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Determination Of WQI For Stormwater : A Case Study Of River Tapi

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Abstract

The River Tapi is one of the major rivers supporting agriculture and domestic usage. It also carries the discharged wastes. Since the latter is mismanaged and over exploited the river water needs constant monitoring for sustaining the quality. The water quality was determined through the following parameters:- pH, Turbidity, Total Alkalinity ,Total Solids , Total Dissolved Solids ,Total Suspended Solids, Dissolved Oxygen, Chemical Oxygen Demand, Biochemical Oxygen Demand, Chloride, Sulphate and Nitrate, Phosphate, Total Coliform and Fecal Coliform. All these parameters were considerably affected by the discharge of Stormwater outfalls. The present study has proven that discharge Outfalls Stormwater has heavy impact on the river. Discharge Stormwater Outfalls is relatively more polluted than the main river itself. Protection and management of the river systems is warranted.

Keywords- *Stormwater outfalls, Polluted water, Water quality standard, Water Quality Index, River Tapi*

I. INTRODUCTION

The quality of river water as determined by its physical and chemical constituents is of great importance in determining its suitability for a certain use such as public water supply, irrigation, industrial application etc. The detailed survey of river revealed that small areas as well as large areas which fall in the way of river, dump and toxic wastes in the river. Anthropogenic activities deterioration of water quality rendering serious environmental problems posing threat on human beings and sustaining biodiversity studied the impact of the industrial effluents and domestic sewage on river. Some of the pollution parameters are beyond the permissible limits and unfit for human consumption (RAI et. al., 2011).

II. OBJECTIVES

- To identify outfalls location discharging polluted water into the river.
- To determine characteristics of polluted water discharging to this outfalls.
- Determine the water quality index at identify location in order to facilitate the identification of emerging issues and future priorities.

III. Methodology

3.1. Study Area

Figure 3.1 Descriptions of Sampling Sites. (Causeway Upstream)

Table 3.1 Location With Longitudes and Latitudes of Sampling Sites

Sites No.	Description	Longitude	Latitude
U	Kholvad Flyover	72°57'6.56"E	21°16'56.35"N
S1	Bhada Village (SMC)	72°55'5.73"E	21°16'16.79"N
S2	Near Valak Kholvad Road	72°54'50.28"E	21°15'14.30"N
S3	Near Sarthana Treatment Plant	72°53'54.22"E	21°14'19.28"N
S4	Near Varachha Treatment Plant(SMC)	72°52'44.58"E	21°13'29.36"N
S5	Utran-Kapodra Bridge	72°51'58.04"E	21°13'16.32"N
S6	Amroli Bridge(SMC)	72°50'32.34"E	21°14'3.20"N
D	Causeway	72°48'13.25"E	21°13'11.53"N

3.2. Sampling Procedure

For sampling the procedure described in Standard Methods and IS 3025 was adopted. Samples were collected from six locations on three times per month. DO fixation was performed at location itself by adding Manganese Sulphate and Alkaline KI solution. Sterile 300 ml glass bottles were used to collect the sample for Total Coliform. For other physico – chemical parameters, samples were collected in 1 litre plastic bottles.

The collected surface water samples segmented as per two seasons for winter and summer during 2013.

3.3. Adopt Weighted Arithmetic Index method

Table 3.3 Grads Water Quality Index (WQI) and status of water quality

Water Quality Index Levels	Description
<50	Excellent
50-100	Good Water
100-200	Poor Water
200-300	Very Poor(Bad)Water
>300	Unsuitable(unfit)For Drinking

(Source: Ahmed I. et al 2012)

Table 3.5 An Example Calculation of WQI for the sample site Kholvad Flyover(U).

Parameter	Actual measured values	WQ standard value(si)	Relative Weight (Wi)	Quality Rating (Qi)	Weighted Values	
pH	**8.41**	**8.5**	**0.117**	**94.13**	**11.07**	
Turbidity (NTU)	**3.30**	**5**	**0.2**	**66**	**13.20**	
Alkalinity (mg/L)	**206.8**	**200**	**0.005**	**103.4**	**0.517**	
TS(mg/L)	**322.5**	**500**	**0.002**	**64.5**	**0.129**	
DO (mg/L)	**7.82**	**6**	**0.166**	**78.84**	**13.13**	
PO4 (mg/L)	**3.45**	**5**	**0.2**	**68.96**	**13.79**	
Sulphate (mg/L)	**16.95**	**200**	**0.005**	**8.476**	**0.042**	**WQI = ΣWi.Qi / ΣWi**
Chloride (mg/L)	**28.30**	**250**	**0.004**	**11.31**	**0.045**	
Nitrate (mg/L)	**1.46**	**20**	**0.05**	**7.316**	**0.365**	
FC (MPN/100)	**89**	**500**	**0.002**	**17.8**	**0.035**	
			ΣWi 0.752314		**ΣWi.Qi 52.3412**	**69.57**

$$W_{pH} = \frac{K}{S_n} = \frac{1}{8.5} = 0.1176$$

$$Q_{pH} = 100\left[\frac{V_{actual} - V_{ideal}}{S_{standard} - V_{ideal}}\right] = \left[\frac{8.41 - 7}{8.5 - 7}\right] = 94.13$$

$$\boldsymbol{WQI = \frac{\sum Wi.Qi}{\sum W_i} = \frac{52.34}{0.7523} = 69.57(Good\ Water)}$$

IV. RESULT ANALYSIS

4.1. WQI

Table 4.1 Calculated Water Quality Index

Sampling Location	WQI
S_1	**589.29**
S_2	**1079.31**
S_3	**648.25**
S_4	**485.39**
S_5	**867.64**
S_6	**264.07**

