ORISSA STATE WATER PLAN

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WATER QUALITY

STATUS OF WATER QUALITY IN MAJOR RIVERS OF ORISSA.

Data on water quality of 6 major rivers i.e Mahanadi, Brahmni, Baitarani, Rusikulya, Nagaballi & Suvarnarekha are available only and for other 5 river no observation site exists.

1.1 Mahanadi River

Water pollution in Mahanadi Basin

- **Municipality Waste Water**

A study of the water quality of Mahanadi River, particularly in upper reaches was made by the University College of Engineering, Burla and School of Life Science, Burla from 1983 to 1988 with support of the Department of Environment, Government of Orissa. Table 45 shows this study's results prepared by Pollution Control Board for the year 2002.

The table shows that the Mahanadi water is not directly potable, except in the middle stretches near Kiakata, where the population density is less. It also does not confirm to Class "C" character at many places (i.e downstream of Sambalpur, Cuttack and Chowdwar). The pollution load on Mahanadi is mainly from municipal and other domestic waste waters except at Chowdwar. The pollution of river Ib is mainly due to paper mill and large thermal plant.

- **Industrial Pollution**

The industrial pollution is mostly due to presence of large industries in some locations like Paper Mills at Brajarajnagar and Chowdwar, Fertiliser plants i.e. PPL and OSWAL at Paradeep and Thermal plants at Ib river.

Besides there are Ferrochrome factory and other industrial complexes at Chowdwar and some industrial plant in and around Sambalpur. The above industrial units release industrial pollutants to river and causes pollutions.

1.2 River Rushikulya

The principal activities that generate waste water are mainly from Industries, domestic, mining and agriculture.

- **Pollution from agricultural activities**

The net sown area of the basin is 367,500 ha out of which only 55.93% i.e. 2,05,540 ha area comes under irrigation coverage from all sources. Fertilizer application in the basin is on the lower side. So also the pesticides. Since dominant agriculture in the basin is Khariff based, the residual effect of fertilizer load is dilluted due to monsoon flow in rivers. Hence effect of agriculture waste on water quality on Rushikulya river is minimal.

- **Pollutions from Industrial centres**

There are only four prominent industries in the basin as given below.

The Industries which produce major pollutants are as follows:

Industry	Product	Parameter / Major pollutant
Aska Co-op. Sugar Industries	Sugar	BOD, COD
Aska Co-op. Sugar Industries	Distillery	BOD, COD
Jayashree Chemicals	Caustic soda, Mercury	by product of chlorine
Rare Earth Ltd.	Synthetic Acid	

- **Pollution from domestic source**

The pollution load in Rushikulya basin is mainly from municipal and domestic source. There is no organised sewage disposal system in the urban bodies and all waste is directly released from urban areas and village waste is washed to rivers mostly during monsoon. The fecal coliform remains within acceptable limit though it has crossed the desirable limit.

- **Monitoring of water quality**

There are only two stations in Rushikulya River, at Madhapur and Pottagarh, located on either side of N.H.5 and the south side is nearer to sea. This gives the indication of water quality of Rushikulya for a limited area nearer to confluence. However these stations monitor the effect of industrial pollution coming from Aska and Ganjam.

Pollutions – Trend

The overall water quality conforms to Class "C", but for BOD parameters it is not conforming to Class "C". The value of "EC" is higher at Pottagarh due to effect of Jayashree Chemicals and sea comes under Class "E" grade. The concentration of mercury for the year 1998 was observed to be 0.0017 mg/l against the tolerance limit of 0.001 mg/l.

1.3 Baitarani River

The Ministry of Environment and Forest have monitored the water quality of large number of rivers in India and has suggested to improve the water quality in some stretches. For Baitarani River, the Ministry has suggested that upstream of Chandbali the river has become Class "D" and it is desirable that it should be upgraded to Class "C".

