ACTION PLAN FOR RESTORATION OF POLLUTED RIVER STRETCH OF RIVER BRAHMANI AND GURADIH NALLAH

FOR POLLUTED RIVER STRETCHES OF

1. BRAHMANI (ROURKELA TO BIRITOLA)

2. GURADIH NALLAH (ALONG ROURKELA)

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WATER QUALITY MANAGEMENT PLAN- RIVER BRAHMANI ALONG ROURKELA STRETCH

Background

Water quality assessment of major rivers carried out by the State Pollution Control Board, Odisha under the project "National Water Quality Monitoring Programme" forms the basis for identification of polluted river stretches in the State of Odisha. The polluted river stretches are categorized under different priorities based on the BOD values as per Central Pollution Control Board (CPCB) classification. Based on BOD concentrations, CPCB has categorised the river stretches under five priorities. Monitoring locations with BOD concentration exceeding 30 mg/l has been categorized as Priority-I. Monitoring locations with BOD concentrations in the range 20-30 mg/l, 10-20 mg/l, 6-10 mg/l and 3-6 mg/l are categorized as Priority-II, Priority-III, Priority-IV and Priority-V respectively.

CPCB has identified the polluted river stretches in the country based on the water quality data during the period 2009-2012 and published in the Report "River stretches for restoration of Water Quality" (Series : MINARS/37/2014-15). Out of the 12 numbers of pollutedriver stretches identified in the State of Odisha, Rourkela stretch along Brahmani river is one of the polluted river stretch under priority category IV.

Further, CPCB has prepared another report in the year 2017 "Restoration of Polluted River Stretches-Concept and Plan-July, 2017" in which 18 numbers of river stretches of the State has been identified as polluted and Rourkela stretch is one of them.

The State Pollution Control Board, Odisha has been monitoring the water quality of Brahmani river from its origin in Odisha at Vedvyas to Pottamundai, before it joins with river Baitarani and named as Dhamra river. Based on the BOD values during the period 2009-2017, Brahmani river has been observed to be polluted along the Rourkela stretchunder priority category IV.

Rourkela city

Rourkela city is located at 84.54^{0}E longitude and 22.12^{0}N latitudein Sundargarh district of Odisha. The city is established on the bank of river Brahmani and river Koel. It is the third largest urban agglomeration in the state. It is situated about 340 kilometres north of the state capital Bhubaneswar. The city is also known as Ispat Nagar because of the establishment Rourkela Steel Plant, one of the largest steel plants of Steel Authority of India Limited (SAIL). The Koel river and Sankh river flowing fromJharkhnad state meet at Vedavyas near Rourkela and flow as Brahmani river. Rourkela city map is shown in Figure-1.

Population of Rourkela city

The Rourkela township is divided into two separate townships under Census of India as Steel township and Civil township. As of 2011 census, Rourkela had a population of 552,970 of which 210,412 are in steel township and 273,217 are in civil township.Due to its importance of industrial and trading activity, there are good number of floating population in the town.

Water supply

Water from Brahmani river and Koel river is supplied after treatment for domestic use. The existing water supply is from surface source with 77.8 MLD water treatment plant capacity. As the city is situated amidst a hilly region, the fluctuation of groundwater table is very high and the yield is very poor. The water table normally is 6-7m below ground level (bgl)and fall as low as 20m during non-monsoon season. The open wells and majority of hand pumps, tube wells dry up during monsoon. The yield of deep bore well is also quite low. Therefore, Rourkela city mainly depends upon river water for the domestic as well as industrial purposes.

Water Quality of rivers along Rourkela stretch

The State Pollution Control Board, Odisha monitors the water quality of river Brahmani at five stations and of its tributaries, that is,Sankh and Koelriver at one station on each river. Details of water quality monitoring stations are given in Table-1 and are shown in Fig.2.

Table-1 Details of water quality monitoring stations on Sank, Koel and Brahmani rivers

Sl. No.	River	Water quality Monitoring station	Justification of the Water quality Monitoring station	Longitude	Latitude
1	Sankh	Sankha U/s	Downstream of Mandira dam and before confluence with river Koel	$84^0$44’59.66”E	$22^0$14’58.08”N
2	Koel	Koel U/s	Before confluence with River Sankh and after wastewater discharge of Koelnagar	$84^0$50’27.99”E	$22^0$16’27.78”N
3	Brahmani	Panposh U/s at Vedavyas	Water quality before Industrial activity after confluence of Sankh and Koel	$84^0$47’57.19”E	$22^0$14’12.24”N
4	Brahmani	Panposh D/s at Deogan	Impact of industrial activities like Rourkela Steel Plant and domestic wastewater discharge from Rourkela city	$84^0$49’43.44”E	$22^0$12’04.98”N
5	Brahmani	Rourkela D/s at Jalda	To assess water quality improvement at further downstream of Rourkela city and identification of polluted stretch	$84^0$49’41.06”E	$22^0$10’54.96”N

