CHAPTER-I
INTRODUCTION

1.1 PURPOSE OF THE REPORT:

The Public Works Department is the single agency to operate the sand quarry operation in State since 2003 as the amended rule 38A in Tamil Nadu Minor Mineral Concession Rules 1959 to ensure the systematic and scientific sand quarry operation. To increase the functional efficiency of the newly constructed Kattalai Barrage, the Public Works Department has proposed to set up a sand quarry operation over an extent of 196.25 Ha. in River Cauvery at upstream and downstream of the above Barrage in SF No.293 of Sriramasamuthiram village and SF No. 288 of Silaipillayaputtur village in Thottiyam tehsil of Trichy District in Tamil Nadu. As per the approved mining plan, the total production capacity of the project is 15,01,247 m^3 of sand.

As per EIA Notification dated 14th Sep, 2006 as amended on 1st December 2009, the project falls under category "A" project or Activity 1(a).

The precise area communication has been approved by the District Collector, Trichy vide Lr. No.291/Kanimam/2013/ dt.18.6.2013. (Annexure 1.1). The mining plan has been prepared for production of 15,01,247 m^3 for three years period and it was approved by the Assistant Director, Geology and Mining, Trichy vide letter No. 291/Kanimam/2013 Dt.19.7.2013 (Annexure 1.2.)

Public Works Department submitted Form-I and prefeasibility report to MoEF on 02.09.2013. This proposal was submitted before the 14th meeting of the Recostituted Expert Appraisal Committee on 22.11.2013 for Environmental Appraisal of Mining projects constituted under EIA Notification 2006 for issuing ToR. The committee issued the ToR vide the Letter No. J-11015/343/2013-IA.II(M) dt.31st March 2014 to carry out the Rapid Environmental Impact Assessment (REIA) studies spanning one season Viz December 2013 to February 2014 , so as to delineate Environmental Management Plans (EMP) to mitigate any adverse impacts due to mining activity caused by the quarrying operation to remove the sand shoals in upstream and downstream of Kattalai Barrage. Copy of ToR letter enclosed as Annexure 1.3.

The public hearing for the above project was conducted on 18.7.2014 at Sriramasamuthiram village of Thottiam tehsil under the chairmanship of Additional District Magistrate of Trichirapalli after giving the vide publicity through English and local vernacular daily.

The above proposal for seeking Environmental Clearance was considered by the Expert Appraisal Committee in its 22nd meeting held during August 26-27, 2014. The committee mentioned some remarks vide the Letter No. J-11015/343/2013.IA-II(M) dt.17.9.2014 and the clarifications for the above remarks has also been incorporated in this final EIA/EMP Report. (Annexure 1.4)

1.2 PROJECT PROPONENT AND IDENTIFICATION OF PROJECT:

The Public Works Department is the single agency to operate the sand quarry operation in State since 2003 as the amended rule 38A in Tamil Nadu Minor Mineral Concession Rules 1959 to ensure the systematic and scientific sand quarry operation. The project proponent is Executive Engineer, River Conservancy Division, Trichy who is conservator of Cauvery River from mile 33/0 to 131/0 from Mettur reservoir and 0 to 47/6 mile of Coleroon river from Upper Anicut. The Executive Engineer maintains and regulates the irrigation channel in either side of Cauvery river in above mentioned chainage to a ayacut of 1,82,000 acres besides controlling Sand quarry operation.

1.3 BRIEF DESCRIPTION OF THE PROJECT:

1.3.1 SALIENT FEATURES OF THE PROJECT:

Salient features of the project is given in Table 1.1

TABLE: 1.1 SALIENT FEATURES OF THE PROJECT

Sl. No.	Particulars		Details
A.	**Location Details:**		
1.	Location		Sriramasamuthiram and Sillaipillayaputhur Village, Thottiyam Tehsil
	A. District		Trichy
	B. State		Tamil Nadu
2.	Co-ordinates of four corners of proposed project site		
	NW	Latitude	10°57’ 46.0” N
		Longitude	78°12’ 28.9” E
	NE	Latitude	10°58’ 02.1” N
		Longitude	78°13’ 38.7” E
	SW	Latitude	10°57’ 29.4” N
		Longitude	78°12’ 28.5” E
	SE	Latitude	10°57’ 57.5” N
		Longitude	78°14’ 28.0” E
B.	**Proposed Project Area:**		
3.	Total Proposed Area		196.25 Ha.
	Elevation above Mean Sea Level in m		95.70m to 101.00m
4.	Government Land		Govt. River Poromboke land owned by PWD
5.	Private Land		Not Applicable.
C.	**Production Capacity:**		15,01,247 m^3
D.	**Environmental settings:**		
6.	Nearest Railway Station		Mayanur (a km away in southern side)

7.	Nearest Village	Sriramasamuthiram, Silaipillayaputtur, Mayanur, Kattalai.
8.	Nearest Town/City	Karur – 21 KM, Kulithalai – 20 KM Musiri – 25 KM, Thottiyam – 15 KM
9.	Nearest Highway	NH 67 in Southern Side SH 25 in Northern Side
10.	Nearest Airport (By road-Appx.)	Trichy – 65 KM
11.	Nearest River/Canal (By road-Appx.)	Lease area is river bed of Cauvery. The North Bank Canal, South Bank Canal, Kattalai High Level Canal, New Kattalai High Level Canal and Krishnrayapuram Canal runs along the bank.
12.	Nearest Hill Ranges	Nil
13.	Source of water in the area	River, Bore well and Community wells.
14.	Soil Type	Sand shoals
15.	Ground Water Level	(i) Pre-monsoon (April/May) Core Zone - 2.00 mbgl Buffer Zone - 6.05 mbgl (ii)Post-monsoon (November) Core Zone - 2.10 mbgl Buffer Zone - 4.17 mbgl
16.	A. Temperature	Min: 10.40°C Max: 35.40°C
17.	B. Relative Humidity	
	At 08.30 hrs	Min: 76% Max: 96%
	At 17.30 hrs	Min: 37% Max: 100%
18.	C. Mean Annual Rainfall	630.00mm
E.	**Cost Details:**	
19.	Cost of the Project	Rs. 6.66 Crores
20.	Cost for Environmental Protection	Rs. 92.35 Lakhs
21.	Cost of Socio-Economic Development	Rs. 4.51 Crores

Source:- Site Visit/Survey

1.3.2 SIZE OF THE PROJECT:

The area of the project spreads over an extent of 196.25 Ha in Sriramasamuthiram village (93.95 Ha) and Silaipillayaputtur village (102.30 Ha) in Thotiyam tehsil of Trichy District. The total quantity of sand proposed to excavate is 15,01,247 m^3 in three years.

1.3.3 LOCATION OF THE PROJECT:

The proposed area for sand mining operation is 196.25 Ha, falls in the villages of Sriramasamuthiram and Silaipillayaputtur in Thotiyam tehsil of Trichy District. Land documents are enclosed an **Annexure 1.5**

- The proposed site falls a 2 KM away from north side of NH 67 (Karur to Trichy) and 12 KM away from south side of SH 25 (Salem to Trichy). The approximate road distance from major town is as follows.
  Karur 21 KM, Kulithalai 20 KM, Musiri 25 KM, Thottiyam 15 KM, Trichy 65 KM.
- The nearest railway station is Mayanur, approximately 2.00 KM from the quarry site in south side.
- The nearest airport is Trichy, approximately 65 KM away in east side.

The site is well connected with communication facilities like Telephone, Fax, Wireless and Telex and as such, no constraints are envisaged in this aspect as the Tehsil and District headquarters are near to the site.

1.3.4 IMPORTANCE OF THE PROJECT TO THE COUNTRY AND REGION:

The interlinking of river is the vision of our Tamil Nadu State Governmentand play a role model for entire Nation. It is widely accepted that the interlinking of river is the need of the hour. To fulfil the vision, our State Government is taking the pioneering effort to link the river Agniyar, Southvellar, Manimutharu,Vaigai, Gundaru with River Cauvery in first phase by constructing the Kattalai Barrage across Cauvery river at Mayanur village, Krishnarayapuram tehsil of Karur district.

It would serve the intra-state river linking plan to provide water parched districts in the south Tamil Nadu. Excess water during floods in the Cauvery could be diverted to the parched areas in the southern districts by linking the Agniyaru, Koraiyaru, Manimutharu, Vaigai and Gundaru.

Construction of Barrage at Kattalai is an important inevitable in linking rivers in the southern peninsula which was proposed by National Water Development Agency (NWDA).

Based on that, the Government of Tamil Nadu sanctioned an amount of Rupees 165 Cores for the construction of Barrage across the River Cauvery at 250 Meters downstream of existing Kattalai bed regulator in Mayanur village of Krishnarayapuram tehsil in Karur district of Tamil Nadu in G.O.Ms.No.116PW(N2) Dept. dated: 09.05.2008 under Accelerated Irrigation Benefit Programme.

Continuous deposition of sand on the upstream and downstream of Kattalai old bed regulator which is situated 250 meters, upstream side of new barrage on the river Cauvery has caused serious problem for the very existence of bed regulator itself . This envisages danger mark for the bed regulator.

Public Works Department creates, maintains and protects all irrigation systems including the rivers. Periodical maintenance including desilting of the drains/canals had carried out to maintain the functional efficiency including the carrying capacity of the canal. But in rivers flood protection works are carried out

by increasing top level of bund and protecting the sides of bund with revetment. The desilting was never carried out in rivers due to the cost constraints. Therefore, prolonged siltation for decades and more, the level of river bed has increased and reduced the carrying capacity.

Whenever floods and consequent damages occurred, it was resorted to increase the bund level to restore the carrying capacity of rivers. It was never thought of removing the sand shoals in the river due to the enormous cost it require and the problem of ways and means to dispose the removed sand. This situation led to an unnatural phenomenon of Cauvery and Kollidam (Coleroon in colonial English) rivers running in embankment. In majority of the stretches the adjacent field levels are lower than the bed of river. Consequence of this change in river regime and reduction in carrying capacity of the river, the shoals in the rivers, divert the flow of water resulting to bund erosion and consequent breaches which lead to loss of property and lives.

Solution to the above problem is to remove the sand shoals in the river by expending huge amount. Alternatively, the economical solution to this problem is to quarry the sand to remove the shoals. This option would yield net Revenue to the State exchequer apart from making available the important construction material for infrastructure development at a reasonable price to the common people.

It is proposed to excavate the quantity of sand is 15,01,247 m^3 in three years. The yearwise production is as follows.

Year wise Production

Village	S.F. No.	Block No.	Yearly Production			Total Qty. in CuM
			1st Year	2nd Year	3rd Year	
Silaipillayaputtur	288	I	175516	208713	276055	**660284**
		II	104653	43156	34982	**182791**
Sriramasamuthiram	293	III	254993	201395	201784	**658172**
Grand Total in Cu.M.						**1501247**

These production sand will be useful for infrastructure development activities in western and southern districts of Tamil Nadu. The aim of the Public Works Department will fulfil to get the sand at reasonable price by the common man at the same time to restore the efficiency of newly constructed barrage to store the designed capacity of water in upstream side and discharge the maximum flood in downstream side.

1.4 SCOPE & COVERAGE OF THE REPORT:

The Public Works Department prepares the Environmental Impact Assessment (EIA) report as per TOR issued vide Lr.No. J-11015/343/2013-IA.II(M),GOI, Ministry of Environment and Forests,IA Division, in its 14th meeting of the Reconstituted Committee of the Expert Appraisal Committee for Environmental Appraisal of Mining projects constituted under EIA Notification

2006 dated 22.11.2013., to carry out the Rapid Environmental Impact Assessment (REIA) studies spanning one season Viz December 2013 to February 2014, So as to delineate Environmental Management Plans (EMP) to mitigate any adverse impacts due to mining activity caused by the quarrying operation to remove the sand shoals in upstream and downstream of Kattalai old bed regulator in Karur District. The above proposal for seeking Environmental Clearance was considered by the Expert Appraisal Committee in its 22nd meeting held during August 26-27, 2014. The committee mentioned some remarks vide the Letter No. J-11015/343/2013.IA-II(M) dt.17.9.2014 and the clarifications for the above remarks has also been incorporated in this final EIA/EMP Report.

1.4.1 POINT-WISE COMPLIANCES OF THE APPROVED ToR

Environmental Impact Assessment studies have been carried out covering all points prescribed in the approved ToR. Pointwise compliance of the approved ToR is given in **Table 1.2**

TABLE 1.2 POINT WISE COMPLIANCE OF THE APPROVED ToR

Sl. No.	ToR Points	Compliance
1.	Year wise Production	The project proposed is new. The proposed quantity of production is 15,01,247 m^3. The year wise production is as follows. **I – Year – 5,35,162 m^3** **II – Year – 4,53,264 m^3** **III – Year – 5,12,821 m^3** The details of proposed production, pit configuration and method of mining discussed in detail of chapter-2, Table 2.4 & Fig 2.8
2.	Copy of document, whether proponent is the rightful lessee.	The land is Cauvery river bed classified as Government River Poromboke owned by Public Works Department. The District Collector, Trichy has given Letter of Intent (LOI) to Executive Engineer, PWD vide R.C.No. 291/Kanimam/2013 dated 18.6.2013 as Annexure 1.1
3.	All documents including approved mine plan, EIA and Public hearing should be compatible with one another interms of mine lease area, production levels etc.	Yes, mine lease area, production levels are compatible with each other in mine plan, EIA and Public Hearing. All the documents are in the name of the lessee ie. Executive Engineer, Public Works Department, River Conservancy Division, Trichy.
4.	All corner co-ordinates of the mine lease area, super imposed on a High Resolution imaginery/Topo sheet	The map enclosed in vide Annexure 1.6
5.	Hierarchical system or administrative order of the company to deal with the environmental issues and for ensuring compliance with the EC conditions.	The Executive Engineer, PWD is project proponent. The well organised system, functions under his control to deal the environmental issues and ensuring compliances with the EC conditions. The Head of Department will look the over all functions and gives necessary administrative order if necessary.

6.	Issues relating to mine safety and safe guard measures.	The project is open cast, Semi mechanized shallow mining on shoals without drilling and blasting. The details regarding safety of labours and occupational health and hygiene are discussed in Chapter-9.
7.	The study area will comprise 10KM Zone around the project site.	Study area comprises of 10KM Zone around the project site. Copy of key plan showing study area of 10 KM radius around the project is enclosed vide Annexure 4.1.
8.	Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary and National park, migratory routes of faunal, water bodies, human settlements and other ecological features.	Land use delineating forest area, agricultural land, grazing land, water bodies, human settlements and other ecological features are discussed in Chapter-4, Fig.No. 4.11 and Table 4.10 There is no wildlife sanctuary, bird sanctuary and National park within 10 KM radius of project area.
9.	Details of the land for any over Burden Dumps outside the mine lease.	The project is to remove the excess sand shoals in U/S and D/S of newly constructed barrage. The sand is directly sale by Public Works Department to needy consumers for various development activities. Hence, the question of burdening dumps does not arise.
10.	Certificate from the Competent Authority in the State Forest Department, confirming the involvement of forest land, if any in the project area.	The land is Cauvery river bed classified as Government river poromboke owned by Public Works Department. No Forest land is involved.
11.	Status of forest clearance for the broken up area and virgin forest land involved.	Not Applicable
12.	Implementation status of recognition of forest rights.	Not Applicable
13.	The vegetation in the RF/PF areas in the study area, with necessary details.	Details of vegetation in the RF are studied and listed in Chapter-4. The study reveals that there is no endangered and endemic species in that area.
14.	Ascertain the impact of the Mining Project on Wild life of the Study area, according detailed mitigative measures with cost implications.	The project is open cast, semimechnized shallow mining on sand shoals without drilling and blasting to a limited extent of 196.25 Ha in U/S and D/S of barrage. The detailed study on Flora and Fauna in study area of 10 KM reveals that there are schedule I and II species are identified as per wildlife (Protection) Act 1972 and detailed conservation plan and its budget are given in Chapter 7. The Chief Wildlife Warden approved the plan vide Lr.No WL5/30163/2014 Dated 10.02.2015 (Annexure 7.3)
15.	Location of National parks, Sanctuaries, Bio-sphere Reserves, Wild life corridors,Tiger/Elephant Reserves (Existing/Proposed) within 10KM of the project site, if any should be clearly	There is no National parks, Sanctuaries, Biosphere Reserves, Wild life Corridor, Tiger/Elephant Reserves within 10 KM of the project site. It is clearly shown in Eco-sensitive map vide Fig.4.15.

	indicated, a location map duly authenticated by the competent authority/chief wildlife warden may be obtained and provided. Necessary clearance, if any be appreciable to such projects due to proximity of the ecologically sensitive areas as mentioned above should be obtained from the State Wild life Department/competent authority under Wild life (protection Act'72 and submitted.)	
16.	Detailed biological study of study area. In case of any scheduled-I fauna found, the necessary plan for their conservation in consultation with State Forest and Wild life Department and allocation of fund.	The project is open cast, semimechnized shallow mining on sand shoals without drilling and blasting to a limited extent of 196.25 Ha in U/S and D/S of barrage. The detailed study on Flora and Fauna in study area of 10 KM reveals that these are schedule I and II species are identified as per wildlife (Protection) Act 1972 and detailed conservation plan and its budget are given in Chapter 7 and enclosed as Annexure 7.3.
17.	Areas declared as critically polluted	Not Applicable
18.	For coastal projects CRZ map duly authenticated by authorized officers.	Not Applicable and the project area is 225 KM away from sea shore.
19.	R&R plan/compensation details for the Project Affected People (PAP) should be furnished.	Not Applicable.
20.	Collection of one season (non-monsoon) primary baseline data on ambient air quality, water quality, noise level, soil and flora and fauna. Site specific meteorological should be collected. The location of the monitoring stations should be justified. Date wise collected baseline AAQ should form part of EIA and EMP report. The monitoring shall be carried out by NABL/MOEF/GoI approved laboratory.	Primary baseline data on ambient air quality, water quality, noise level, soil are collected from the study area for the period of Dec, 2013 to Feb, 2014. Datas are incorporated in Chapter-4.
21.	Air quality modelling should be carried out for prediction of impact of the project to the air quality of the area. It should also taken into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input	Air quality modelling has been carried out to predict impact of air quality due to project activities, discussed in detail in chapter 4. The chapter 5 discussed impacts and mitigation measures. The chapter 7 discussed the Impacts of movement of vehicles.