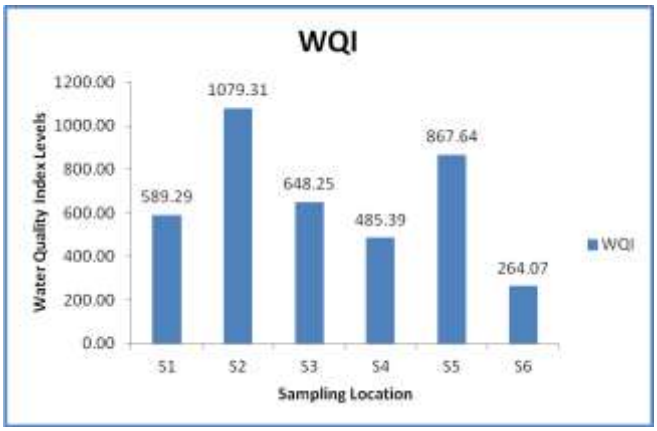

Figure 4.1 Different Location Water quality index of the Storm water outfalls

Table 4.2 Calculated Water Quality Index

Sampling Location	WQI
U (Kholvad Flyover)	**69.57**
D (Causeway)	**94.27**

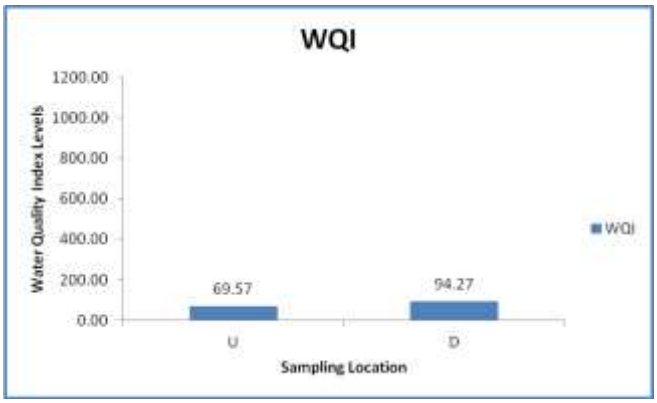

Figure 4.2 Different Location Water quality index Upstream and Downstream.

V. Conclusions

The study reveals that the water of the river tapi is deteriorated badly as a result of addition of Stormwater, urban wastewater, domestic sewage , which enters the river from outfalls of surat city. Direct discharge of human and animal waste not only imparts the quality of water but also affects the health of the people down stream of Surat city where the same water is used for washing, bathing and sometimes for drinking purposes. The stormwater and continuous dumping of waste materials affecting the water quality of river tapi .There is considerable need for better understanding of these small outfalls affecting river water so that they can be managed effectively. A comparative study of water samples of Storm water at different sampling stations by taking certain important parameters like pH, TS, TDS, TSS, dissolved oxygen, BOD,COD, phosphate, chloride, nitrate TC, FC,. The physicochemical analysis of storm water samples concluded that the water quality at all the sampling point is above the permissible limit which may affect to the water quality of Tapi River All these stormwater outfalls will make the water quality degarade and not acceptable for drinking as well as for other purposes.

The qualities of water and outfalls are compared Indian Standard and WHO guidelines. The sample stations are within 500 meter long upstream and 5 km downstream of the outfalls. The level of eutrophication in the river water. Affected by the domestic sewage discharged from Surat City, the waters discharge through the outfalls are seriously polluted by PO_4 and NO_3. The concentrations of BOD and COD organic material in outfalls are relatively higher than permissible limits and obvious adverse effects tapi river water. The concentration of PO_4 is very high. The outfalls waters have been seriously polluted. Comparing the river water quality and outfalls water quality. The waters of outfalls have the enough nutrients load, appropriate meteorological and hydrological condition for red tide. It is suggested that the risk of eutrophication and red tide may be reduced if domestic sewage of Surat city is denitrogenated and dephosphorized before discharged.

Water Quality index (WQI) of the present study for tapi river and outfalls was calculated from important various physiochemical parameters in order to evaluate the suitability of water for various purposes. The calculated WQI provides an easy way of understanding the overall water quality and water management. The water quality rating at more of the sampling sites clearly showed that the status of the water body in tapi river was degraded and unsuitable for the human uses during the period of study because it was not within the WHO standards and guidelines for drinking. It was also observed that the pollution load was relatively high by direct discharge outfalls. It has been concluded that discharging of domestic and industrial wastewater and also other anthropogenic activities were the main factors for contaminating tapi river water. However, there is need for regular monitoring of water quality in order to detect changes in physiochemical parameters concentration and convey it to the public through WQI.

From the result of this study, the levels of DO, BOD, COD, TDS and TSS were higher than india standard and WHO guideline regulatory limits for discharged of wastewater from outfalls into river. Hence, the discharged of this outfalls wastewater into river tapi would raise the levels of these contaminates thereby putting the river unsafe for usage by residence along the river and for farming activities. Based on the results obtained, the outfalls wastewater should be monitor strictly by relevant agencies in order to prevent environmental pollution and reduced health hazards caused by activities of outfalls wastewater.

The corporation authority of Surat city should take proper steps to control the pollutants at source and to treat the stormwater completely without any direct discharge into the water bodies. The city residents also should be more committed to maintain the quality of the river waters.

Future Work

- ✓ To identify the point sources of discharged pollutant in to the river tapi in order to aware and envisage the local authority toward careful management of water resources.
- ✓ To examine and evaluate the Stormwater quality of outfalls discharge in river tapi based on the Physiochemical characteristics and to identify the most serious pollutant parameters which caused alterations to ascertain the quality of river tapi water.
- ✓ To determine the Water Quality Index (WQI) by different methods.
- ✓ To study the feasibility of reuse of stormwater (in agriculture or recharge)

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