6	Brahmani	Rourkela FD/s at Attaghat	-do-	$84^0$51’19.24”E	$22^0$09’02.82”N
7	Brahmani	Rourkela FD/s at Biritola	-do-	$84^0$53’52.10”E	$22^0$04’28.70”N

Status of water quality of the river has been assessed with respect to the criteria parameter Biochemical Oxygen Demand (BOD) and comparing the value with the tolerance limit laid down by CPCB for designated best use of surface water bodies. Based on the best use of the river stretch, these monitoring stations have been designated as Class C(drinking water source after conventional treatment followed by disinfection). Tolerance limit of BOD for class C is 3.0 mg/l or less.

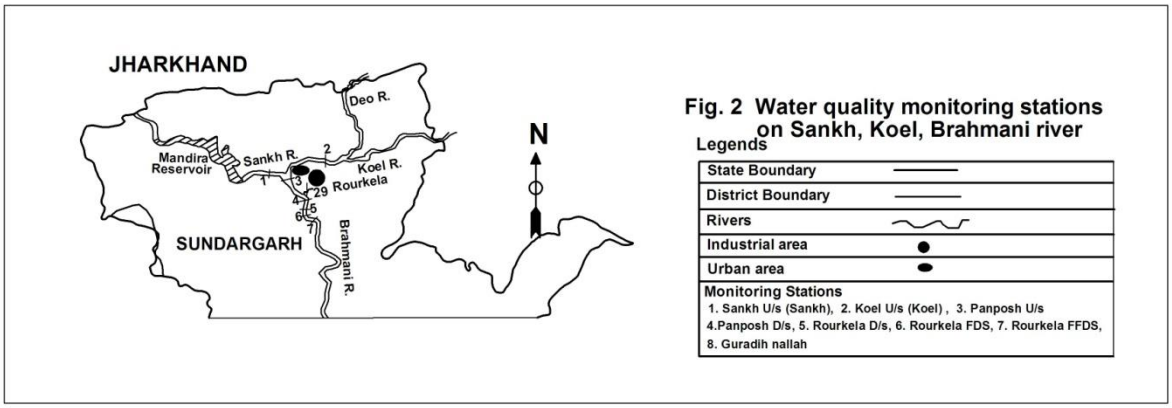

Fig. 2 Water quality monitoring stations on Sankh, Koel, Brahmani river

Maximum BOD values in a year at these monitoring stations during the period 2009-2017 are presented in Table-2.

Table-2 Water quality of Sankh, Koel and Brahmani river with respect to BOD (mg/l) during the period 2009-2017

Monitoring station	Maximum BOD (mg/l) value in a year								
	2009	2010	2011	2012	2013	2014	2015	2016	2017
Sankh U/s	1.8	2.2	2.8	2.1	2.8	2.1	2.5	1.7	2.1
Koel U/s	1.8	1.6	2.8	2.2	3.1	1.8	2.1	2.9	1.7
Panposh U/s at Vedavyas	2.7	2.4	1.8	2.2	2.5	1.4	1.5	1.5	1.5
Panposh D/s at Deogaon	5.8	5.6	6.6	5.6	5.6	5.6	5.3	5.8	5.8
Rourkela D/s at Jalda	5.4	4.6	5.3	4.4	4.7	5.0	4.5	5.4	4.8
Rourkela FD/s at Attaghat	2.8	2.8	3.2	2.6	3.6	2.9	4.2	4.6	3.2
Rourkela FD/s at Biritola	2.6	3.0	3.6	3.0	3.9	4.5	3.5	2.5	2.7

From the data, it is revealed that the water quality of Sankhriver conforms to Class-C. Maximum BOD value in Koelriver marginally exceeded the tolerance limit only once during the period 2009-2017. Therefore, the stretch may not be considered as polluted. Water quality at Panposh U/s (Vedvyasa) on Brahmani river after the confluence of Sankh and Koel river has been observed to conform Class C. However, the water quality deteriorates at Panposh D/s and Rourkela D/s. Maximum BOD range during the period 2009-2017 has been observed to be 5.5 – 6.6 mg/l at Panposh D/s and 4.4-5.4 mg/l at Rourkela D/s.