	parameters used for modelling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any and the habitation. The wind roses showing pre-dominant wind direction may be indicated on map.	
22.	The water requirement for the project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh Water requirement for the project should be indicated.	The minimum quantity water ie. 10.4 KLD is required for spraying on haul road, domestic usage for toilets and drinking purpose. This quantity of water will meet from river and well owned by PWD. Briefed in Table-2.6.
23.	Necessary clearance from the Competent Authority for drawal of requisite quantity of water for the Project should be provided.	Not Applicable
24.	Description of water conservation measures proposed to be adopted in the Project should be given. Details of rainwater harvesting proposed in the Project, if any, should be provided.	Not Applicable
25.	Impact of the project on the water quality, both surface and groundwater should be assessed and necessary safeguard measures, if any required, should be provided.	In this sand mining project, the study on removal of excess sand shoals to restore the river hydrological regime will not cause any increase in suspended solids. The over all drainage plan should be done in such way that the existing lean stream flow will not get affected by providing necessary number of pipes using sand and biogradable materials to approach the sand shoals. However, the existing water quality, both surface and ground water was assessed and propose to monitor continuously for every three months. Chapter 4,5 & 6.
26.	Based on actual monitored data, it may clearly be shown whether working will intersect groundwater. Necessary data and documentation in this regard may be provided. In case the working will intersect groundwater table, a detailed Hydro Geological Study should be undertaken and Report furnished. Necessary permission from Central Ground Water Authority for working below ground water and for pumping of ground water should also be	The object of sand mining is to remove the excess sand shoals above the river bed to restore the efficiency of barrage. However, the details ground water table in core zone and buffer zone are provided in Chapter 4. The project activity does not intersect the ground water table. Not Applicable.

	obtained and copy furnished.	
27.	Details of any stream, seasonal or otherwise, passing through the lease area and modification/diversion proposed, if any, and the impact of the same on the hydrology should be brought out.	The object of sand mining is to restore the hydrological section of river bed in upstream and downstream of newly constructed barrage. It will be ensured that the lean stream will not disturbed by providing necessary pipelines and forming the approaches using biodegradable materials, while removing the sand shoals. Chapter 2 & mine flow Chart 2.6.4
28.	Information on site elevation, working depth, groundwater table et. Should be provided both in AMSL and bgl. A schematic diagram may also be provided for the same.	The detailed contour of proposed area, cross section of working depth are discussed in detail of approved mining plan.
29.	A time bound Progressive Greenbelt Development Plan shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind, the same will have to be executed up front on commencement of the project.	There is a thick vegetational cover in either side of river bank. However, The green belt shall be developed in consultation with the local forest authorities regarding the selection of site specific species, seeding management, plantation techniques and their up keep by deseeding, manuring and regular watering. The budget provision of Rs.16.00 Lakhs has been alloted for the Green Belt development vide Table 9.1 and Chapter-9
30.	Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of the Project in the present road network (including those outside the Project area) should be worked out, indicating whether it is capable of handling the incremental load. Arran - gement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered.	As per IRC 64-1990 and IRC 86-1983, the proposed rise of PCU value due to movement of trucks does not alter the level of service of existing roads. Detailed proposal is discussed in Chapter-7
31.	Details of the onsite shelter and facilities to be provided to the mine workers should be included in the EIA report.	The shelter will be provided for workers at site. The detailed proposal is given in Chapter-9
32.	Conceptual post mining land use and Reclamation and Restoration of mined out areas (with plans and with adequate number of sections) should be given in the EIA report.	The object is to remove the sand shoals to reclamate the river bed to carry the maximum flood discharge. The conceptual post mine plan depicts vide fig 2.9
33.	A time bound Progressive Greenbelt Development Plan	There is a thick vegetational cover in either side of river bank. However, The green belt shall be

	shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind, the same will have to be executed up front on commencement of the project. Phase-wise plan of plantation and compensatory affore-station should be charted clearly indicating the area to be covered under plantation and the species to be planted. The details of plantation already done should be given.	developed in consultation with the local forest authorities regarding the selection of site specific species, seeding management, plantation techniques and their up keep by deseeding, manuring and regular watering. The budget provision of Rs.16.00 Lakhs has been alloted for the Green Belt development vide Table 9.1 and Chapter-9
34.	Occupational Health impacts of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations.	The workers engaged in quarry site have been provided with personal protective equipments like helmets, hand gloves, masks, safety shoes, goggles, ear plugs etc. Besides that, the rest shed will be provided at site for workers with first aid kits. The authorities will provide the required facilities at the Public Health Center at Sriramasamuthiram to conduct medical examination for pre-entry level workmen and staff Detailed proposal is discussed in Chapter-9
35.	Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations.	Detailed proposal is given in Chapter-6
36.	Measures of socio economic significance and influence to the local community proposed to be provided by the Project Proponent should be indicated. As far as possible, quantitative dimensions may be given with time frames for implementation.	The strong percentage of seinorage charges, ie nearly 20% of total revenue of project i.e. Rs.451.00 Lakhs will be given to local village panchayat to improve the road, drinking water schemes, health system, minor irrigation system, drainage system, community centres, afforestation and green belt development as a Corporate Social Responsibility. Detailed proposal is discussed in Chapter-4
37.	Detailed environmental management plan to mitigate the environmental impacts which, should inter-alia include the impacts of change of land use, loss of agricultural and grazing land, if any, occupational health impacts besides other impacts specific to the proposed Project.	Detailed proposal is given in Chapter-9

38.	Public hearing points raised and commitment of the project proponent on the same along with time bound action plan to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project.	Detailed proposal is discussed in chapter-7 vide Table 7.1
39.	Details of litigation pending against the project, if any, with direction/order passed by any Court of Law against the project should be given.	No litigation is pending against the project.
40.	The cost of the project (capital cost and recurring cost) as well as the cost towards implementation of EMP should clearly be spelt out.	Capital cost: 6.66 Crores Cost for implementation of EMP: 52.75 lakhs Recurring Cost: 13.20 Lakhs Cost for CSR Activities: 4.51 Crores
41.	Details of replenishment studies	The study on sedimentation analysis through theoretical and analytical method of calculation reveals the replenishment. Detailed proposal is discussed in Chapter-7.2
42.	Details of Transportation of mined out materials as per the Indian Road Congress for both the ways (loaded as well as unloaded trucks) load and its impact on Environment.	The proposed quarry operation is to load the sand averagely 300 lorry loads per day. The loaded lorry/trucks will directly enter into the State Highways through ODR and National Highway. The proposed transport route will bypass the village settlement. As per IRC 64-1990 and IRC 86-1983, the proposed rise of PCU value due to movement of trucks does not alter the level of service of existing roads. Hence, the impact on local transport infrastructure is much lower and considered to be negligible. Detailed proposal is discussed in Chapter-7.3 and alternate transport plan bypassing village settlement is enclosed vide figure No. 7.8
43.	Proper species specific Conservation Plan for Schedule-I and II species	Detailed study on fauna in study area of 10 KM reveals that there are Schedule I and Schedule II species are identified as per Wildlife (Protection) Act 1972 and detailed conservation plan and its budget are given in Chapter-7.4.
44.	Impact of mining on plankton	The study on plankton reveals that water is clear and free from pollution. The sand quarrying activity will not affect the life of plankton as they are well adapted with their locomotive ability to move fast to ensure their survival.Detailed proposal is given in Chapter-7.5.
45.	Details of mining activity to be provided	Detailed proposal is discussed in Chapter-2.
46.	Details of Gradient of river bed to be provided.	Detailed proposal is discussed in Chapter-7.6.
47.	Details of excavation schedule & sequential mining plan to be indicated.	Detailed proposal is discussed in Chapter-2 and mining plan.
48.	The base line data shall be collected so as to represent the whole mine lease area.	Primary baseline data on ambient air quality, water quality, noise level, soil are collected from the study area for the period of Dec, 2013 to Feb, 2014.Data is incorporated in Chapter-4.

1.4.2 METHODOLOGY ADOPTED FOR THE REPORT:

The methodology adopted for the preparation of EIA report is in line with norms prescribed by SPCB and MoEF along with sound advanced practices.

The major steps are,

- Collection and enumeration of base line data from State and District authorities.
- Physico chemical & microbiological analysis of ambient air, surface water, ground water and soil.
- Description of project activities and project components, Evaluation and Quantification of Impacts by using suitable method.
- Preparation of EMP by going through the details project report. Visit to site & different similar project by department.

1.4.3 STRUCTURE OF ENVIRONMENTAL IMPACT ASSESSMENT REPORT:

The report has been divided into ten chapters and presented as follows:

CHAPTER-1 – INTRODUCTION

The chapter provides the purpose of the report, background information of the proposed project, brief description of nature, size and location of project, estimated project cost, scope and organization of the study. The methodology adopted in preparation of this report have also been described in this chapter.

CHAPTER-2 - PROJECT DESCRIPTION

The chapter deals with the need of the project, location, environmental setting of the project, details of project, other technical and design details and sources of pollution from the proposed activity and measures proposed to control pollution.

CHAPTER-3 – ANALYSIS OF ALTERNATIVES FOR TECHNOLOGY AND PROJECT SITE

The technology and project site alternatives are discussed in the chapter.

CHAPTER-4–BASELINE ENVIRONMENTAL STATUS

The chapter presents the methodology and findings of field studies undertaken to establish the environmental baseline conditions, which is also supplemented by secondary published literature.

CHAPTER-5– ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

The chapter details the inferences drawn from the environmental impact assessment of the proposed project during various phases of project advancement, such as design, location of project, construction, and regular operations. It also describes the overall impacts of the proposed project activities and underscores the areas of concern, which need mitigation measures.

The chapter also provides recommendations/ Environment Management Plan (EMP) including mitigation measures for minimizing the negative environmental impacts of the project.

CHAPTER-6 – ENVIRONMENTAL MONITORING PROGRAM

Environmental monitoring requirements for effective implementation of mitigatory measures during operational phase have been delineated in this chapter.The chapter describes the institutional arrangements for environment protection and conservation during the operational stage of the Project.

CHAPTER-7 – ADDITIONAL STUDIES, PUBLIC HEARING, RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN

The Additional studies conducted as per the Terms of References issued in 14th meeting of the Reconstituted Committee of the Expert Appraisal Committee for Environmental Appraisal of Mining projects constituted under EIA Notification 2006 on 22-11-13 to carry out the Replenishment study, Details of transportation of mined out materials and plan to bypass the village settlement, Proper specific Conservation plan for Schedule-I and II species, Impact of mining on plankton, Details of mining activity, Details of gradient of river bed, Details of excavation schedule. In addition to that this chapter discussed the various risks associated during operational stage of the project. A disaster management plan to minimise the risks or to combat the associated risks is also discussed.

CHAPTER-8 – PROJECT BENEFITS

The chapter describes various benefits of the project to the community in the vicinity and as well as to the region on the whole.

CHAPTER -9 – ENVIRONMENTAL MANAGEMENT PLAN

Environment Management Plan have been proposed to take care of the environment in respect of air, water, noise, soil & the green cover of the project site and nearby villages. The proposed cost for environmental protection measures is Rs. 52.75 lakhs and its recurring cost is 13.20 lakhs per annum.

CHAPTER-10 –SUMMARY AND CONCLUSION

CHAPTER - 2
PROJECT DESCRIPTION

2.1 INTRODUCTION:

The brief history of the Tamil Nadu Public Works Department can be traced back to the period of the East India Company as far back as to 1820s. This is the third oldest Department, the first two being the Revenue Department and Judiciary. When many parts of India came directly under the British Crown, the Public Works Department had become the Government Department in 1858. Public Works Department is executing and maintaining all the Government buildings and all Irrigation Projects such as Dams, Canals, Tanks, Multi various works such as construction of buildings, roads, bridges, culverts, water harvesting structures.

2.1.1 TYPE OF PROJECT:

It is a project based quarrying to remove the shoals, to restore the designed storage capacity of barrage in upstream and increase the functional efficiency of discharge in downstream during the maximum flood. The area applied for grant of mine lease is on the river bed above the sill of barrage in upstream and downstream. The sand shoals above the river bed are to be quarried to make the river section hydro-logically safe. The mining plan has been prepared for production of 15,01,247m^3 for three year period.

2.1.2 NEED FOR THE PROJECT:

The construction of Barrage at Kattalai is an important inevitable in linking rivers in the southern peninsula which was proposed by National Water Development Agency (NWDA). Based on that, the Government of Tamil Nadu sanctioned an amount of Rupees 165 Cores for the construction of Barrage across the River Cauvery at 250 Meters downstream of existing Kattalai bed regulator in Mayanur village of Krishnarayapuram taluk in Karur district of Tamil Nadu in G.O.Ms.No.116 PW(N2) Dept. dated: 09.05.2008 under Accelerated Irrigation Benefit Programme.

The continuous deposition of sand on the upstream and downstream of Kattalai old bed regulator which is situated 250 meters, upstream side of new barrage on the river Cauvery has caused serious problem for the very existence of bed regulator itself . This envisages danger mark for the bed regulator. The solution to the above problem is to remove the sand shoals in the river by expending huge amount. Alternatively, the economical solution to this problem is to quarry the sand to remove the shoals. This option would yield net Revenue to the State exchequer apart from making available the important construction material for infrastructure development at a reasonable price to the common people.

2.2 LOCATION:

The mining lease area falls in Sriramasamuthiram and Silaipillayaputtur villages of Thottiyam taluk in Trichy district of Tamil Nadu state. The location is in the upstream and downstream of Kattalai bed regulator in Cauvery river at mile 85/0 from Mettur reservoir project.

The above area lies in the coordinates of

	Latitude	**Longitude**
NW	- 10°57'46.0"N	78°12'28.9" E
NE	- 10°58'02.1"N	78°13'38.7" E
SW	- 10°57'29.4"N	78°12'28.5" E
SE	- 10°57'57.5"N	78°14'28.0"E

The location map is as shown in Fig. 2.1& Fig. 2.2

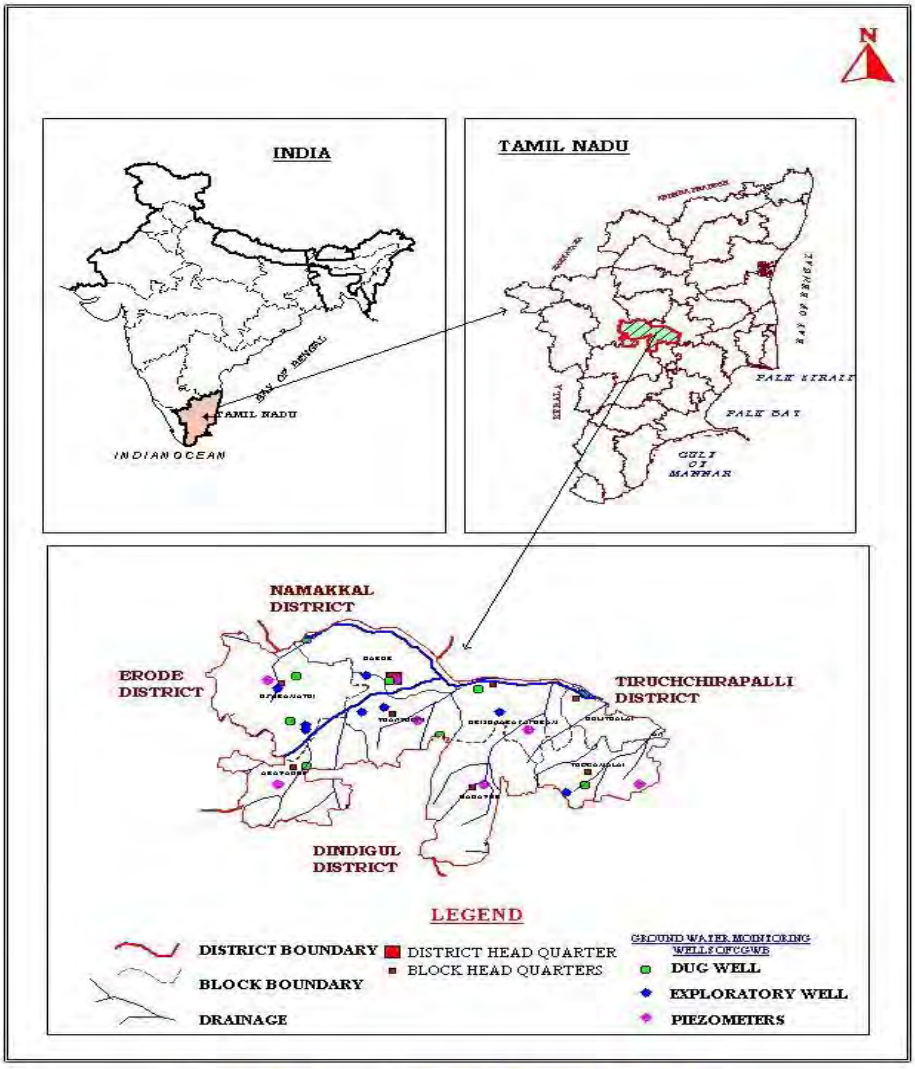


Fig-2.1 LOCATION MAP

Figure 2.2 Google Map Showing Location of the Project

2.2.1 INFRASTRUCTURE:

2.2.1.1 ROAD:

Sriramasamuthiram and Silaipillayaputtur villages of Thottiyam taluk in Trichy district are well connected by good roadways maintained by the State Government and Panchayat bodies. The applied area is river bed of Cauvery and well connected with Panchayat road and river bank.