The Pollution Control Board, Orissa have set up 5 monitoring stations in river Baitarani since 1988 and observing the water quality parameters. The stations are:

(1)Joda, (2) Anandpur, (3) Jajpur, (4) Chanddbali, (5) Dhamra.

Source of water pollution:

- **Pollution from Agricultural source**

The pollution loads from agricultural activities are fertilizer and pesticides residue coming from agricultural field to the river system. The fertilizer consumption in some areas are highest i.e. 105 kg/ha and is much higher value compared to the Orissa average. However chemical fertilizer in combination with pesticides causes some pollution in the middle and downstream areas but not of serious concern for the water quality.

- **Pollution from Industrial area**

The industrial complex at Joda due to available of raw materials have come up and they are mostly Ferro manganese, sponge iron and ferroalloy plants. Some industrial centers at Keonjhor and Jajpur road have resulted in some pollution to river system. There are 10 industrial units and discharging 26857 m^3 of waste water daily.

- **Pollution from Mining area**

Baitarani basin has rich mining potential with availability of chromite, manganese and iron ore. The Joda area has manganese and iron ore, where as Sukinda area is rich with chromite and iron ore. The Chromite mines in the area discharging waste water rich in hexavalent chromium compounds. This results in pollution of river systems

- **Pollution from Domestic sources**

Domestic sources are another major contribution of the waste water. In Baitarani basin almost all the waste water are discharged untreated. There are 13 urban settlements in the basin which discharges19654 million Litres. of waste water annually.

Water quality trend

As per TC, Joda, Anandpur, Jajpur comes under classification "C"

So far as BOD is concerned, Joda and Anandpur come in class "B" classification, where as Jajpur, Chandbali and Dhamara comes in Class "C" classification.

Though the BOD trend is improving for the Stations Joda, Anandpur, Jajpur, but declining for the station of Chandbali and Dhamara. Dhamara declining trend is attributed to the pollutant load coming from Brahmani River which joins Baitarani at Dhamara.

1.4 Brahmani River

Sources of water pollution

- **Pollution from Agricultural source**

This is one of the most developed basins so far as agriculture is concerned, and due to construction of Rengali Irrigation Project, the irrigation coverage is likely to go very high. The net sown area of the basin in the year 2000 is 863,250 ha and Rengali Irrigation Project will have the potential of irrigation of 240,000 ha. The runoff from chemical fertiliser and pesticides are the source of pollution and at present the use of above is within limit. The Sambalpur and Jajpur districts have some moderate figure of fertilizer use and comes in the range of 89 and 55 kg/ha. This is much less compared to the use in neighboring states like Andhra Pradesh and West Bengal. The agricultural pollutants is not a problem now and due care should be taken for future.

- **Pollution from Industrial sector**

The Brahmani River is the most polluted river of Orissa. In the upper reaches there is a integrated steel plant of One million ton capacity at Rourkela and this has resulted in setting up of a large number of small industrial units around like the IDL Chemicals etc.

In the middle reaches the Talcher-Angul Zone has been developed as the highly industrialized area of Orissa, where the NALCO Smelter Plant, NALCO Captive Power Plant, NTPC Power Station at Kaniha and Talcher have already been established. More steel based industries are in the pipe line. All these industries are releasing their effluents to the river Brahmani after some treatment. The Thermal plants have started recycling their ash disposal system and taken steps for not releasing direct ash to river Brahmani. However in spite of the best effort by the industries some degree of industrial

effluents are entering the stream and causing concern in maintaining the water quality. It is estimated that 198,701 m^3/day of waste water are being released from different industries into river Brahmani in this zone.

- **Pollution from Mine area**

The Brahmani basin is rich in mineral and to exploit the ores mines are in operation. The discharge from coal mines in Talcher-Angul area is predominant. There are 11 Nos. of coal mines both open cast and underground are operative. Talcher area is under the control of Mahanadi Coal field Company owned by Government of India. They release a discharge of 50750m3/day to different streams which ultimately joins river Brahmani and causes a considerable pollution. In some mines they are treated through settling tanks which arrest the suspended particle to a great extent.