Though BOD values at the further downstream stations such as Attaghat and Biritola shows improvement, still these stations may be considered as polluted due to frequent deviation of BOD values from the tolerance limit. Maximum BOD range exceeding the tolerance limit during the period 2009-2017 at Attaghat has been observed to be 3.2-4.6 mg/l and at Biritola it is 3.5-4.5 mg/l.

Frequency of deviation of BOD values at these monitoring stations during the period 2009-2017 is shown in Fig. 3.

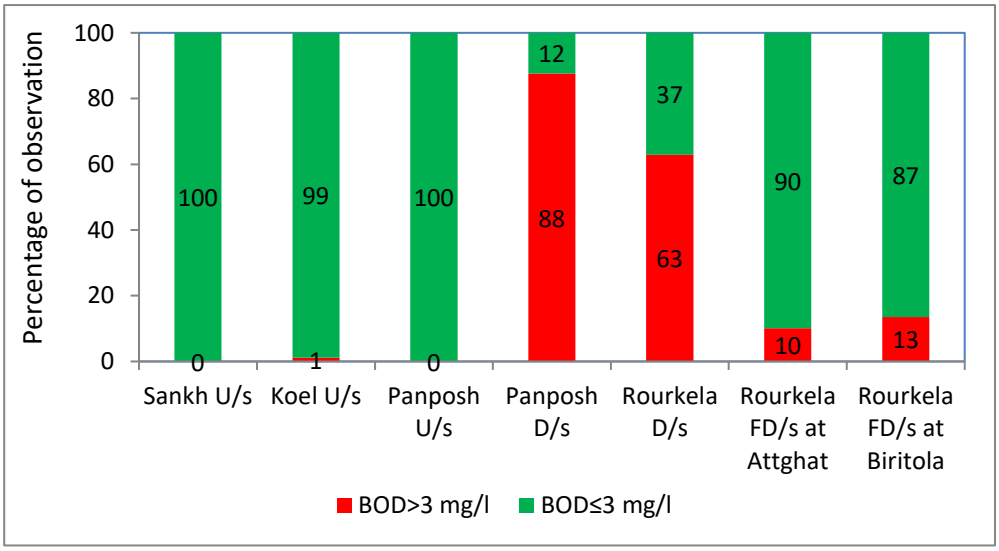

Fig. 3 Frequency of deviation in BOD values in Sankh, Koel and Brahmani river during 2009-2017

Based on the BOD values, the entire stretch of Rourkela along Brahmani river from Panposh D/s atDeogaon to Biritola may be identified as polluted and falls under category IV.

Water quality data of Sankh river, Koel river and Brahmani river along Rourkela stretch with respect to pH, DO, BOD, COD, Total coliform and fecal coliform during the period 2009-2017 are given in Table-3.

Table-3 Status of water quality of River Sankh, Koel and Brahmani during 2009-2017