In Northern side of Sriramasamuthiram and Silaipillayaputtur villages, the Salem to Trichy State Highways (SH-25) is 12 KM away and it is well connected to the quarry site through village road and river bank. In southern side Karur to Trichy, National Highways (NH-67) is running between Trichy and Karur.

Approximate road distance from major town is as follows.

- Kulithalai 20 KM
- Karur 21 KM
- Musiri 25 KM
- Thottiyam 15 KM
- Trichy 65 KM

2.2.1.2 RAIL:

A section of broad gauge (Southern railways) line passes through Mayanur village to the south of lease area. This railway line links Trichy and Karur.Passengers train from Trichy to Karur, Trichy to Erode and Mayiladuthurai to Mysore Express passes via Mayanur making the local villagers to commute easily to various places.

2.2.1.3 AIR:

The nearest airport is at Trichy, approximately 65 KM away.

The site is well connected with communication facilities like Telephone, Fax, Wireless and Telex and as such, no constraints are envisaged in this aspect as the Tehsil and District head quarters are near to the site.

2.3 PHYSIOGRAPHY (Topography and Drainage):-

(i) Regional physiography:-

This part of South India experiences semi-arid climatic conditions with moderate rainfall averaging about 630mm per year. The river Cauvery is perennial river in this region. The seasonal streams and river inlets which get activated during monsoon, often confluence in to river Cauvery which ultimately debauches in the Bay of Bengal which is 200KM away from the project site, the basin map is enclosed vide fig 2.3

(ii) Local physiography:-

Topographic elevation varies from 101.00m to 95.70m above MSL. The area applied for is river bed in which sand shoals are formed above the sill of the barrage. The shoal formations above the barrage affect the proposed storage capacity of the barrage and decrease the efficiency of discharge in downstream side during maximum flood. The drainage map is enclosed vide Fig. 2.4

2.4 GEOLOGY:-

2.4.1 REGIONAL GEOLOGY:-

The region falls mainly under cretaceous rock formations. The regional rock formation is the largest granulite block of southern granulite terrain of India. It is bounded by Palghat Cauvery shear zone in the north and Achankoil shear zone in the south. It is dominantly composed of high grade metasedimentary rocks, mafic granulites, highland charnockites, Massif Anorthosites and related rocks. The river Cauvery is flowing on the northern and eastern boundaries. Refer Regional Geological Plan vide fig 2.5

2.4.2 LOCAL GEOLOGY:-

The area falls under recent alluvial formation. The sand produced by the tide and flow of river Cauvery. The sediments of the river Cauvery are derived from Archean gneissic and charnockitic source regions. The sediments possess the geochemical signature of prominently exposed source of rocks for almost all elements.

The formation of sandy bed in U/S and D/S of Barrage based on bore log details reveals that 14m and 9.5m respectively. The soil sample report and chemical analysis report is herewith enclosed vide table 2.1- 2.2 and particle size distribution curve for upstream and downstream soil samples depicted in fig 2.6 - 2.7 based on the analysis of soil sample by National Institute of Technology, Trichirapalli-620015. The chemical analysis reveals that the presence of Mica, estimation of oxides of other elements and Al., etc. is found to be small enough to ignore.

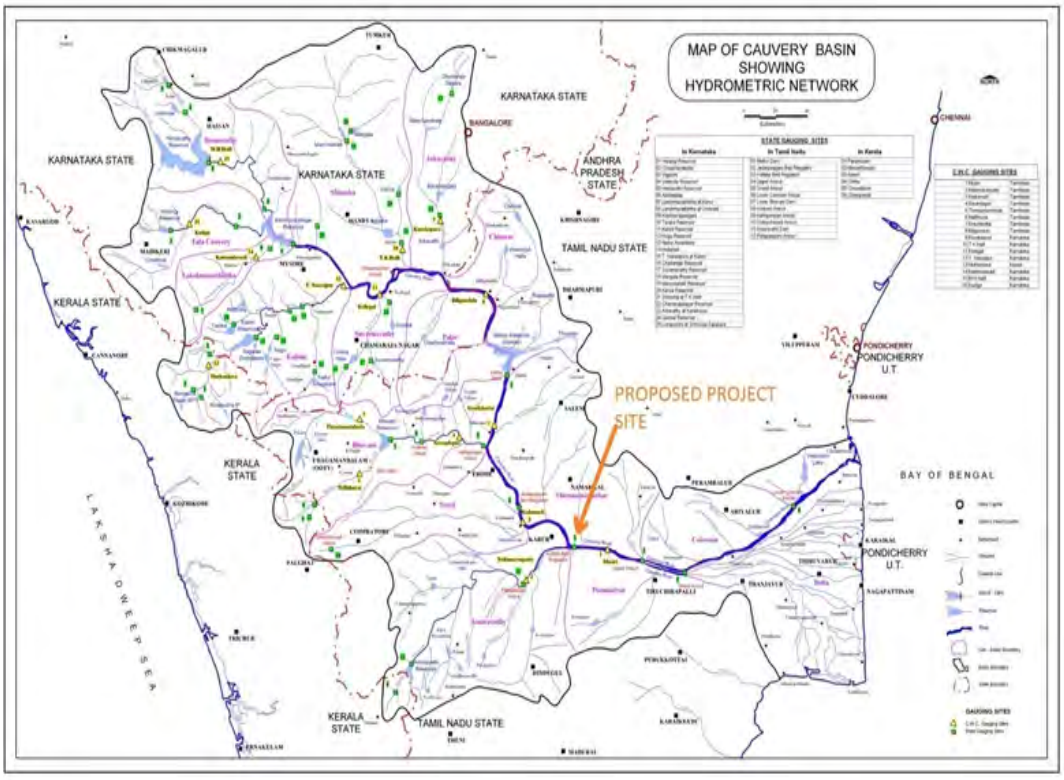


FIG 2.3 CAUVERY RIVER BASIN MAP

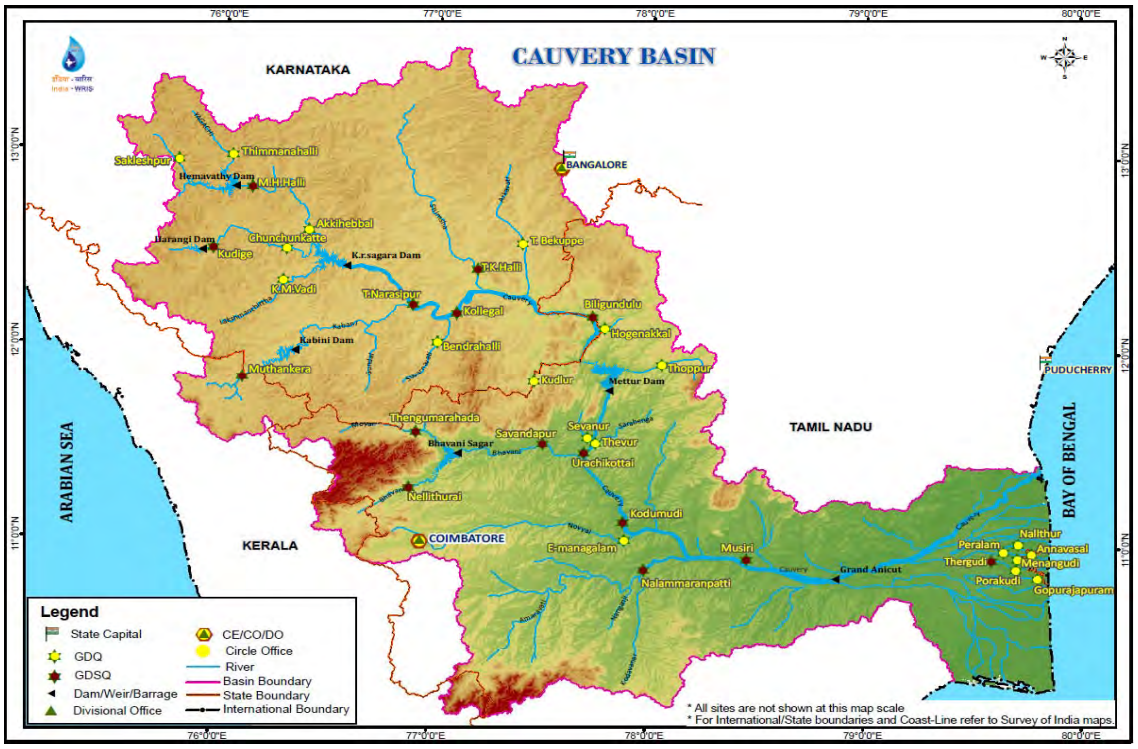


FIG 2.4 Drainage Map

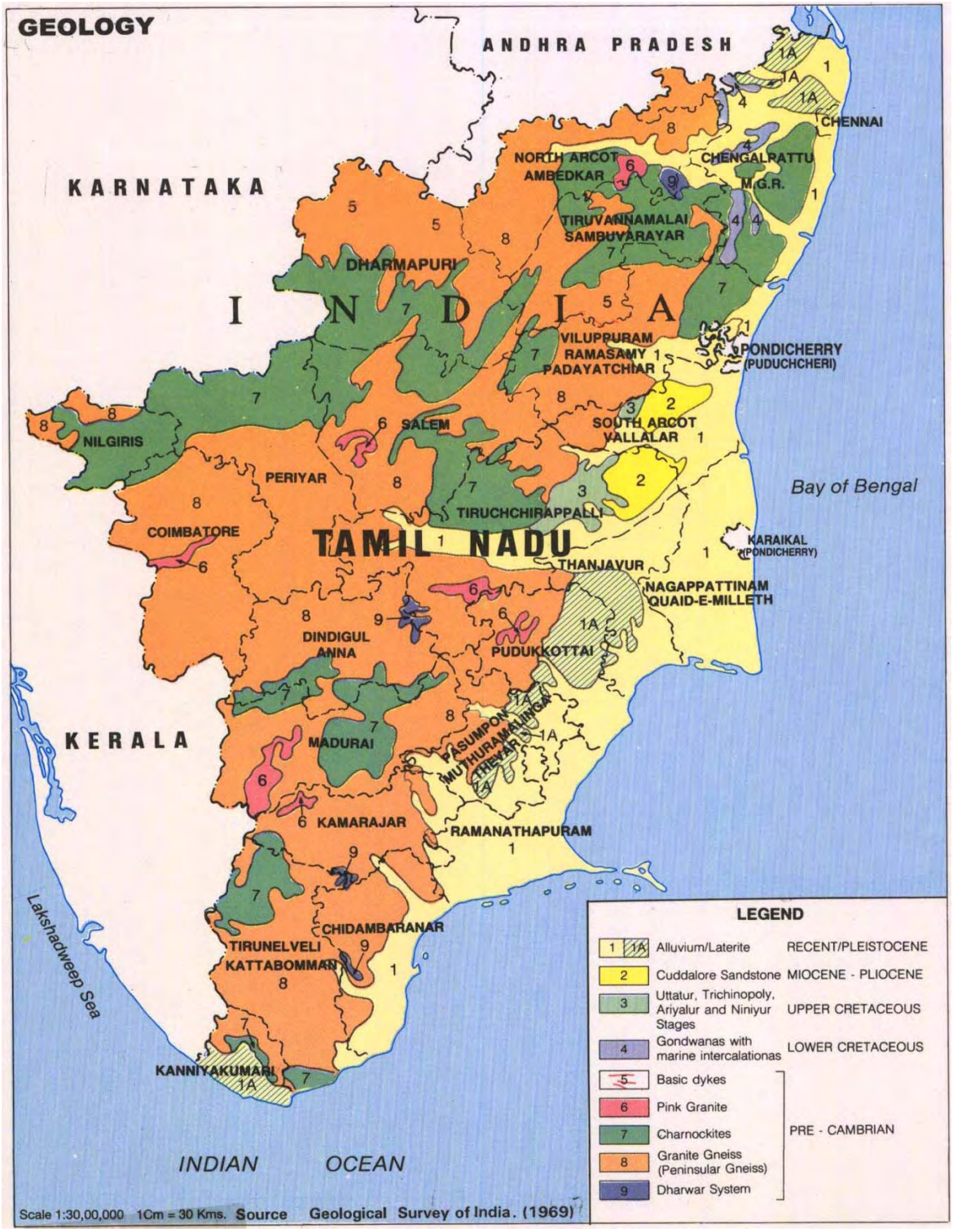


FIG 2.5 GEOLOGICAL MAP

Table 2.1

Soil Sample Report

Up Stream Samples

Depth, m	Sand, %	Clay, %	Silt, %	Remark
1.426	93.25	4.81	1.94	Sandy
2	92.66	5.66	1.68	Sandy
3	92.78	5.13	2.09	Sandy
4	94.12	5.07	0.81	Sandy
5	93.18	5.1	1.72	Sandy
6	93.88	4.94	1.18	Sandy
7	94.64	5.21	0.15	Sandy
8	86.84	9.42	3.74	Sandy, Dark
9	90.66	7.61	1.73	Sandy
10	88.41	7.89	3.7	Sandy, Dark
11	87.48	8.13	4.39	Sandy, Dark
12	85.12	8.9	5.98	Sandy, Dark, soft
13	83.16	9.61	7.23	Sandy, Dark, soft
14	82.14	9.88	7.98	Sandy, Dark, soft

Chemical Analysis

Depth, m	Silica, %	Fe, %	Ca, %	Mg, %	Mica, %
1.426	92.13	0.66	0.11	0.02	0
2	90.37	0.62	0.09	0.04	0
3	91.24	0.61	0.09	0.04	0
4	92.11	0.67	0.11	0.03	0
5	91.45	0.61	0.1	0.04	0
6	91.89	0.65	0.12	0.03	0
7	92.86	0.64	0.12	0.03	0
8	90.19	0.68	0.12	0.04	0
9	88.78	0.71	0.11	0.03	0
10	86.31	0.77	0.22	0.05	0.002
11	84.14	0.76	0.21	0.04	0.003
12	82.43	1.81	0.28	0.11	0.002
13	80.33	1.82	0.27	0.09	0.002
14	78.125	1.78	0.32	0.05	0.003

Average size (1.95m depth), D50: 1.45mm

Uniformity coefficient, D60/D10: 1.764mm

Table 2.2

Down Stream Samples

Depth, m	Sand, %	Clay, %	Silt, %	Remark
1.95	92.97	4.31	2.72	Sandy
2	92.54	4.11	3.35	Sandy
3	92.9	4.51	2.59	Sandy
4	92.66	4.32	3.02	Sandy
5	93.17	4.43	2.4	Sandy
6	93.7	4.22	2.08	Sandy
7	92.66	4.61	2.73	Sandy
8	91.33	4.57	4.1	Sandy, Dark
9.5	89.57	5.91	4.52	Sandy, Dark

Chemical Analysis

Depth, m	Silica, %	Fe, %	Ca, %	Mg, %	Mica, %
1.95	91.8	0.64	0.13	0.03	0
2	91.74	0.61	0.14	0.03	0
3	92.34	0.58	0.06	0.02	0
4	91.61	0.63	0.06	0.001	0
5	92.91	0.43	0.008	0.005	0
6	93.22	0.3	0	0	0
7	91.6	0.39	0	0.001	0
8	89.78	0.57	0	0.001	0
9.5	88.89	0.41	0	0.002	0

Average size (1.95m depth), D50: 1.5mm

Uniformity coefficient, D60/D10: 2.11mm

19/4/13

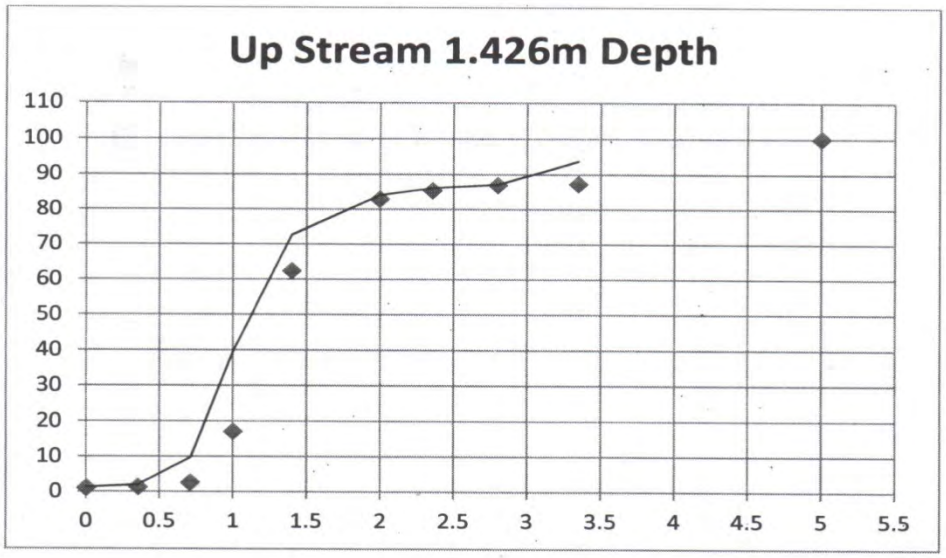


Figure : 2.6 PARTICLE SIZE DISTRIBUTION

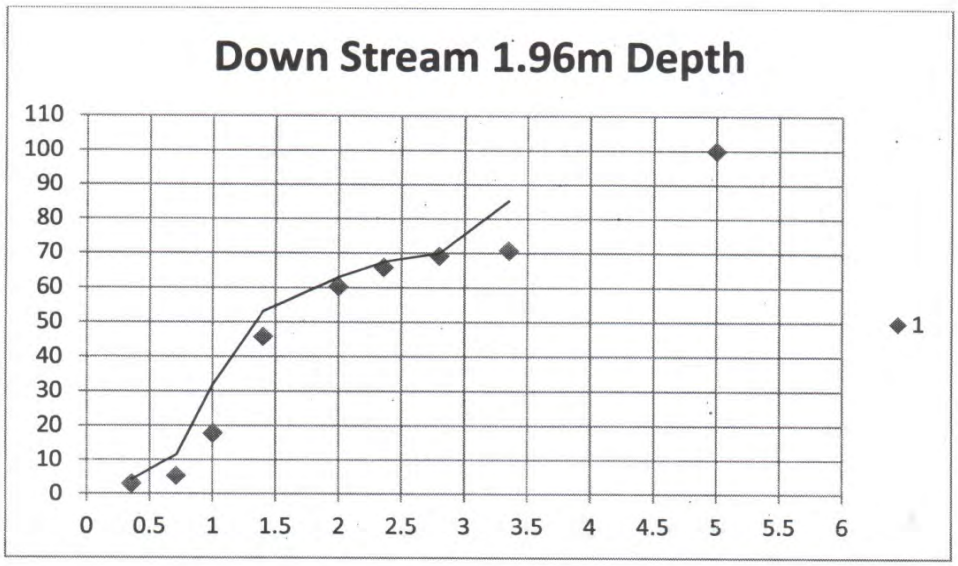


Figure : 2.7 PARTICLE SIZE DISTRIBUTION

2.5 RESERVES AND QUALITY OF SAND :-

The area applied for grant of ML is on the river bed, the entire overburden shoals (ie.,0.76m avg.) above the sill of barrage in upstream and downstream is purely sand. The sand shoals above the river bed are to quarry to make the river section hydro-logically safe. There is no top soil,overburden or mineral rejects. The study reveals that the total depth of sand available in upstream and downstream is 14m and 9.5m respectively.