The other mines which are in operation are chromite mines. Chromite reserve is highest in India and its discharge from Sukinda area comes to Brahmani River through Damsala Nalla which is a tributary of river Ramiala. The chromite mines have their individual ETP for treating their mine drainage containing high hexavalent chromium.

In Iron ore area also some mine washing water also joins the Brahmani river.Before release they are treated at the mine head to arrest the washing particles and other oily and greasy substances.

Waste water from Domestic sources

In Brahmani Basin, there are large number of urban township which have developed due to setting up of industries and other related ancillary facilities created to support the industrial development.

Out of 15 urban local bodies, 9 townships are developed due to industries and 6 are due to local urban settlements. These townships discharge about 80% of the required intake as waste water into the nearby streams which ultimately joins river Brahmani. These urban settlements except the industrial towns like Rourkela, Talcher, Thermal, NTPC and Nalco do not have sewage treatment plant, as a result of which untreated waste water flows into the river which contributes a total BOD load of 8.7 tons/day. Due to release of untreated human waste, the T.C. value at downstream of Panposh, downstream of Rourkela and below Dharmasala and Pattamundai comes in high range.

1.5 Nagavali River

Nagavali basin is considered as one of the rivers having some pollution in industrial area. In Rayagada area the river is polluted to certain degree due to Paper Mills and Ferro chrome Plant.State Pollution Control Board maintains two stations in the river.
J.K.Pur D/S.
Rayagada D/S
From the result, it is seen that BOD and TC level is higher.
However it is clear that the water quality of river in Orissa portion except in about 15km stretch from the d/s of the wastewater discharge point of J. K. Paper mills and for d/s of Rayagada be normally fit for all normal use.

1.6 Subarnarekha River

In Subarnarekha basin pollution control Board maintains a station at Rajghat and it is reported that there are no pollution in Subarnarekha river. Though it is expected to carry some pollution load from the industrial, mining and urban activities of Jharkhand and West Bengal, the river has considerable regenerating capacity.
The river quality at Rajghat upto Jaleswar town confirms to Class C of inland surface water.

2.0 Special Analysis of Water Quality for Brahmani and Mahanadi River

2.1 Brahmani River

Brahmani River due to location of large number of industries as well as existence of number of industrial towns and suburban bodies is considered as the most polluted river of Orissa.

The Rourkela Steel and Captive Power Plant, Nalco Smelter and Captive Power Plant at Angul, NTPC Power Plant at Kaniha and Talcher, Orissa Poly Fibre Plant at Angul discharges industrial waste water to the tune of 198,701 m3/day. About 11 coal mines from Talcher area and five chromite mines are discharging mine waste water to the tune of 50,750 m3/day and 7019 m3/day respectively. Besides nine Industrial towns and six civil townships discharge waste water at the rate of 93088 m3/day.

Use based classification and status of river stretches conforming to water quality:

In Brahmani River there are eleven stations where water quality is monitored by the State Pollution Control Board. The stations are

Panposh U/S, (2) Panposh D/S,(3) Rourkela D/S, (4) Bonaigarh, (5) Rengali, (6) Samal, (7) Talcher U/S, (8) Talcher D/S, (9) Bhuban, (10) Dharmsala, (11) Pattamundai.

The seasonal (Winter, Summer, Monsoon and post Monsoon) values of pH, DO, BOD and TC are available for all the eleven stations for last few years. The Am-N i.e. free ammonia (measured as N) is observed to know the status of propagates of Fishery and other wild life. This was observed mostly in the year 2000 and thereafter reduced to once in a year.

The EC, SAR and B are considered to be three primary quality criteria for water to be used for irrigation (Class-E). EC is related to salinity, which beyond certain limit may effect vegetative growth and yield. SAR which gives the concentration of sodium relative to the concentration of calcium and magnesium is a guide to judge the sodium hazards of irrigation water. Boron (B) though is an essential nutrient for plant growth becomes toxic beyond concentration of 2 mg/l in irrigation water.

