proximity to the capital city and also the excellent communication links with the same. The location of some of the major wastewater generating industries are shown in fig. 2 and their approximate discharge points along the river. One of the industries operates a wastewater treatment plant that was operating well at the time of study, 2 industries had overloaded treatment works while the rest had no treatment facilities at all.

6. SAMPLING POINTS AND TEST RESULTS

In order to investigate the changes in river water quality and hence obtain a quality profile it was necessary to choose sampling points governed by certain factors. It was important to know the conditions prior to the discharge point and some distance downstream of the discharge point. Following this procedure five sampling points covering a distance of about sixteen kilometers were chosen taking into consideration accessibility and convenience. The same sampling points were used over the year 1990 to take account of the seasonal variations of flow. The results are presented in tables I, II and III for the conditions of peak, medium and low flows respectively. Figure 3(a),(b)& (c) show plots of three of the above selected parameters to indicate the longitudinal pollution profile of the river over the considered distance with respect to these selected parameters.

7. DISCUSSION AND CONCLUSIONS

From the test results tabulated and the pollution profiles, the direct impact of wastes from industrial discharges from Thika town is clearly indicated. The low values of the chosen parameters above Bulley's Tannery are dramatically increased below the tannery discharge point. Between the tannery and the Textile mills there is a small reprieve as the river recovers. There is a marked increase again in the level of pollution all the way past the textile mills, the synthetic fibre mills to the discharge point of the Delmonte fruit canning industries, near Oloitiptip bridge. A small reprieve is again noticeable until the discharge point of the Leather Industries of Kenya.

Although the natural flow volume of Thika river is quite high (which accounts for the fair amount of dilutions it is capable of achieving) one does not wish to ignore the fact that most of the industries considered here are not in full production capacity yet, which means that even without the additional industries that will come up, the wastewater flow volumes will definitely increase. This will impose a bigger burden on the assimilative capacity of the river as the only available point of discharge of effluents. It is gratifying to note that some of the industries are investing in wastewater treatment plants for example Thika Cloth Mills, Leather Industries of Kenya and Delmonte Kenya Ltd. There is however, no room for relaxation in enforcement of the effluent standards that may have been set for the affected industries if the life of this river is to be preserved as a source of water for the developments planned downstream of the town notably the Yatta Furrow which supplies water to Kitui district and farm irrigation for coffee and fruit production.

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