As the entire stretch consists of shoals with different height over the river bed, the calculation of resource and reserves are taken in block method. The sum total of each block gives the geological resource of the area applied for lease. As there are no

wastages during the quarry operation, the geological resources are considered as recoverable reserves.

Table 2.3 depicts the total recoverable resources in block 1&2 in Silaipillayaputtur village and Block 3 in Sriramasamuthiram village for three years.

Table 2.3 (Recoverable Resource)

SI.No	Village	Blocks	Section	L (m)	W (m)	D (m) (Avg)	Volume (Cum)	ROM (Cum)
1	Silaipillayaputtur	Block1	X1Y1- CD	900	523	1.400	660284	660284
		Block2	XY-AB	780	686	0.341	182791	182791
2	Srirama samuthiram	Block3	XY-AB	1516	627	0.692	658172	658172
							TOTAL	**1501247**

The average size of particle (ie., D50) in upstream and downstream is 1.45mm and 1.50mm, which represent the sand is medium grained, most suitable for construction.

2.6 MINING:-

The overburden shoals above the sill of newly constructed barrage to quarry to make the river section hydro-logically safe. The earth moving machineries like excavators are to deploy to load the sand directly to the public carrier vehicles.

2.6.1 PROPOSED METHOD OF MINING:-

Open cast method of shallow mining is proposed by using two number of earth moving machineries like excavators in blocks of each revenue village for quarrying the sand in shoals. No drilling or blasting is proposed for this type of desilting, by way of sand quarrying, it is a conventional, eco- friendly quarrying operation. By using the earth moving machineries sand will be loaded directly to the trucks/ lorries for transportation to the needy customers. Initially to approach the quarrying site from village roads, a temporary road will be formed by using of sand mixed with bio-degradable materials and formed a grid around the sand quarrying site to move the vehicles easily. During formation of the approach road and grid, necessary temporary hume pipes will be provided wherever necessary for free flow of lean stream water to downstream.

The trucks are loaded by excavators under the direct supervision of the Assistant Engineer, Public Works Department. The supervisors will also be deployed for the safety movement of vehicles inside the quarries. In this process contract labours from neighbouring villages are engaged for the purpose of maintaining the approaches, regulating the vehicle movements, assisting to take levels, issuing of permits etc., to regulate the quarry in a scientific and systematic manner. After that the loaded vehicles are allowed to go out after covering the sand load properly by tarpaulin to avoid any spillage.

Since the sand is well graded, it is scooped by excavator and directly loaded on trucks/lorries, the dust generation is negligible. However, the water continuously sprinkled on approach road and village roads to avoid dust generation by movement of trucks using water tanker vehicle driven by tractor.

2.6.2 DETAILS OF PROPOSED PRODUCTION:-

The mining plan has been prepared for production of 15,01,247 m^3 for three year period. It is project based quarrying to remove the shoals, to restore the designed storage capacity of barrage in upstream and increase the functional efficiency of discharge in downstream during the maximum flood. Please refer table 2.4 and fig 2.8 for year wise development and production.

Table 2.4 year wise production

Sl. No	Village	S.F No	Block No	Yearly Production			Total Qty in CuM
				1st Year	2nd Year	3rd Year	
1	Silaipillayaputtur	288	I	175516	208713	276055	**660284**
			II	104653	43156	34982	**182791**
2	Sriramasamuthiram	293	III	254993	201395	201784	**658172**
						Total	**1501247**

2.6.3 PIT CONFIGURATION:-

The entire ML area is divided in to three longitudinal slice along the direction of river in upstream and downstream of barrage in block 1and 2 in Silaipillayaputtur village and block 3 in Sriramasamuthiram village. The proposed quarrying is starts from slice from middle of river in first year and ends on outer slice along the river bank. Please refer slice plan in fig 2.8

The conceptual reclamation plan in fig 2.9 depicts the reclamation of river bed by removing of excess overburden shoals above the sill of barrage. It implies that the mining on sand shoals itself is a reclamation measure to make the river cross section hydro-geologically safe.

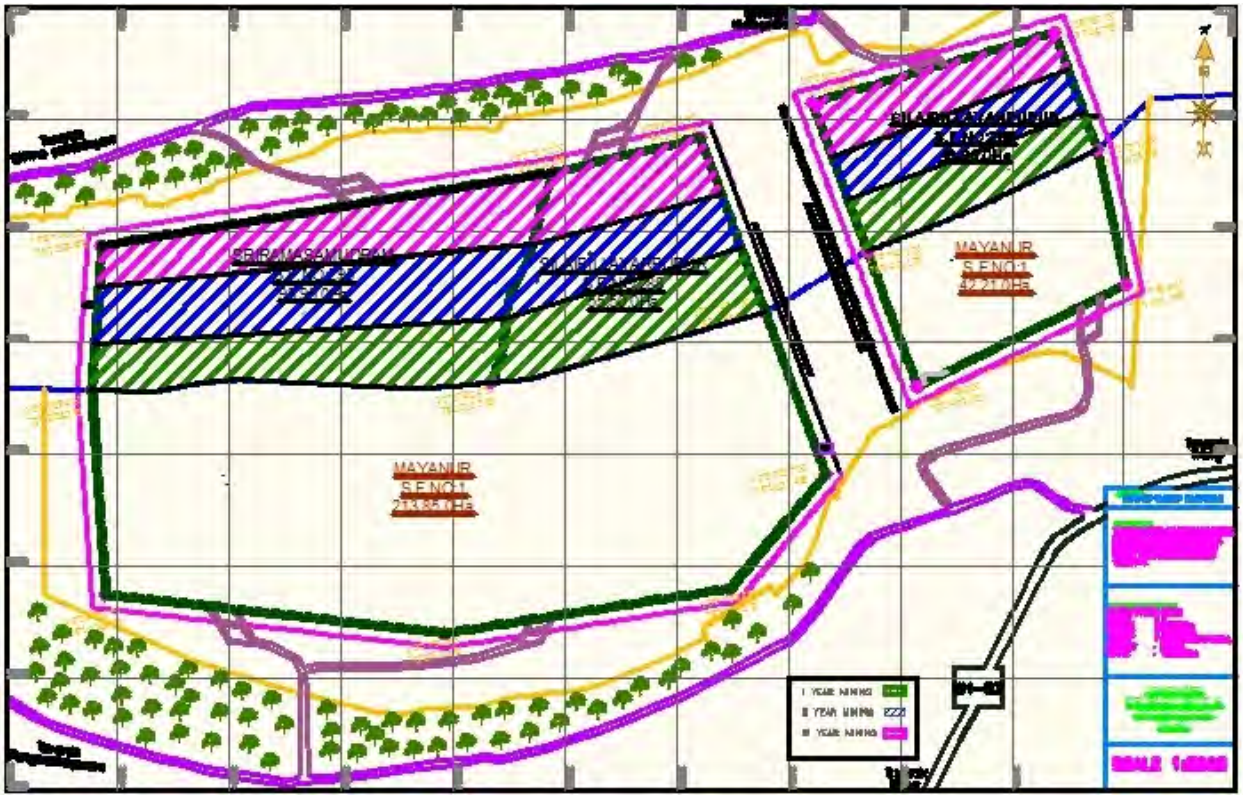


Fig. 2.8 Yearwise Production Plan

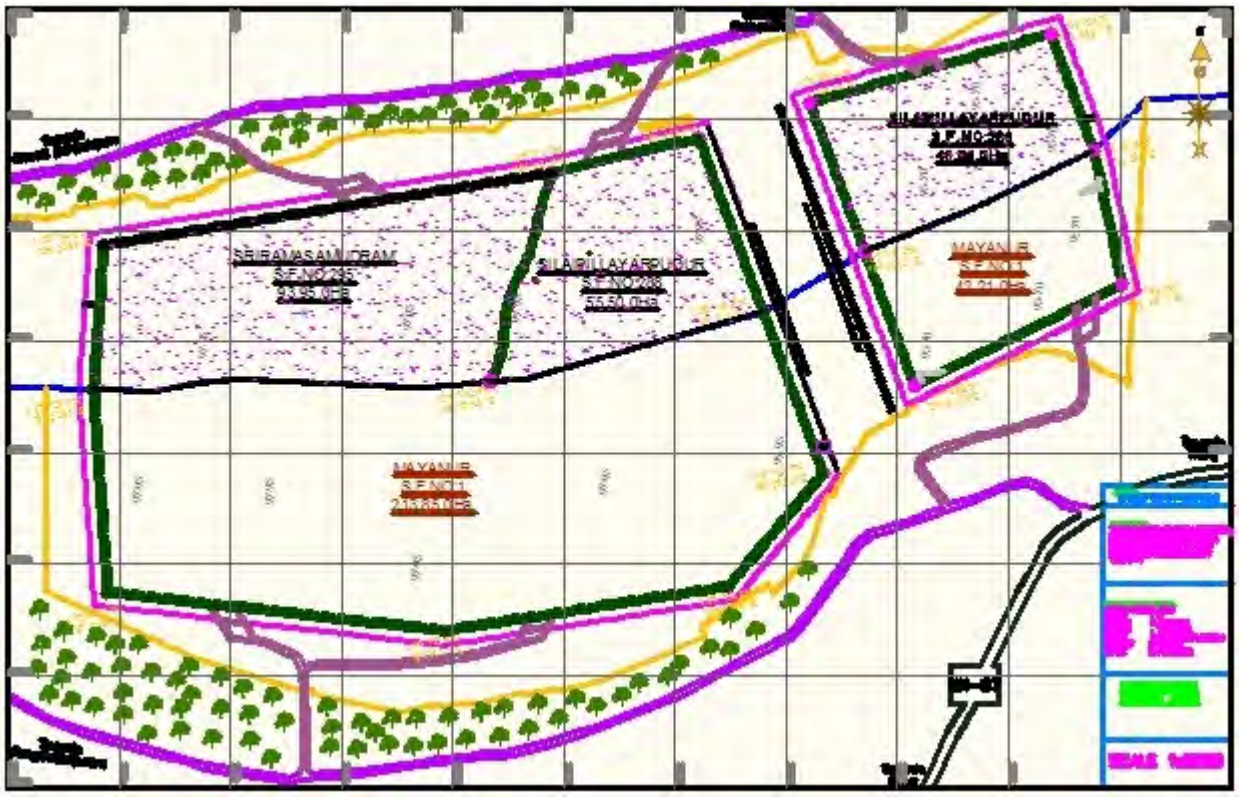
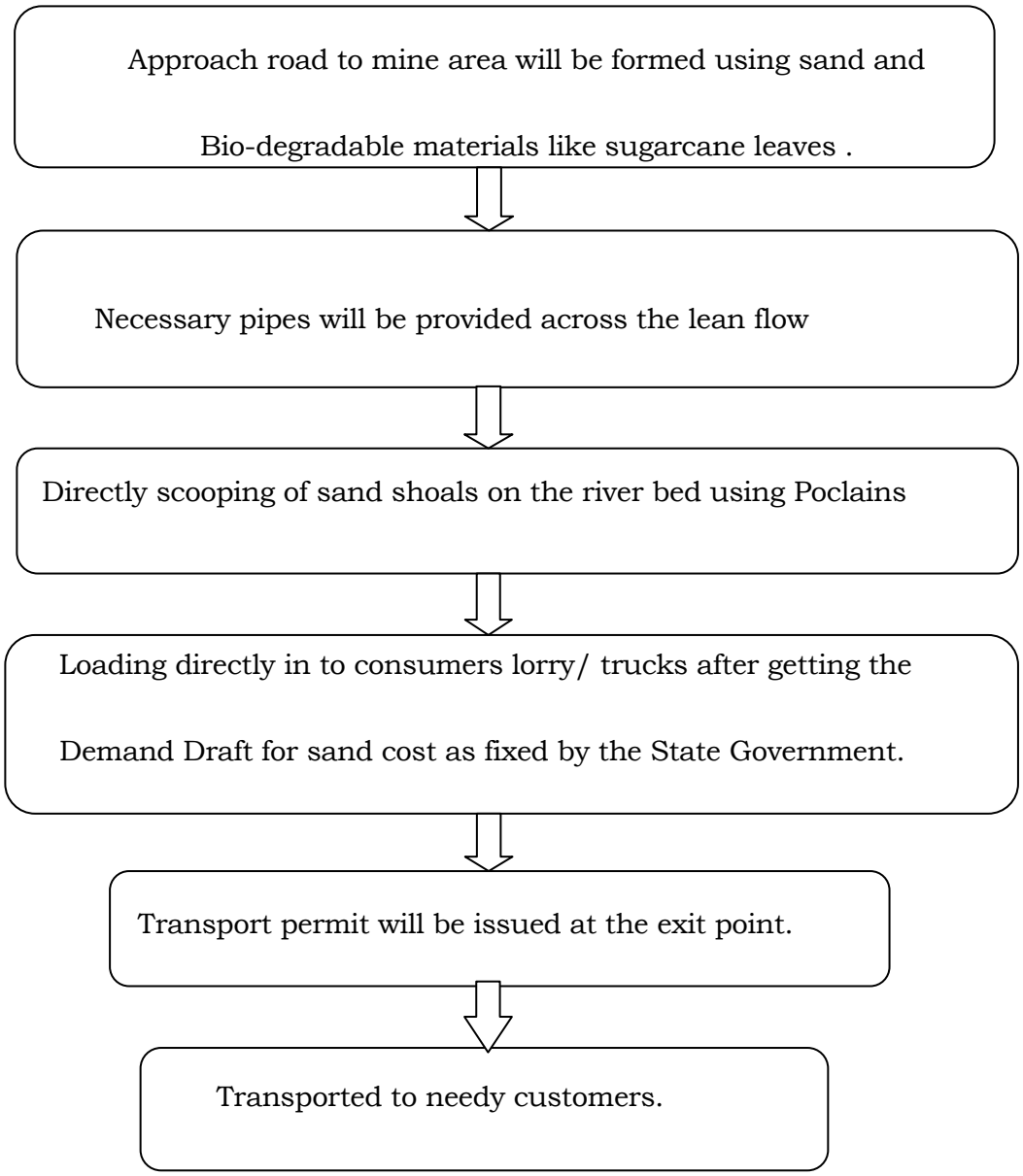


Fig. 2.9 Conceptual Reclamation Plan

2.6.4 MINE FLOW CHART



2.7 EXTENT OF MECHANIZATION (EQUIPMENT DETAILS):-

2.7.1 EQUIPMENT SELECTION

Selection of major mining equipment is an integral part of mine production plan. Here the object of Public Works Department, Government of Tamil Nadu is to remove the overburden sand shoals above the sill of newly constructed barrage in upstream and downstream to restore the designed storage capacity of 1.04 TMC and increase the efficiency of flood discharge through barrage during maximum flood, with in the period of three years.

The major factors considered for equipment selection are:-

1. Quantity of production.
2. Mining practice.
3. Geography

4. Geological and Geo-Technical characteristics.
5. Considering Environment.
6. Equipment availability, Maneuverability and support.
7. Economics.

List of Mining Machineries and other to be deployed are given Table No.2.5 as follows.

Table 2.5 Machineries and other to be deployed

S.No	Name of Machinery	Nos.	M^3/Hr.	Capacity
1.	Excavator 200-220	2	80	0.90 cu.m.
2.	Water sprinkler	2		10000 Ltr.