Year	Location	pH		DO (mg/l)		BOD (mg/l)		COD (mg/l)		TC (MPN/100 ml)		FC (MPN/100 ml)	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
2009	Sankh U/s	7.1	8.2	7.5	9.6	1.3	1.8	7.9	13.7	1200	1700	630	1100
2010		7.5	8.0	6.1	8.5	1.2	2.2	10.2	20.0	840	1700	270	940
2011		7.2	8.3	5.5	9.1	0.7	2.8	5.2	16.2	630	54000	210	24000
2012		6.9	8.1	6.5	9.2	0.9	2.1	7.8	22.2	490	5400	210	3500
2013		7.5	8.2	6.3	10.2	0.3	2.8	5.2	20.0	220	54000	78	1700
2014		7.1	8.1	6.0	8.9	0.3	2.1	3.9	13.6	230	24000	78	13000
2015		6.0	8.3	6.0	9.4	0.3	2.5	3.8	15.8	330	35000	110	13000
2016		6.9	8.4	6.3	9.7	0.4	1.7	3.6	15.2	1100	13000	330	4900
2017		7.6	8.1	5.9	8.6	0.4	2.1	7.5	14.0	23	16000	<1.8	16000
2009	Koel U/s	7.4	8.3	7.1	11.3	1.0	1.8	4.0	9.8	1300	1700	630	1100
2010		7.9	8.2	6.3	8.1	0.8	1.6	6.0	14.6	700	3500	260	1700
2011		7.0	8.3	5.3	9.0	0.6	2.8	6.1	25.6	580	35000	230	17000
2012		6.9	8.4	5.5	9.6	0.6	2.2	5.2	25.3	700	9200	230	3500
2013		7.5	8.4	5.9	13.5	0.4	3.1	5.6	28.0	490	7000	170	4900
2014		7.1	8.3	6.2	8.9	0.3	1.8	3.8	12.1	230	92000	130	35000
2015		7.3	8.4	6.2	9.6	0.5	2.1	3.9	13.1	1300	54000	330	24000
2016		7.2	8.2	5.8	8.3	0.5	2.9	4.0	24.2	790	35000	330	24000
2017		7.3	8.5	5.8	9.7	0.6	1.7	2.9	19.9	1600	16000	490	16000
2009	Panposh U/s	7.1	8.4	7.4	9.7	0.4	2.7	2.5	20.0	940	2800	630	2200
2010		6.9	8.3	5.8	8.8	0.6	2.4	6.6	18.0	1200	3500	790	1700
2011		7.1	8.1	5.5	8.6	0.6	1.8	4.7	20.5	1300	13000	790	7900
2012		7.0	8.3	5.0	8.7	1.0	2.2	6.1	19.7	2100	16000	1300	9200
2013		7.5	8.4	6.3	9.8	0.4	2.5	5.6	16.9	1300	35000	490	13000
2014		7.1	8.2	6.4	8.6	0.5	1.4	3.8	18.7	1300	26000	790	13000
2015		7.1	8.2	6.7	8.0	0.4	1.5	3.8	11.8	3300	17000	1100	11000
2016		7.1	8.3	5.8	9.0	0.6	1.5	4.0	16.2	1400	92000	490	54000
2017		7.5	8.4	5.4	8.8	0.4	1.5	4.3	14.1	1300	16000	230	16000
2009	Panposh D/s	6.9	8.3	4.5	11.5	2.6	5.8	12.7	37.4	7000	22000	4600	15000
2010		7.2	8.2	5.7	12.1	0.9	5.6	10.0	44.0	3300	92000	630	35000
2011		6.7	7.8	5.0	7.8	3.0	6.6	19.5	44.8	3500	54000	1700	35000
2012		6.8	8.3	5.2	9.2	2.4	5.6	12.1	49.7	16000	92000	7900	54000
2013		6.8	8.0	5.1	8.8	2.1	5.6	15.2	45.5	7900	160000	2700	92000
2014		7.1	8.2	5.6	8.4	3.4	5.6	23.1	53.1	11000	54000	7000	35000
2015		6.8	8.1	5.3	7.8	2.6	5.3	19.6	43.3	11000	92000	4600	54000
2016		6.5	7.9	4.2	8.2	2.3	5.8	20.3	52.5	22000	160000	11000	160000
2017		6.5	7.9	4.4	7.5	1.5	5.8	11.5	44.6	7900	160000	1100	160000
2009	Rourkela D/s	6.7	8.3	6.2	18.3	2.4	5.4	10.6	35.8	3500	17000	2300	11000
2010		7.1	8.1	5.6	12.3	1.6	4.6	12.0	38.0	1100	54000	700	35000
2011		6.8	8.1	5.4	7.5	1.8	5.3	9.4	41.1	1700	92000	940	35000
2012		7.2	8.1	5.2	8.6	2.0	4.4	10.1	43.1	3900	92000	2200	54000
2013		6.4	8.5	5.6	10.0	0.9	4.7	13.5	40.3	2400	160000	790	92000
2014		7.1	8.3	5.9	13.5	2.7	5.0	19.3	45.3	17000	160000	7000	92000
2015		7.0	8.2	6.0	7.8	2.2	4.5	15.8	43.8	7900	54000	3300	22000
2016		6.7	7.9	4.2	8.3	2.0	5.4	17.8	52.5	13000	160000	7900	160000
2017		6.8	8.1	4.9	8.5	1.2	4.8	11.5	38.0	4900	160000	200	160000