The EC is observed in four seasons of the year and is available for last four years in all the eleven monitoring stations.

As regards SAR and B (Boron) this is observed once in a year and is available for all the stations.

All the above parameters, i.e., pH, DO, BOD, TC, Am-N, EC, SAR and Boron are observed to designate a river stretch under different use based classifications like A, B, C, D and E. The above relates to a specific use like drinking, bathing, fish life or agricultural use etc.

As regards other parameters like Nitrates, Chlorides, Sulphates and Flourides these are directly related to industrial effluent. Besides metals and cyanides also relates to industrial pollutions and unless otherwise can be established to geological origin. There are standard of tolerance limit for above and the river stretches can be declared safe or otherwise depending upon its observation and value limit.

Use based Classification like A, B, C, D and E

pH and DO: The entire river strech of Brahmani is mostly alkaline and fairlyh rich in oxygen. This conform to Class "A"

BOD: Except Panposh (D/S), Rourkela (D/S) and Talcher (D/S) all other stations conform to Class "C".

TC: Except Panposh (D/S), Rourkela (D/S) and Talcher (D/S) (where 5000 MPN/100 ml is the limit for Class C) all other stations confirm to Class C.

Am-N All Stations confirm to Class D (0.2 to 2.0 mg/l) to occasional violation at Panposh (D/S, Talcher (U/S), Talcher (D/S) and Dharmasala(D/S) in 2003 with 1.2 mg/l as the limit.

There are certain sporadic high values (except Panposh D/S and Talcher D/S) could be due to agricultural runoffs containing ammonium fertilizers. However, the values observed at Panposh (D/S) and Talcher (D/S) coupled with the alkaline nature of water (which facilitate formation of free ammonia from relatively harmless ammonium components) and the fact that water at these locations carry industrial discharges indicate that the river water in these stretches may not be particularly conducive to fish propagates.

EC, SAR and B

These values are within limit and the entire stretch of Brahmani River is fit to be used for irrigation.

Status of quality in Brahmani

Panposh U/S	CDE
Panposh D/S	E
Rourkela D/S	D
Bonaigarh	CDE
Rengali	CDE
Samal	CDE
Talcher (U/S)	CDE
Talcher (D/S)	E
Bhuban	CDE
Dharmsasla	CDE
Pattamundai	CDE

From the above analysis it can be concluded that this stretch below D/S Panposh, D/S Rourkela and D/S Talcher comes under degraded stretch and needs to be improved.

BIOLOGICAL ASSESSMENT OF WATER QUALITY

Biological assessment is based on the fact that pollution of water bodies will cause changes in the physical and chemical environment of water, which, in turn, will disrupt the ecological balance of the ecosystem. Through bio-monitoring the cumulative effects of all the pollutants can be determined and the overall health of the ecosystem can be properly assessed.

Bio-monitoring results are generally expressed in terms to two indices, namely the Saprobic Index (SI) and the Diversity Index (DI). Determination of SI involves preparation of an inventory of the presence of benthic macro-invertibrate fauna up to the family level with taxonomic precision and expressing the SI on a scale of 1-10. The methodology for DI involves pair-wise comparison of sequentially encountered benthic individuals upto the species level. The diversity is the ratio of total number of different animals (runs) and the total number of organisms encountered. The DI has a value between 0 and 1. The criteria used for classification of water quality on the basis of biological indicators are the following.

Indicator	Water Quality
High biodiversity DI $\geq$ 0.6 SI = 6-10 BOD < 3 mg /l	Clean
Moderate biodiversity DI = 0.2 – 0.6 SI = 2 to 6 BOD = 3 – 6 mg / l	Slight to Moderate Pollution
Poor biodiversity DI < 0.2 SI < 2 BOD $\geq$ 6 mg / l	Heavy to severe pollution

Source: Environment Atlas of India, CPCB, 2001

The range of SI and DI values observed at different monitoring stations during 2002 and 2003 are given in Table 46. The data show that as measured by these indicators the stretch of Brahmani River from Panposh to the estuary is in a state of slight to moderate pollution.