2.7.2 JUSTIFICATION OF THE MINING MACHINERIES:-

EXCAVATOR 200-220

The Public Works Department is proposed to remove the sand shoals of 1501247 m^3 for three years.The average rate of removal per year is 5,00,000 m^3. The average number of working days per year is 300.

The proposed number of Excavators deployed = 2Nos.

The average production per day =1600 m^3

The bucket capacity of excavator =0.90 m^3

The proven capacity of excavator to load the sand in to lorry/ trucks =80 m^3/Hr.

The average production per day (10Hrs. ie., 07.00am to 5.00 pm) per excavator =800 m^3/Hr.

Hence, it is justified the use of two excavators to load the sand of volume 1600 m^3 per day for an average of 300 working days per year.

The other machineries like water sprinkler will need auxiliary equipment. The requirement of machinery has been carefully assessed to meet the requirements.

2.8 WATER REQUIREMENT:-

Table 2.6 Water Requirement details

a.Drinking	0.1 KLD	Brought from the nearby community wells after obtaining permission from panchayat authorities or from approved water vendors.
b.Domestic Purpose	0.3 KLD	For Domestic purpose will be brought from well owned by PWD.
c.Dust Suppression and Afforestation	10 KLD	For dust suppression will be brought from river.

2.9 EMPLOYMENT POTENTIAL:-

Table 2.7 Employment details

Technically Skilled		
1. PWD Engineers	:	1 No.
Total	**:**	**1 No.**
Skilled		
1. Excavator Operators	:	2 Nos.
2. Co-operators	:	2 Nos.
Total	**:**	**4 Nos.**
Semi-Skilled		
1. Supervisors / clerks	:	**2 Nos.**
Un-Skilled		
1. Helpers	:	8 Nos.
2. Watchman	:	2 Nos.
3. Office boy	:	1 No.
Total	**:**	**11 Nos.**
Grand Total	:	**18 Nos.**

2.10 SUPPORT FACILITIES:-

It is proposed to create the temporary office shed to issue permit and rest shed for labours in outside of river bund.

2.10.1 SANITARY WASTE SYSTEM OF THE MINE:-

It is proposed to construct eco toilet with septic tank and chock pit outside of river bund.

CHAPTER-3

ANALYSIS OF ALTERNATIVES FOR TECHNOLOGY AND PROJECT SITE

3.1 ANALYSIS OF ALTERNATIVE SITE:

The Public Works Department is proposed to produce the capacity of 15,01,247 M^3 in Sriramasamuthiram and Silaipillayaputhur villages of Thottiam tehsil of Trichy district.

The present site has the following advantages

- To remove the shoals above the sill in U/S and D/S of newly constructed barrage through quarrying. The removal of Sand will restore the storage capacity ie. 1.04 TMC of water during non Mettur season in upstream side and to increase the functional efficiency of discharging the maximum flood in downstream side.
- To influence the better recharge of sandy bed by storing water during non Mettur season. It will be useful for number of existing and proposed drinking water schemes during summer season when the flow in the river is minimum.
- To ensure the proper gradient of river.
- To protect the flood bank by restoring the flood carrying capacity.
- To make available the sand in the open market at a reasonable price.
- To optimize the use of the natural resources.
- Augmentation of the revenue to the State exchequer by quarrying the sand instead of spending huge amount to quarry sand shoals.
- Site is well connected with NH-67 which is at a distances of 1.0 KM away from the project site.
- No eco-sensitive areas within 10 KM of the project site.

3.2 ANALYSIS OF ALTERNATIVE TECHNOLOGY:

- Excavators are used to quarry the sand shoals on river bed and directly loaded in to Public carrier trucks.
- Temporary biodegradable pathways are provided using sugarcane leaves and sand bucket elevators are provided for raw material lifting.
- Waste water from Eco-Toilet will be discharged safely into septic tank outside the river bank.

Hence, the question of seeking alternate technology is not warranted.

CHAPTER-4

DESCRIPTION OF THE ENVIRONMENT

4.1 STUDY AREA:

The study area is the buffer zone of 10KM radius measured from the boundaries of the project boundary in every direction. The buffer zone area falls in Thottiyam Tehsil in Trichy District and Krishnarayapuram Tehsil in Karur District.

The study area falls on survey of India Toposheet No. 58 J/1 and the study area marked vide Annexure 4.1.

There were 26 villages, two town panchayat (Krishnarayapuram and P.J. Cholapuram) in Karur District and one town Panchayat (Kattuputhur) in Trichy District. The total population in these villages is 2,29,559 persons. The total male population is 1,14,301 and female population is 1,15,258. It is observed that there are only 6 villages with more than 5000 population. All the remaining villages, the population is less than 5000. The total literacy in the study area is 65.30% of the population.

Silaipillayaputhur village (0.76 KM away in North East), Sriramasamudram village(0.76 KM away in North West), Mayanur (1.00 KM away in South East), Kattalai (1.00KM away in South West) are the nearest villages to the proposed quarrying site.

4.2 BASELINE ENVIRONMENT:

The main objectives of environmental baseline study are (i) to assess present environmental quality and the environmental impacts and (ii) to identify environmentally significant factors that could preclude project development. The chapter contains information on existing environmental scenario for the following parameters.

1. Meteorology
2. Air Environment
3. Noise Environment
4. Water Environment
5. Land Environment (Land use Pattern & Soil Environment)
6. Biological Environment
7. Socio-Economic Environment

To achieve these objectives, air quality, noise parameters,water quality and soil Environment monitored by the National Institute of Technology, Trichy. The Biological Environment i.e., study on Flora and Fauna for the study area of 10Km radius was carried out by the Department of Environmental Science, Bishop Heber College, Trichy. This chapter and the related discussions contain the results of field studies carried out during the winter season ie. 1st December' 2013 to 28th February' 2014.

4.3 METEOROLOGY:

4.3.1 GENERAL METEOROLOGY OF THE AREA:

The climate of Trichy district varies moderately. The summer temperature reaches upto 40.2° Celsius and Winter temperature down to 15.0° Celsius.

The average rainfall is 356.1 millimeters in North East Monsoon and 270.3 millimeters in South West Monsoon. Monthly rainfall data for the years 2009 to 2013 is given in Table 4.1. Variation of monthly rainfall is shown in Figure 4.1

Table 4.1: Monthly Rainfall (mm) data of Trichy District 2009 to 2013

Year	January		February		March		April		May		June	
	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP
2009	7.6	-48	0.0	-100	3.6	-70	19.2	-46	28.8	-54	21.1	-19
2010	7.5	-49	0	-100	0	-100	1.7	-95	131.5	121	62.3	114
2011	1.9	-86	3.2	-65	2.9	-75	78.1	103	16.7	-72	5.9	-81
2012	7.9	-68	8.3	-54	35.9	23	28	-46	8.9	-71	0	-100
2013	0.8	-94	5.7	-37	14.4	22	1.6	-96	42.2	-29	5.4	-83
Year	July		August		September		October		November		December	
	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP
2009	8.4	-83	109.4	53	92.4	-26	32.4	-81	269	129	83.9	28
2010	46	-15	81	5	67.9	-49	128.1	-30	`282.2	118	97.9	33
2011	18.2	-66	114.1	55	125.8	-7	224	29	225	61	32.5	-59
2012	0	-100	0.4	-97	0	-100	198	31	99	-47	33.4	-63
2013	1.3	-98	83.3	13	117.9	-13	85.5	-51	127.1	-9	37.7	-52

Note : (1) The District Rainfall in millimeters (R/F) shown below are the arithmatic averages of Rainfall of Stations under the District.
(2) % Dep. are the Departures of rainfall from the long period averages of rainfall for the District.

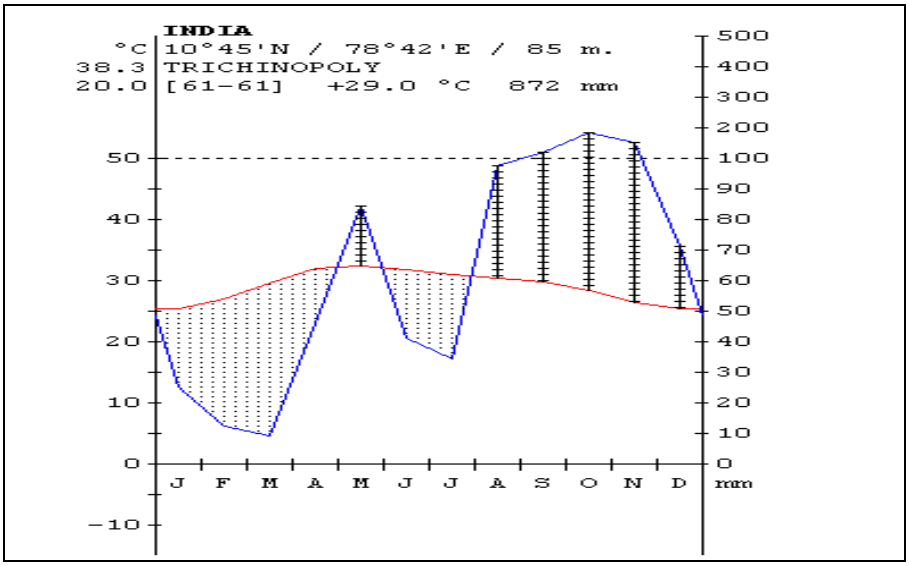


Figure 4.1 Variation of monthly rainfall - Trichy District

Source:http://www.globalbioclimatics.org/plot/in-trich.htm

General climate condition of the Trichy district is given in Table 4.2 and monthly average temperature of Trichy district is given in Figure 4.2.

Table 4.2 Climatic condition of District Trichy

Month	Temparature °F		Monthly Average rainfall in mm		Average snow days	Average Fog days
	Max	Min	Daily	Monthly		
January	86.9	69.1	0.5	14.1	0	1
February	91.4	70.7	0.4	11.5	0	0
March	96.4	74.1	0.8	24.4	0	0
April	99.1	78.6	1.5	44.2	0	0
May	100.0	79.5	2.4	75.1	0	0
June	98.2	79.5	1.6	47.9	0	0
July	97.0	79.0	1.9	59.2	0	0
August	96.3	78.1	2.4	73.4	0	0
September	95.0	76.8	4.1	121.7	0	0
October	90.5	75.4	5.2	160.8	0	0
November	86.5	73.2	6.6	196.5	0	0
December	85.1	70.0	3	92.3	0	0

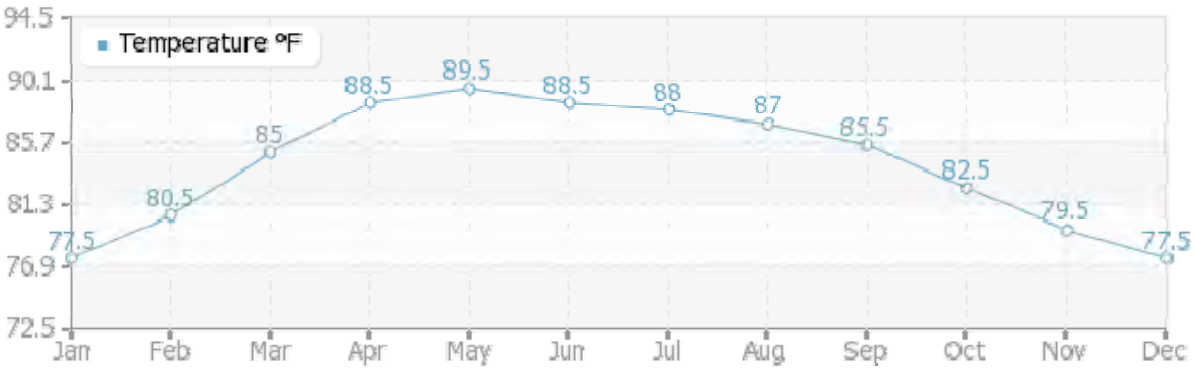


Figure 4.2 Average Monthly Temperature – Trichy District

Source:http://www.meoweather.com/history/India/na/10.805/78.685556/Trichy.html

4.3.2 MICRO METEOROLOGY OF THE STUDY AREA:

Meteorology plays vital role in affecting the dispersion of pollutants, once discharged into the atmosphere. Since meteorological factors show wide fluctuations with time, meaningful interpretation can only be drawn, when the parameters like temperature, wind speed, wind direction, rainfall etc. are closely observed.

The Public Works Department, Hydrology section, Mayanur maintains an All Weather Station at Mayanur a kilometre away from proposed quarry site. The hourly readings of wind velocity, wind direction, temperature, relative humidity, rainfall, sunshine were recorded continuously. The datas are given to Indian Meteorological Department, Government of India.

The collected monthly abstract of hourly data of wind parameters viz., wind velocity, direction, temperature, relative humidity along with rainfall data are presented on Annexure 4.2, the wind roses are drawn and presented as fig.4.3-4.5

Station Name	District	Lattitute	Longitute
Mayanur	Karur	10°57'21"	78°14'23"

During the monitory period in the study area, the predominant winds were from South East quadrants. Wind velocity readings were recorded in the range 0 to 6 KM/Hour with a mean value of 2.39 KM/Hour , temperature readings were ranging from 10.4 to 35.4°C (degree Celcius) and the mean temperature value was 23.78°C. The relative humidity values were ranging @ 08.30 Hrs. is in between 76 to 96%, @ 17.30 Hrs. is in between 37 to 100% and the mean value was 71.24%. The clear and partly cloudy sky prevailed most of the times and there were 4 rainy days during the monitoring period which accounted for 49 mm of rainfall.