Year	Location	pH		DO (mg/l)		BOD (mg/l)		COD (mg/l)		TC (MPN/100 ml)		FC (MPN/100 ml)	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
2009	Rourkela FD/s (Attaghat)	7.1	8.3	7.6	12.0	1.2	2.8	5.1	12.8	1100	12000	1400	7000
2010		7.1	7.9	6.2	8.3	1.2	2.8	11.4	22.0	1500	9200	940	2400
2011		6.7	8.2	5.1	8.5	1.0	3.2	7.6	27.7	940	22000	330	13000
2012		6.9	8.4	6.1	9.6	1.3	2.6	8.1	29.8	2500	35000	1300	13000
2013		7.4	8.1	6.2	9.8	1.5	3.6	10.3	30.9	130	13000	78	7900
2014		70	8.4	6.5	9.3	1.3	2.9	11.5	27.7	330	35000	130	16000
2015		6.9	8.4	5.8	8.9	1.5	4.2	7.7	37.4	170	17000	330	4900
2016		6.9	8.4	5.9	9.8	0.6	4.6	10.7	28.8	790	92000	220	54000
2017		7.2	8.1	5.4	9.8	0.7	3.2	7.3	22.1	20	16000	<1.8	16000
2009	Rourkela FD/s (Biritola)	6.8	8.3	7.1	11.0	1.5	2.6	9.5	15.1	1400	9400	1100	4900
2010		7.3	7.9	6.5	7.7	2.0	3.0	13.0	24.0	2200	4300	1300	2300
2011		7.1	8.2	5.0	8.0	1.2	3.6	6.3	31.5	1500	22000	790	13000
2012		7.4	8.2	6.9	9.1	1.2	3.0	6.1	33.1	2400	13000	790	7900
2013		7.0	8.2	5.9	11.7	1.1	3.9	8.4	37.6	330	24000	130	17000
2014		7.8	8.4	6.0	9.3	1.8	4.5	11.5	42.2	790	35000	230	11000
2015		7.1	8.4	5.6	8.8	1.0	3.5	11.1	25.6	790	13000	78	7900
2016		7.1	8.3	6.3	9.7	0.5	2.5	6.8	18.2	170	17000	68	13000
2017		7.3	8.2	5.5	9.6	0.4	2.7	5.6	18.4	230	16000	130	16000

Sources of Pollution

Industrial Wastewater

M/s Rourkela Steel Plant is the major industrial unit situated in Rourkela near Brahmani river. The industry discharges its treated wastewater to Brahmani river through Guardih nallah. The nallah is a natural rivulet originating from the Durgapur hill Range of Rourkela, and flows on the northern side of the hill. The Nallah flows through the boundary of the Steel Plant. At one extreme and outside of the plant a lagoon has been built across the nallah to provide storage facility of wastewater and is known as the “Oxidation lagoon”. The effluents from the sewage treatment plant (located inside the Steel Plant) are also being discharged into the Guradihnallah. An embankment with sluice gate has been made near the outlet of the Lagoon. The overflow from the lagoon falls into the river Brahmani after flowing a distance of only 0.5 km away from the outlet of the Lagoon.

Annual average of BOD in Guradih nallah during 2017 was 6.5 mg/l with the maximum BOD value being 11.5 mg/l.

The COD values ranged between 24.5 – 60.3 mg/l with an average value of 40.8 mg/l during 2017.

The annual range of total and fecal coliform bacteria during 2017 were observed to be54000-160000 MPN/100 ml and 22000-160000 MPN/ 100 ml respectively. This indicates significant contribution of untreated sewage on Guradih nallah.

Municipal Wastewater

Municipal wastewater of Rourkela city is also discharged to Guradih nallah which ultimately outfalls into Brahmani river. Besides these, there are small unorganized drains carrying wastewater from different sectors of the City, discharge to Koelriver.

Plan for Restoration of Water quality

To restore the water quality of Brahmani river along Rourkela stretch, interventions through treatment of municipal wastewater as well as industrial wastewater of Rourkela is necessary. The increasing population in the city with the growing demand on water supply for domestic purpose as well as industrial purpose has put pressure on the restoration of water quality.

Steps already have been taken for improvement of water quality are as follows.

- Directions issued to Rourkela Municipal Corporation under section 5 of the Environment (Protection) Act, 1986 for planning and execution of facilities by the Municipal authorities to develop infrastructure for sewage treatment.
- Directions issued for setting up of online monitoring system on Brahmani river at the downstream of Rourkela.
- Directions issued to M/s Rourkela Steel Plant under Section 25/26 of Water (Prevention and Control of Pollution) Act, 1974 to treat the wastewater so as to meet the prescribed standards prior to discharge into Guradih nallah.
- Odisha Water Supply and Sewerage Board (OWSSB) have taken steps for construction of three numbers of STPs of capacities 7.0 MLD, 5.0 MLD and 53 MLD at Rourkela to treat the municipal wastewater prior to discharge Brahmani river.
- Land acquisition / alienation work by OWSSB are also in progress for execution of Septage Management project under AMRUT programme.