WATER QUALITY IN TERMS OF WHOLESOMENESS:

The basic objective of the Water (Prevention and control of pollution), Act, 1974, which governs the water quality management in the country, is "to provide for the prevention and control of water pollution and maintaining or restoring the wholesomeness of water". Since the Act does not define the level of 'wholesomeness' to be maintained or restored, the CPCB linked wholesomeness to the quality as required for designated uses by humans. Criteria were developed for different uses, which were subsequently adopted as the Indian Standard by the Indian standards Institution, later named as the Board of Indian Standards (Sec. 2.2)

Over the years it was felt that the designated use concept with the objective of protecting the direct beneficial uses to humans and classifying water quality accordingly, needs to be reviewed and 'wholesomeness' should incorporate an overall integrated view of the water ecosystem. The first priority in water quality assessment and management should be to maintain and restore to a desirable level of its environmental quality. Accordingly specific requirements for 'Acceptable', 'Desirable' and 'Excellent' levels of wholesomeness with short, medium and long term goals have been laid down (Water Quality – Criteria and Goals, CPCB, MINARS/17/2001/2002).

Parameters for the above classifications are grouped in three categories:

Simple Parameters (sanitary surrounding, general appearance, colour, smell, transparency, presence of fish and insects).

Regular monitoring parameters.

Special parameters to be monitored when need or apprehensions arise.

Wholesomeness in Terms of Regular Parameters: The requirements in respect of regular monitoring parameters for different classes are as follows.

Parameter	Requirements		
	Excellent	Desirable	Acceptable
pH	7.0 – 8.5	6.5 – 9.0	6.5 – 9.0
DO (% saturation)	90 – 110	80 – 120	60 – 140
BOD (mg/l)	Below 2	Below 5	Below 8
EC (micromhos/cm)	< 1000	<2250	< 4000
(Nitrite + Nitrate) N (mg/l)	< 5	<10	< 15
Suspended Solids (mg/l)	< 25	<50	< 100
FC (MPN/100ml) *	< 20	<200	< 2000
Bio assay (Zebra fish)	No death in 5 days	No death in 3 days	No death in 2 days

* FC Values should be met for 90% of samples

Of the 8 parameters listed, data for suspended solids and bioassay are not available. Hence presently the water quality is to be assessed with regard to the remaining six parameters.

The pH, DO, BOD and EC values have been determined in 2001, 2002 and 2003. Except on three occasions during 2001 and once during 2002 at Panposh (D/S), twice in 2001 and once in 2002 at Rourkela (D/S), the N values have never exceeded 10 mg/l. Even in these two stations, no deviation from 10mg/l was observed during 2003. Hence considering pH, DO, BOD, EC and N, the present level of wholesomeness of the river water may be considered as 'desirable'.

However, the situation changes entirely, on introduction of FC values in the above assessment. Data given in Table 47 (percent violation of FC values from 2000 MPN / 100ml) would show that except for the relatively undisturbed stretch from Banaigarh to Talcher (U/S) and at Dharmsala, the river water quality is not even 'acceptable' during most part of the period under report.

Wholesomeness in terms of special parameters: Acceptable limits for the special parameters that are relevant to the present study are given below.

Parameter	Requirement (mg/l) Max		
	Excellent	Desirable	Acceptable
Total Phosphours	0.1	0.2	0.3
TKN	1.0	2.0	3.0
(Ammonium + Ammonia) N	0.5	1.0	1.5
Zinc	0.1	0.2	0.3
Nickel	0.05	0.10	0.20
Copper	0.02	0.05	0.10
Chromium (Total)	0.02	0.05	0.10
Lead	0.02	0.05	0.10
Cadmium	0.001	0.0025	0.005
Mercury (micro gm)	0.2	0.5	0.001

Total Am – N and total phosphorus at all stations during 2002 and 2003 are within acceptable limits. The total Kjeldahl Nitrogen (TKN) reflecting organic pollution was observed to the more than 3 mg/l at all stations measured during 2002 (March), while

there is a significant decrease in 2003 (June), exceeding a value of 3mg/l only at Talcher (D/S) (3.6).