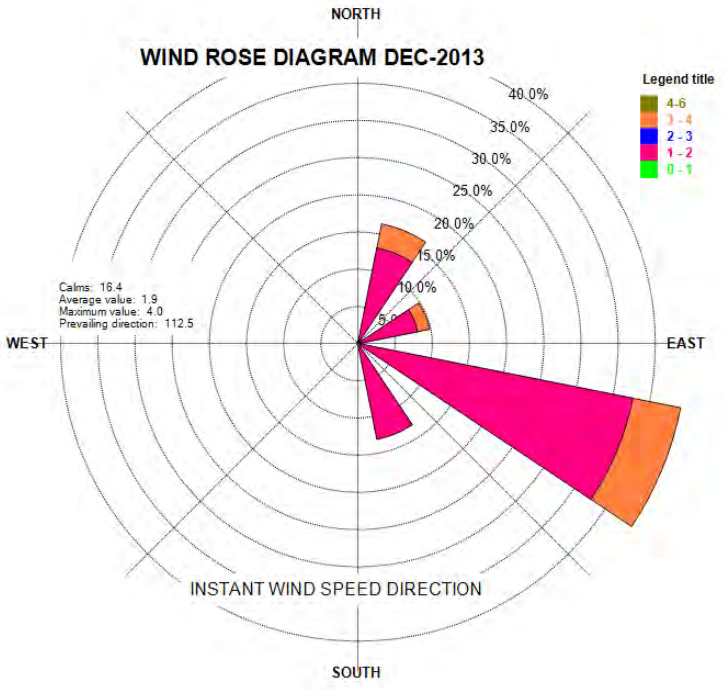


Figure 4.3 Wind Rose Diagram for December 2013

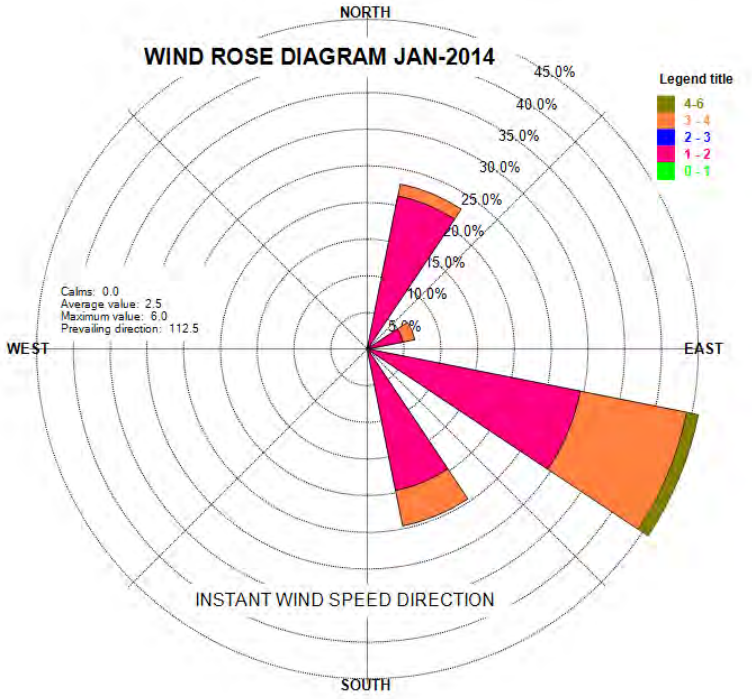


Figure 4.4 Wind Rose Diagram for January 2014

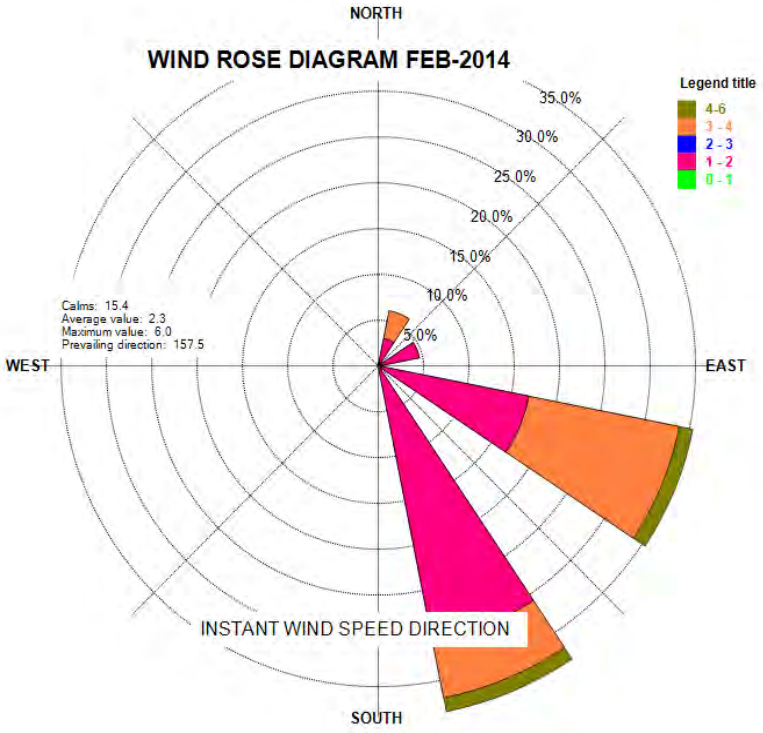


Figure 4.5 Wind Rose Diagram for February 2014

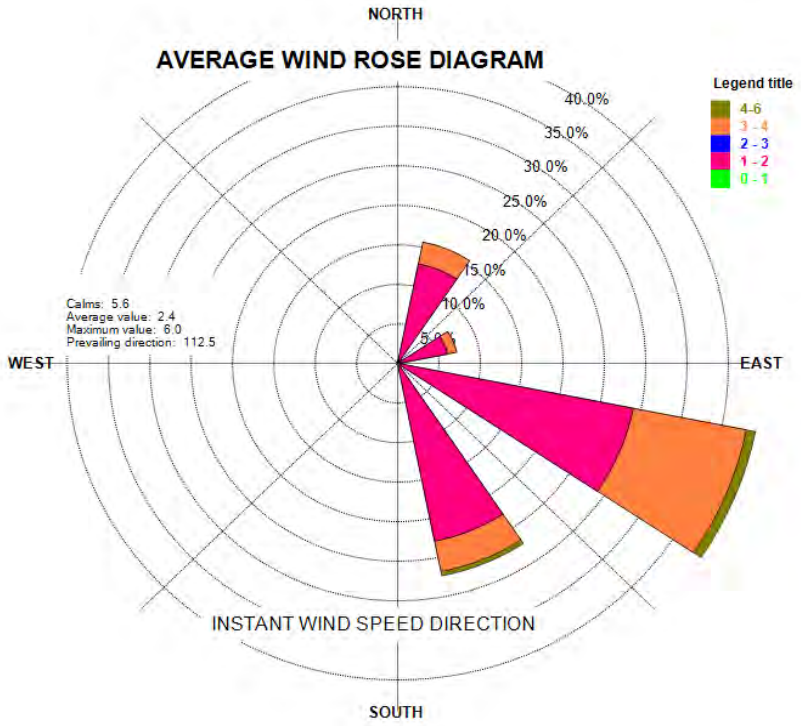


Figure 4.6 Average Wind Rose Diagram for Study Period

4.4 AIR ENVIRONMENT:

4.4.1 SAMPLING LOCATION:

Eight sampling stations were selected to generate baseline data of background air quality. The locations have been chosen so as to obtain the air quality upwind and downwind of the project, as well as, the base line air quality in the study area.

4.4.2 PARAMETERS AND FREQUENCY OF MONITORING:

The parameters monitored at each location were PM_{10}, $PM_{2.5}$, Nitrogen Oxides (NO_x) and Sulphurdioxide (SO_2). The sampling was carried out for 8 hours per day in three shifts. The frequency of sampling at each station is twice in a week.

4.4.3 COLLECTION AND ANALYSIS:

4.4.3.1 METHODOLOGY:

Ambient air sampling was done at different locations (24 hourly, twice a week for one season), the samples were collected from different locations, brought to laboratory and analyzed for various parameters as per standard methods given in IS5182/CPCB guidelines.

Brief description of methodology adopted for sampling and analysis is in Table 4.3 and 4.4

Table 4.3: Methodology Adopted for Ambient Air Quality Sampling

Sl. No.	Parameter	Methodology	Equipment used
1	Particulate Matter ($PM_{2.5}$ and PM_{10})	Collection of particulate matters on filter papers	Fine particulate matter sampler and respirable dust sampler
2	Sulphur Dioxide (SO_2)	Absorption of gases in liquid absorbent	RDS with gaseous sampling attachment
3	Oxides of Nitrogen (NO_x)	Absorption of gases in liquid absorbent	RDS with gaseous sampling attachment

Table 4.4: Methodology Adopted for Analysis of Ambient Air Quality Samples

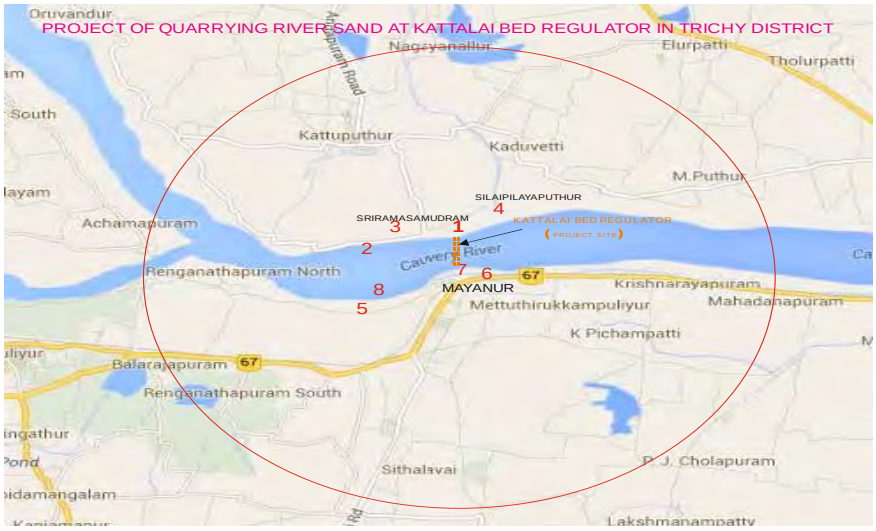
Sl. No.	Parameter	Methodology	Equipment used
1	Particulate Matter ($PM_{2.5}$ and PM_{10})	Gravimetric method	Analytical balance
2	Sulphur Dioxide (SO_2)	Improved West and Gaeke method	UV/VIS Spectrophotometer
3	Oxides of Nitrogen (NO_x)	Modified Jacob and Hochheiser (Na-Arsenite)	UV/VIS Spectrophotometer

4.4.3.2 SAMPLING LOCATIONS:

Eight sampling locations were selected for ambient air quality monitoring. The locations selected for Ambient Air Quality Monitoring with their coordinates are given in Table 4.5. Base Map showing monitoring locations is in Fig.4.7

Table 4.5: Locations Selected for Ambient Air Quality Monitoring

Sl. No.	Location	Distance and Direction from the Project	Monitoring Station Code		Coordinates		Zone (Core/Buffer) /Classified Area
			Ambient Air	Noise	Latitude(N)	Longitude(E)	
1	Mayanur Barrage Top (Left Side)	At new barrage top north side (left side)	TCA-1	TCN-1	10°57'58.9"	78°14' 5.5"	Core Zone
2	Sriramasamuthiram Drinking Water Scheme	At 1700m u/s of barrage (North west side)	TCA-2	TCN-2	10°57'48.1"	78°12'54.9"	Core Zone
3	Sriramasamuthiram Panchayat Office	0.76 km away N.W side of project area.	TBA-1	TBN-1	10°57'55.2"	78°13'13.8"	Buffer Zone/Rural
4	Silaipillayaputtur Panchayat Office	0.76 km away N.W side of project area	TBA-2	TBN-2	10°58' 7.4"	78°14' 0.5"	Buffer Zone/Rural
5	Mela Mayanur Panchayat Office	0.45 km away S.W side of project area	TBA-3	TBN-3	10°55'54.5"	78°12'19.3"	Buffer Zone/Rural
6	Mayanur VAO Office	1.00 km away S.E side of project area	TBA-4	TBN-4	10°57' 1.7"	78°14'30.8"	Buffer Zone/Rural
7	Mayanur Barrage Top (Right Side)	At new barrage top south side (Right side)	TBA-5	TBN-5	10°56'57.7"	78°14'18.5"	Buffer Zone/Rural
8	Mayanur Drinking Water Scheme	At 1300m u/s of barrage (sw side)	TBA-6	TBN-6	10°56'55.1"	78°13'18.7"	Buffer Zone/Rural



LEGEND

1: TCA1- MAYANUR BARRAGE TOP(LEFT SIDE)
2: TCA2- SRIRAMASAMUDRAM DRINKING WATER SCHEME
3: TBA1- SRIRAMASAMUDRAM PANCHAYAT OFFICE
4: TBA2- SILAIPILAYAPUTHUR PANCHAYAT OFFICE
5: TBA3- MELAMAYANUR PANCHAYAT OFFICE
6: TBA4- MAYANUR VILLAGE ADMINISTRATIVE OFFICE
7: TBA5- BARRAGE TOP(RIGHT SIDE)
8: TBA6- MAYANUR DRINKING WATER SCHEME

Figure 4.7 : Ambient Air Quality Monitoring stations

4.4.3.3 AMBIENT AIR QUALITY MONITORING RESULTS:

Datewise baseline data of Ambient Air Quality studied by the National Institute of Technology, Trichy for the study period of winter season i.e., December 2013 to February 2014 is herewith enclosed as Annexure 4.3 and average monthly values for the study period are given in the following Table 4.6.

Table 4.6: Average Monthly Values of Ambient Air Quality

Location	PM_{10} (µg/m³)			$PM_{2.5}$ (µg/m³)			NOx(µg/m³)			SO_2 (µg/m³)		
	Dec-13	Jan-14	Feb-14	Dec-13	Jan-14	Feb-14	Dec-13	Jan-14	Feb-14	Dec-13	Jan-14	Feb-14
TCA-1	70.3	66.9	66.8	4.0	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
TCA-2	67.6	64.6	62.1	45.5	38.8	39.6	BDL	BDL	BDL	BDL	BDL	BDL
TBA-1	88.1	89.4	88.3	100.9	136.4	144.8	1.3	1.8	1.4	1.0	1.10	0.9
TBA-2	78.6	80.1	77.0	74.8	101.6	102.5	1.9	1.8	1.5	BDL	BDL	BDL
TBA-3	92.8	87.9	93.0	1.8	2.0	5.9	2.1	2.4	2.1	1.2	1.1	1.1
TBA-4	147.4	149.6	145.8	2.0	1.8	2.3	2.7	2.6	2.5	1.4	1.8	1.4
TBA-5	75.3	71.5	76.1	12.5	15.0	14.4	0.9	1.0	1.0	BDL	BDL	BDL
TBA-6	68.4	68.1	65.9	85.4	92.8	92.5	0.9	1.1	1.0	BDL	BDL	BDL

The permissible limits to the Industry are for PM_{10}µg/m³, $PM_{2.5}$, NOx& SO_2 is 100 µg/m³, 60 µg/m³, 80 µg/m³, 80 µg/m³respectively.

The levels of Ambient Air Quality within the buffer zone and core zone stations in general were found to be in permissible limits. However, in certain AAQ stations the values of PM_{10} and$PM_{2.5}$ located near to village roads are slightly higher due to its wornout conditions. The local panchayats will be instructed to renew the mud roads with bituminous top before commencement of the project to keep the values with in the norms while operation. However, the alternate paths are suggested by avoiding these village roads and directly enter into State and National Highways.

The graphical representation of variation of ambient air quality is presented in Fiq. 4.8

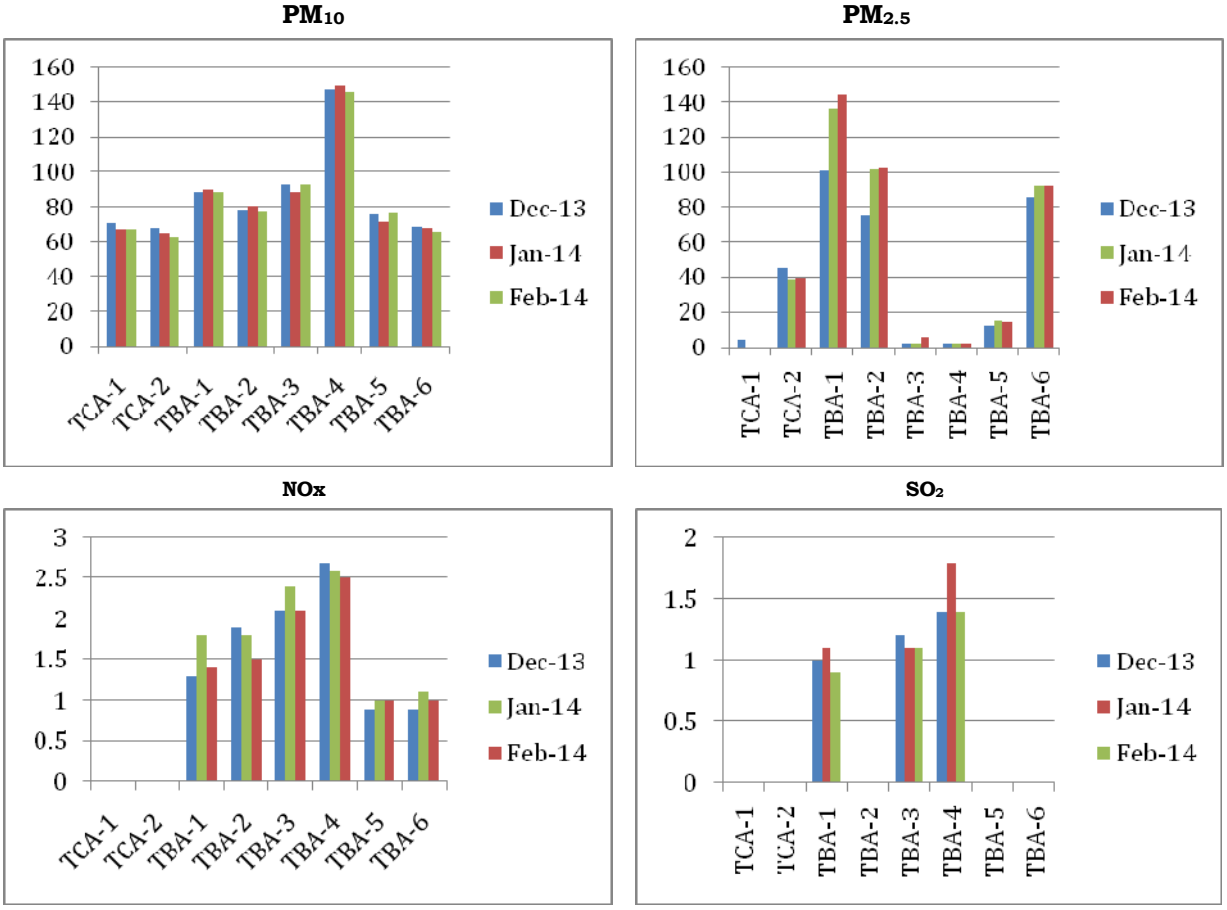


Fig. 4.8 Average Variation of Ambient Air Quality (Dec'13 to Feb'14)

4.5 NOISE ENVIRONMENT:

Any distraction and annoying sound is defined as noise. This noise distracts people from working and causes interference with their normal activity like speech communication and disturbance in sleep. Hence, Noise pollution has an impact on the environment.

4.5.1 NOISE QUALITY MONITORING:

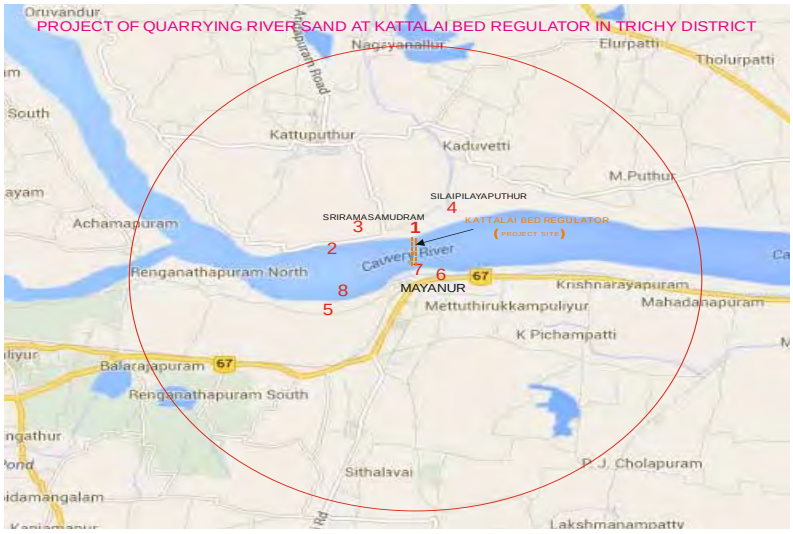
Impact of noise assessment around the mine site due to mining machineries on its workers and on the nearby settlements and movements of vehicles during transportation have been carried out exclusively and objectively in the core and buffer zone.

In the context of mining, some of the mining operations also result in creation of noise such as loading of sand using excavation.

The following studies were carried out:-

- Measurement of baseline noise levels in the villages
- Identification of existing noise sources
- Characterization of the major noise sources
- Measurement of noise levels around existing mine status
- Present noise exposures of general population.

The study area represents commercial area on comparing with the MoEF Ambient Noise Norms. The monitored noise levels are presented as Table 4.7 and the location are depicted in Fig.4.9 for eight numbers of locations.



LEGEND

1: TCN1- MAYANUR BARRAGE TOP(LEFT SIDE)
2: TCN2- SRIRAMASAMUDRAM DRINKING WATER SCHEME
3: TBN1- SRIRAMASAMUDRAM PANCHAYAT OFFICE
4: TBN2- SILAIPILAYAPUTHUR PANCHAYAT OFFICE
5: TBN3- MELAMAYANUR PANCHAYAT OFFICE
6: TBN4- MAYANUR VILLAGE ADMINISTRATIVE OFFICE
7: TBN5- BARRAGE TOP(RIGHT SIDE)
8: TBN6- MAYANUR DRINKING WATER SCHEME

Figure 4.9 Ambient Noise Quality Monitering Stations

TABLE 4.7 AMBIENT NOISE LEVEL STATUS:

Sl.No	Location	Sound Level	
		Daytime 06.00AM to 10.00PM	Night time 10.00PM to 06.00AM
1.	TCN – 1	56.8	48.3
2.	TCN – 2	53.2	44.5
3.	TBN - 1	65.3	51
4.	TBN - 2	56.7	42.3
5.	TBN - 3	58.3	50.4
6.	TBN - 4	70.6	64.3
7.	TBN - 5	79	64.1
8.	TBN - 6	60.4	43.7

As per MoEF Ambient Norms, for commercial area the limits in dB (A) Leq, during day time is 65 and during night time is 55 dB.

The noise monitoring results is compared with the Ambient Noise Quality Standard notified under Environment (Protection) Act, 1986.

4.6 WATER ENVIRONMENT:

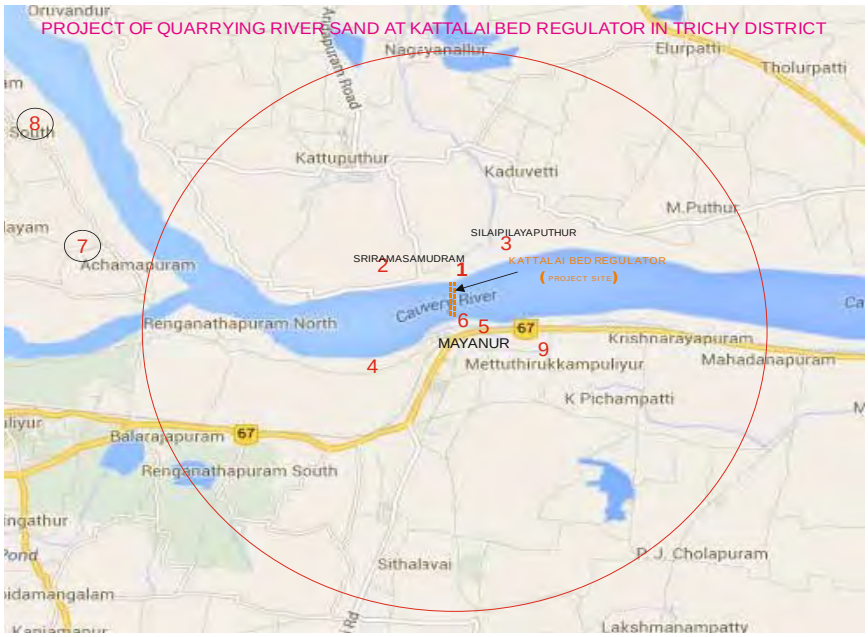
The quality of water occupies an important factor to understand the quality of environment as much depends on its availability and quality for raising crops, domestic utility and drinking purposes. Hence it is necessary to study the quality of water source within project area and the buffer zone. One number of surface water samples in core zone, one number of surface water samples in buffer zone and four numbers of ground water samples in buffer zone were collected and the same is shown vide fig 4.10.The details of the locations are given vide table 4.8

Table 4.8 Description of Water Sampling Location

Sl.No	Station	Location	Distance & Direction from the Project	Zone (Core/Buffer)
1	TCW-1	Mayanur Barrage Top(Left side)	At new barrage top north side (left side)	Core Zone/Surface Water
2	TBW-1	Srirama Samuthram panchayat office	0.76 km away N.W. side of project area.	Buffer Zone/Ground Water
3	TBW-2	Silai Pillayar puthoor panchayat office	0.76 km away N.W side of project area	Buffer Zone/Ground Water
4	TBW-3	Mela mayanur panchayat office	0.450 km away S.W. side of project area	Buffer Zone/Ground Water
5	TBW-4	Mayanur VAO office	1.00 km away S.E side of project area	Buffer Zone/Ground Water
6	TCW-5	Mayanur Barrage Top (Right side)	At new barrage top south side (Right side)	Buffer Zone/Surface Water

Permanent observation bore wells maintains by Ground Water Division/Public Works Department

Station code/Lab ID	Village
CON 185	Rajendram
CON 186	Vaigainallur
CON 187	Nanniyur
CON 188	Achamapuram
CON 189	Nerur south
CON 190	Thirukkampuliur
CON 191	Kallapalli



LEGEND

1: TCW1- NEAR MAYANUR BARRAGE (LEFT SIDE)

2: TBW1- NEAR SRIRAMASAMUDRAM PANCHAYAT OFFICE

3: TBW2- NEAR SILAIPILAYAPUTHUR PANCHAYAT OFFICE

4: TBW3- MELAMAYANUR PANCHAYAT OFFICE

5: TBW4- MAYANUR VAO OFFICE

6: TBW5- NEAR MAYANUR BARRAGE (RIGHT SIDE)

7: CON188- ACHAMAPURAM

Figure 4.10 Water Sampling Locations

The monitored water quality data are presented on table 4.9. The following observation were made based on the physio chemical properties.

Table 4.9 Analysis of Surface Water and Ground Water

Sl. No.	Parameters	Unit	Results						Standard limit
			Surface Water		Ground Water				
			TCW-1	TBW-5	TBW-1	TBW-2	TBW-3	TBW-4	
1.	pH	-	8	8.07	7.64	7.61	7.67	7.77	6.5 – 8.5
2.	TDS	mg/L	277	291	286	437	268	383	500
3.	Turbidity	NTU	0.00	0.00	0.38	BDL	0.00	BDL	5
4.	Chloride	mg/L	80	85	95	115	80	85	250
5.	Calcium as Ca	mg/L	32	30	28	32	30	30	75
6.	Total Hardness	mg/L	230	245	275	360	285	320	300
7.	Sulphate	mg/L	17.53	25.79	29.82	33.98	26.50	22.14	200
8.	Magnesium as Mg	mg/L	36	40.8	49.2	67.2	50.4	58.8	30
9.	Suspended Solids	mg/L	168	79	109	23	132	57	-
10.	Total Solids	mg/L	445	370	395	460	400	460	-
11.	Organic Solids	mg/L	195	140	80	85	170	85	-
12.	Inorganic Solids	mg/L	250	230	315	375	230	375	-
13.	Copper	mg/L	BDL	BDL	BDL	0.0147	BDL	BDL	0.05
14.	Zinc	mg/L	0.1839	0.2068	0.1698	0.2157	0.3008	0.0886	5
15.	Cadmium	mg/L	0.0063	0.0076	0.0090	0.0057	0.0061	0.0068	0.01
16.	Lead	mg/L	0.0302	0.6361	0.5469	0.3412	0.6744	0.5941	0.05
17.	Iron	mg/L	LDL	BDL	0.0782	0.0591	0.0767	BDL	0.3

4.7 LAND ENVIRONMENT:

The district is the middle of the State of Tamil Nadu. It is located between 10°to 11°30' North latitude and between 77°45' to 78°50' East longitude. The district commands a geographical location having a total area of 4,403.83 Sq. KM., which roughly works out to 3.38 percent of the total area (130060 Sq.Km) of the State. The district is irrigated by River Cauvery and its canal. The region in either side of river bank resembles fertile plain and upland areas away from river bank have semi arid like conditions. The sea shore in 225 KM away in east side.

4.7.1 LAND USE PATTERN:

4.7.1.1 COREZONE:

The core zone of this project is upstream and downstream of barrage, sand shoals in Cauvery river bed with a area of 196.25 Ha out of total area of 476.16 Ha in this SF Nos of Sriramasamuthiram and Silaippilayaputtur village. The area falls under river bed, classified as river poromboke owned by Public Works Department. The mining on sand shoals to make the river cross section hydrologically safe and to restore the designed storage capacity of newly constructed barrage in upstream and to discharge the maximum flood in downstream. The sand mining on shoals itself is a reclamation measure of lease area in proposed project.

4.7.1.2 BUFFER ZONE:

In the buffer zone area, land is used mainly for agricultural purpose. There are nearly 26 villages in the buffer Zone (The land use in buffer Zone villages is shown in the pie diagram vide fig 4.11 and summarized as below in Table 4.10 to show the land use of the study area. The data is collected from the district Census book of 2011).

The buffer zone is made fertile by the perennial flows of Cauvery and confluence of Amaravathy river. About 20% of the study area falls under Irrigated land. There were 26 Villages, two town Panchayat (Krishnarayapuram and P. J. Cholapuram) in karur district and one town panchayat (kattuputhur) in Trichy District.

The general land use of an area is the result of an interaction between man and environment in the process of permanent adjustment between constraining properties and socio – economic attributes.

Out of 314.00 sq. kms area of study area, 1.96 sq km (0.62%) is forest area.

TABLE 4.10 Land Use Area

Sl. No	NAME	IRRIGATED	UNIRRIGATED	CULTURABLE WASTE	FOREST	AREA NOT FOR CULTIVATION	TOTAL AREA IN HA
1	Thottiyam	3720.958	11498.593	232.695	73.900	4172.608	19698.755
2	Krishnarayapuram	1798.295	7345.030	139.095	122.16	2296.665	11701.245
Total		5519.253	18843.623	371.79	196.06	6469.273	31400

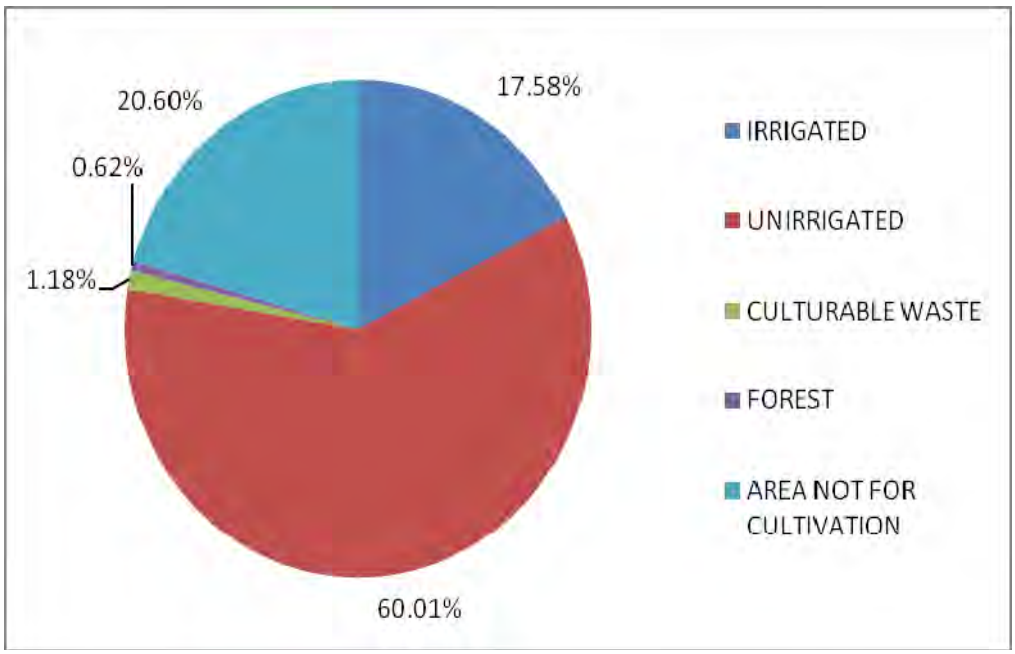


Figure 4.11 Land Use Pattern

4.8 SOIL QUALITY:

The nature of plant and animal life within core and buffer zone largely depend on the content of the soil. Soil is produced due to weathering and alteration of the existing rock formation. The soil characteristics(Physical and Chemical), erosional index, soil fertility etc., have a direct bearing on the life forum ie., Flora and Fauna. The study of the soil chemistry and environment is necessary for planning out afforestation program and green belt development swiftly. The general soil map of Tamil Nadu is depicted in Fig. 4.12

Here, the object of mining is to remove the excess sand shoals deposits in upstream and downstream of barrage in Cauvery river.

Two bore logs tests are conducted in upstream and downstream of barrage reveals that, the depth of sand available is 14m and 9.5m respectively.The location map of soil type monitoring point is depicted in fig 4.13. The soil sample collected have been analysed for soil type(composition sand, clay and silt), chemical analyse and size distribution(D50 and uniformity co-efficient D60/D10) in upstream and downstream of barrage is listed in Table 2.1, 2.2. and Fig 2.6, 2.7.

The estimate for mica and oxides of other elements Al etc, were analysed. However, the mass percentage is found to be small enough to ignore.

The average particle size is sand shoals (ie., 1.95m depth) at upstream and downstream is 1.45mm and 1.5mm respectively. The uniformity co-efficient (D60/D10) in upstream and downstream is 1.764mm and 2.11mm respectively.

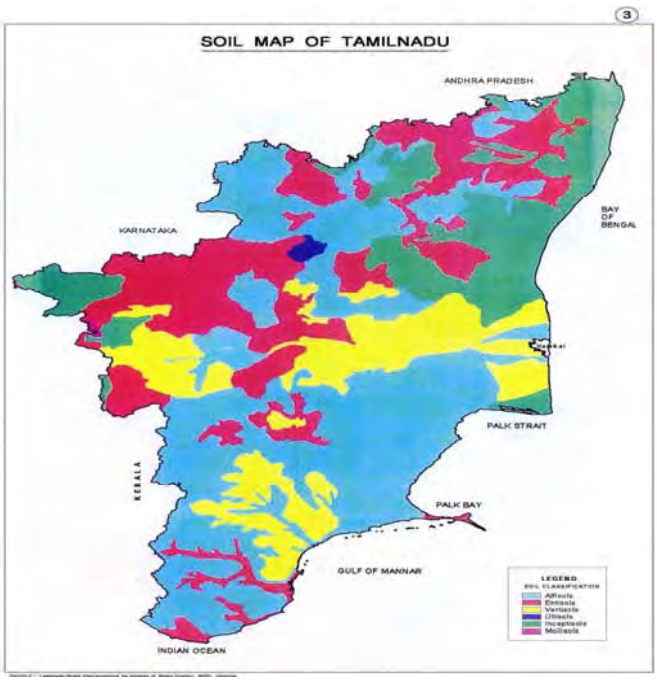


FIGURE 4.12 SOIL MAP OF TAMILNADU

LEGEND

1: UPSTREAM SIDE OF BARRAGE

2: DOWNSTREAM SIDE OF BARRAGE

FIGURE : 4.13 Soil Type Monitoring Locations

FIGURE : 4.14 Photographs showing bore log test in river bed

4.9 HYDROLOGY & HYDROGEOLOGY:

The object of the project is to remove the excess sand shoals above the river bed in upstream and downstream of newly constructed barrage and to restore the river hydrology in order to carry the maximum flood during mansoon season. The region falls mainly under cretaceous rock formations. The project area falls under recent alluvial formation. The sand produced by the tide and flow of river Cauvery. The ground water availability in 2.00m and 6.05m in core zone and buffer zone

respectively during premonsoon season ie. April and May. The availability of ground water depth is 2.10m and 4.17m in core zone and buffer zone respectively during postmonsoon season ie. November. The ground water quality is in general good condition.

The district Trichirapalli is pioneer in agriculture production. Though irrigation is carried out by canal water, ground water is the valuable source for irrigation in most of the region during lean period.

4.10 FLORA AND FAUNA:

4.10.1 INTRODUCTION:

The demands of an ever increasing human population have jolted us into the realization that our environment is precious, finite, and deteriorating. This realization came upon us at the very time great numbers of people were experiencing tremendous benefits from our technologies, which have often resulted in significant losses to the natural environment. The environment is composed of non-living and living factors forming a network of inter-relationships that are easily disturbed by people. Within the larger challenge of sustainable development lies the even greater challenge of the requirement of environmentally sound equitable economic growth.

Conservation, protection and preservation of the environment have been the cornerstone of the Indian ethos, culture and traditions. It has been enshrined in our constitution also, which is one of the first in the world to recognize the importance of environmental conservation. As the constitution provides the framework for creating a welfare State, it is incumbent on the authorities that the finite natural resources of the country be optimally utilized without adversely affecting the health of the people or the environment.

4.10.2 THE PROJECT

The Public Works Department is initiating to open new sand quarries in River Cauvery and Coleroon. This department is operating the sand quarries in a systematic and scientific manner. It is our moral/social responsibility to avert the adverse impact on the environment due to the sand quarrying operations. Hence, it is essential to monitor the environment impact due to these sand quarries.

As a prelude Public Works Department is intending to collect the base line data with reference to Flora and Fauna in Kattalai Bed Regulator - Sand Quarry proposal in Sriramasamuthiram and Seelapillayaputhur villages of Trichy District by the assistance of Department of Environmental Sciences, Bishop Heber College (Autonomous), Puthur, Trichirapalli – 620017 and then to manage the factors to avoid the ill effects on the environment.