It is seen from that metal concentrations, except that for zinc at Panposh (D/S) and Talcher (D/S), are within acceptable limits. However, the rationale for stipulation of a much more stringent standard for Zinc for the wholesomeness of water, compared to Class – A inland surface water, is not very clear. Nickel concentrations during 2002 and 2003 are respectively 0.013 mg/l, BDL at Panposh (D/S) and BDL, 0.007 mg/l at Talcher (D/S).

SUMMARY OF WATER QUALITY ASSESSMENTS:

In the foregoing sections, water quality of Brahmani has been discussed and assessed in terms of three different classification concepts.

Use based, Biological and Level of wholesomeness

The final observations are summarized in Table 48.

2.2 River Mahanadi

River Mahanadi is the largest river system of Orissa. The industrial pollution is not that sever compared to river Brahmani. However some important industrial units are operating in the upper reaches near Sambalpur and lower reaches near Cuttack and sea and the middle reaches remain fairly free from industrial influence and water quality remains pristine.

The industries in the upper reaches are thermal plants of Orissa Power Generation Corporation (OPGC) at Banharpalli (near Brajrajnagar), Indian Alumunium Co.Ltd., Smelter and Captive Power Plant at Hirakud, Tata Refracteries at Brajrajnagar, L & T Cement at Jharsuguda, ACC Cement, Bargarh, Shakti Sugar at Baramba, Indian Chargechrome Ltd. (ICCL), Choudwar, CPP of ICCL at Chaudwar, Paradeep Phosphates Ltd. (PPL), Paradeep, Oswal Ltd. at Paradeep and East Coast Breweries and Distilleries, Paradeep. Besides the above big industries, there are several medium and small scale industries who are on average discharging about 1,00,000 m3 of waste water/day. Of course all are not diverted to river as major part of them is diverted to land.

The coal mines located in Ib valley constitute a cluster of mines and along with one lead mine in Sargipalli constituting a lot of mining activities in the area. They generate about 14,000 m3/day mine waste water per day.

Besides there are quite good numbers of important towns on the bank of Mahanadi, the prominents are Sambalpur, Sonepur, Boudh, Athamallik, Choudwar, Cuttack and Paradeep.

Use based classification and status of river stretches confirming to water quality:

In Mahandi River, the State Pollution Control Board has set up 9 monitoring stations for regular observation of quality of water.

Hirakud, (2) Sambalpur U/S, (3) Sambalpur D/S, (4) Sonepur U/S, (5) Sonepsur D/S, (6) Tikarpara, (7) Narasingpur, (8) Cuttack U/S, (9) Cuttack D/S.

Parameters related to use based classification:

PH, DO, BOD, TC -These parameters are observed seasonally.

Am-N, EC, SAR and B- These parameters are observed once in a year and classification of river stretch is considered based on above.

Use based classification:

Hirakud	B/D/E
Sambalpur (U./S)	D/E
Sambalplur (D/S)	D/E
Sonepur (U/S)	C/D/E
Sonepur (D/S)	D/E
Tikarpara	C/D/E
Narsingpur	C/D/E
Cuttack (U/S)	C/E
Cuttack (D/S)	D/E

As regards other industrial polluting parameters like Nitrates, Chlorides, Sulphates and Fluorides the entire stretch are within the limit pertaining to highest class.

Biological assessment:

Biological assessment is based on the fact that the pollution of water bodies will cause changes in the physical and chemical environment of water which in turn will disrupt the ecological balance of the system. Through bio-monitoring, the cumulative effects of all the pollutants can be determined and the overall health of the eco-system can be properly assessed.

As per above analysis, it may be concluded that the entire stretch is in state of slight to moderate pollution.