4.10.2.1 STUDY AREA:

There are no sanctuaries, Biosphere Reserves, Wild life corridors, Tiger/Elephant reserves (Existing/Proposed) with in 10 KM radius area from the proposed project. The distances of National parks and sanctuaries are marked on the following Eco-Sensitivity Map Fig 4.15 and detailed in Table 4.11

Table 4.11 List of Eco-Sensitive Areas around the proposed project

Sl. No	From (Project Site)	To (Eco-sensitive area)	KM
01	Mayanur	Viralimalai Wild Life Sanctuary	079
02	Mayanur	Karavetti	098
03	Mayanur	Srivilliputhur Sanctuary	216
04	Mayanur	Indira Gandhi Wild life Sanctuary and National Park	218
05	Mayanur	Pointcalimere Wild Life Sanctuary	229
06	Mayanur	Mudumalai Tiger Reserve	252
07	Mayanur	Mukurthi National Park	254
08	Mayanur	Vedanthangal Bird Sanctuary	295
09	Mayanur	Vallanadu Black Buck Sanctuary	313
10	Mayanur	Gulf Of Mannar Marine National Park	324
11	Mayanur	Anna Zoological Park Chenna	333
12	Mayanur	Crocodile Bank Kanchipuram	336
13	Mayanur	Guindy National Park	355
14	Mayanur	Kalakad Wildlife Sanctuary	388

Fig. 4.15 Eco-Sensitivity Map

4.10.3 OBJECTIVES:

(i) To carry out a systematic baseline survey of Flora and Fauna around 10 km radius of the study area.

(ii) To list the plants and animals present in the study area as per the classifications of MoEF.

(iii) To identify the impacts of the proposed expansion activities on the plants and animals.

(iv) Impact of mining on Plankton and it is discussed in detail at chapter-7.

(v) To evaluate the proper species specific conservation plan for Schedule–I and Schedule–II species and to propose Environmental Management Plan and it is discussed in detail at chapter-7.

4.10.4 SCOPE OF THE WORK

(i) The study is required to be carried out as part of EIA study as per the guidelines of the Ministry of Environment and Forests, Govt. of India and action plan for conservation of flora and fauna if any shall be prepared in consultation with the State Forest and Wildlife Department.

(ii) The study should be based on the systematic field survey and secondary data (ie., Winter season December 2013 – February 2014).

The study should cover the following:

4.10.4.1 FLORA

i) Area should be divided as core zone and buffer zone

ii) Listing of all species (scientific and local names) found in the study area - 10 km. radius.

iii) Listing of species as per the following classifications:

- a) Agricultural crops
- b) Commercial crops
- c) Plantation
- d) Natural vegetation
- e) Grass lands
- f) Endangered species
- g) Endemic species
- h) Others

iv) Based on the above findings Impacts of the proposed expansion.

v) Environmental Management plans to improve existing status of flora in the area.

4.10.4.2 FAUNA

(i) Core and Buffer zone divisions

(ii) Listing of all species in the study area of 10 km radius around the study area

(iii) Schedule for each species as per the Wild Life (Protection) Act, 1972 and as amended subsequently should also be furnished.

(iv) Zoological and local name of the species should be furnished

(v) Listing of species should be classified as:

a) Endangered species
b) Endemic species
c) Migratory species
d) Details of aquatic fauna

(vi) Presence of endangered and endemic species should be supplemented by density.

Based on the above findings, impacts of proposed expansion should also be assessed.

4.10.5 BIOLOGICAL ENVIRONMENT ASSESSMENT - FLORA & FAUNA

A habitat or an area comprises of different kinds of plants and animals within its boundary. The distribution of flora and fauna in the given area represents the Biological portion of the environment that includes, what is present in the study area, its value, its response to impacts, description of community uniqueness, the dominant species, and an evaluation of rare or endangered species. The above studies were carried out using the standard methods proposed by John G. Rau and David C. Wooten 1980

4.10.6 ECOLOGY

The detailed ecological assessment of the study area has been carried out with the following objectives:

- Identification of flora and fauna and their biodiversity within the study area
- Preparation of checklist of species which also include endangered, endemic and protected (both floral and faunal categories)
- Evaluation of impact of proposed project on flora and fauna of the area.

4.10.7 STUDY AREA: KATTALAI BED REGULATOR - SAND QUARRY AT SRIRAMASAMUTHIRAM AND SILAIPPILAYAPUTTUR VILLAGES TRICHY DISTRICT.

The Flora and Fauna assessment has been carried out in the Kattalai Bed Regulator - Sand Quarry, Karur situated in Krishnarayapuram taluk. The study area has been divided into core zone and buffer zone. The details of the field monitoring stations are given in Table 4.12.

The flora and fauna studies were carried out in 10 study sites representing the entire study area of 10 km radius around the proposed site.

Table 4.12 Details of Monitoring Stations – Flora and Fauna

Sl. No.	Core / Buffer Zone	Aquatic/ Terrestrial
1	KBR- Sand Quarry site	Aquatic
2	Sriramasamudram	Terrestrial
3	Mayanur	RF
4	Mettuthirukkampuliyur	Terrestrial
5	Silapilliyarpudur	RF
6	Unniyur	Terrestrial
7	Nagayanallur	Terrestrial
8	Kattuputhur	Terrestrial
9	Thottiyapatty	Terrestrial
10	Sithalavai	Terrestrial
11	Veerarackiyam	Aquatic
12	Natham	RF
13	Kattalai	RF
14	Sithalavai	RF
15	Thirumukkoodalur	Aquatic

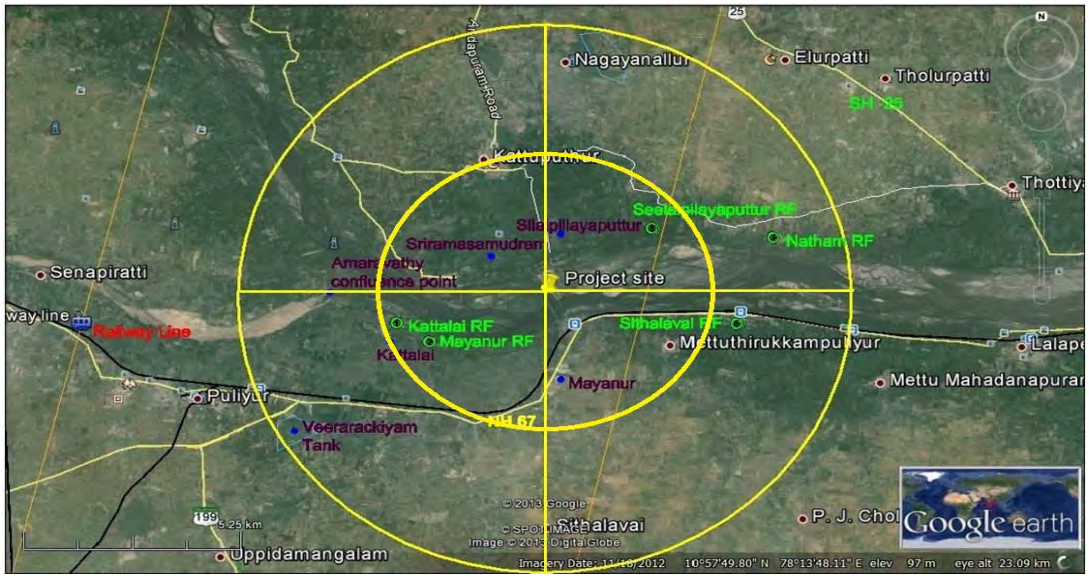


Figure 4.16 Study Area showing RF & Tank

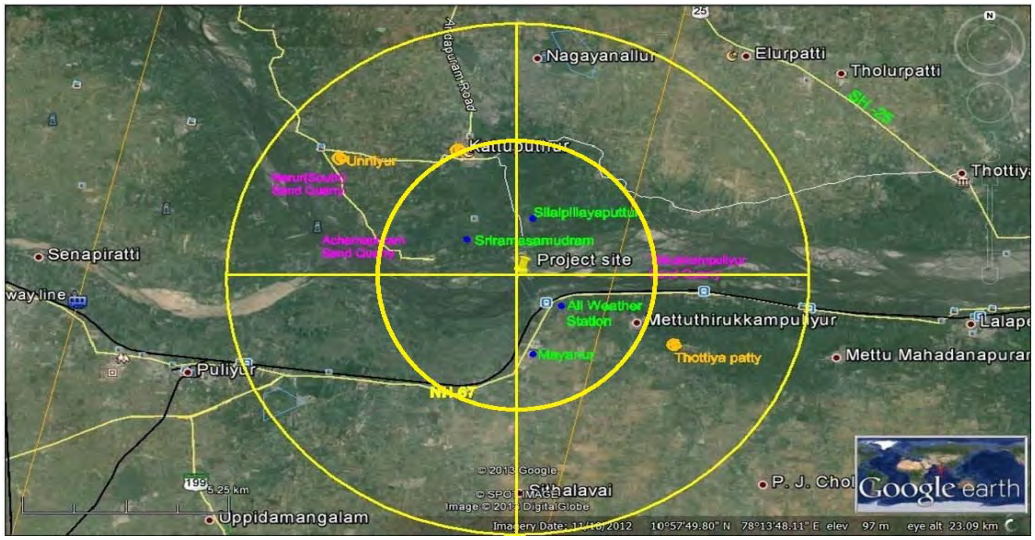


Figure 4.17 Study Area showing Terrestrial and Aquatic Habitats.

4.10.8 METHODOLOGY

4.10.8.1 FLORA

The Study of flora involved intensive sample survey of vegetation in the project site and other locations applying standard methods (e.g., Greig-Smith 1983, Caustan 1988). To examine the trees and shrubs, quadrats of 25 x 25 m and for herbs 2 x 2 m were laid. In each of the larger quadrats (i) Species (ii) their number, and (iii) Girth at Breast Height (GBH) were measured. (Chaturvedi and Khanna, 1982).

Abundance, relative abundance, density and relative density of each species and species diversity and evenness for each of the Zones were calculated using the numerical data (Ludwig and Reynolds 1988, Lande 1996, Smith and Wilson 1996).

The standard statistical analysis, the normal frequency diagram and distribution of plants in the study area were analyzed using the procedures of Raunkiaer, 1934. The analysis carried out as per Raunkiaer's law of frequency classes provides the information on the Heterogeneity and Homogeneity of plants and its pattern of distribution in the study area.

The species of vegetation found in each station were identified and listed according to their families, both in dicotyledons and monocotyledons of the plant kingdom. The plant species were classified as per the classifications of "Bentham and Hooker" and identified by using Gambles book on "Flora of Madras Presidency" and Mathew's book on "Flora of the Tamil Nadu Carnatic".

4.10.8.2 FAUNA

Both direct and indirect observation methods were used to survey the fauna. Visual encounter (search) method was employed to record vertebrate species. Additionally survey of relevant literature was also done to consolidate the list of vertebrate fauna distributed in the area (Smith 1933-43, Ali and Ripley 1983, Daniel 1983, Prater 1993, Murthy and Chandrasekhar1988).

Since birds may be considered as indicators for monitoring and understanding human impacts on ecological systems (Lawton, 1996) attempt was made to gather quantitative data on the group by.

Point Count (South Wood): Point count is the most commonly used survey technique in determining the composition and abundance. The survey is done on 360˚ arch around a fixed survey station and a radius of 20 metres was covered.

Roadside counts(South Wood): The team travelled within and between the sites on a slow phase in which all the fauna sighted were recorded and identified.

Indirect evidence: Pug marks, track marks were also recorded and later identified. (South Wood, 1978).

Information from local people: Information was also collected from the local people and was recorded in the list.

Based on the Wildlife Protection Act, 1972 (WPA 1972, Anonyomous. 1991, Upadhyay 1995, Chaturvedi and Chaturvedi 1996) species were short-listed as Schedule II or I and considered herein as endangered species. Species listed in Ghosh (1994) are considered as Indian Red List species.

4.10.9 DESCRIPTION ABOUT THE STUDY SITES

4.10.9.1 CORE ZONE

The study was carried out in the core zone including the proposed quarry site. The terrain of the area is plain and sandy. The entire area is characterized by Scrubby elements and the type of forest is Tropical Scrub forest with riparian vegetation. It is chiefly characterized by *Acacias* and *Prosopis* community representing the Umbrella thorn forest.

4.10.9.2 BUFFER ZONE

The terrain of the area is plain with mixed scrub vegetation. The entire area is characterized by Scrubby elements and the type of forest is Tropical Scrub forest. It is chiefly characterized by *Acacias* and *Prosopis* community representing the Umbrella thorn forest.

4.10.10 ASSESSMENT OF FLORA IN THE STUDY AREA

4.10.10.1 PLANT COMMUNITIES

The study reveals that in core and buffer zones 134 plant species were recorded and there is no endangered, threatened, or rare species of plants. The distribution of vegetation in the Core and Buffer zones, its density, dominance, frequency, Ecological status of vegetation as per Raunkiaer's Law, Importance Value Index (IVI), economic importance, and medicinal uses were studied by the Department of Environmental Science, Bishop Heber College, Trichy.

4.10.11. ASSESSMENT OF FAUNA IN STUDY AREA

The animal life of an area is dependent upon the vegetation and there are countless relationships between the species composing an animal community. Fauna assessment involves more problems than flora assessment by virtue of the greater variety of animal types, their mobility and behaviour. Faunal assessment provides a basis for determining relative abundance and evaluating commonness or rarity of each species encountered.

In the study area, the animal survey was conducted in all the sampling sites along with the plants. The study includes surveys of the animal communities such as aquatic organisms, insects, molluscs, reptiles, fishes, amphibians, birds and mammals. The number of Fishes, Crabs and Amphibians identified are 10, 8 and 5 respectively. The total number Birds and Mammals listed are 60 and 10 respectively.

Fig. 4.18 Photographs showing study on species in Study area

The proposal for Environmental Clearance was considered by the Expert Appraisal Committee in its 22nd meeting held during August 26-27, 2014. The committee was examined and of viewed that the project proponent need to submit the authenticated list of Flora and Fauna. The list of Flora and Fauna is herewith enclosed vide Annexure 4.4.

4.11 SOCIO - ECONOMICS

Any developmental activity and spurt in industrialisation and mining will have an impact on the socio – economic conditions of the population in the region and thus on the quality of life by invariably bringing about a drastic change in the environment including the society connected within the region. Here, the mining area is river bed, and object is to remove the excess sand shoals to make the river cross section hydrologically safe. The mining area is away from human habitation. However there will be an impact of Socio – Economic criteria due to influence of transporation of loaded and unloaded trucks in the surrounding villages. This activity is likely to cause effect on the general quality of life of human settlement in the surrounding villages.

However, the strong percentage of seinorage charges, ie nearly 20% of total revenue of project will be given to local village panchayat to improve the road, drinking water schemes, health system, minor irrigation system, drainage system, community centres, afforestation and green belt development as a Corporate Social Responsibility. These activities will be more beneficial to village panchayat and detailed socio – economic survey was carried out with in 10km radius of the mining area which forms the impact zone from mining. The villages fall under the 10kms radius of the project and have been selected to study the socio –economic profiles.

The following parameters have been selected.

1. Demographic features.
2. Amenities like Educational facilities, Medical facilities etc.
3. Cultural aspects.
4. Economic aspects.

4.11.1 DEMOGRAPHIC DATA.

Since the lease area is river bed, there is no habitation. The mine area surrounded by Mayanur village in South East direction, Kattalai village in South West direction, Silaipillaiya Puttur village in North East direction and Sriramasamudram village in North West direction. The population of surrounding villages of core area is as follows in Table 4.13.

TABLE 4.13 POPULATION OF SURROUNDING VILLAGES OF CORE AREA

S.No	Name of the Village	Approximate distance and Direction from lease applied area	Approximate population
1.	Silaipillaiya puthur	0.76 Km – NE	2266
2.	Sriramasamudram	0.76 Km – NW	3234
3.	Mayanur	1 Km – SE	4766
4.	Kattalai	1 Km – SW	5566

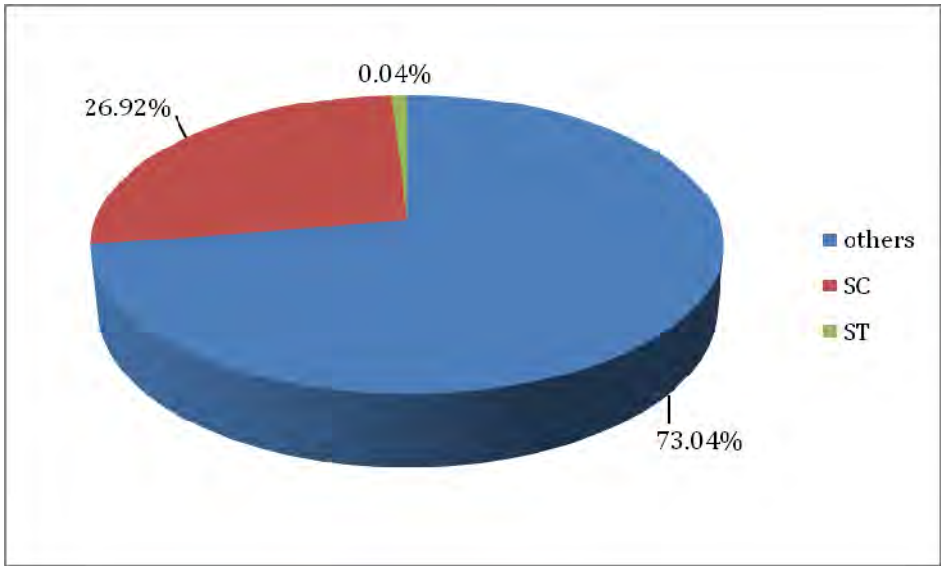


FIG 4.19 PIE DIAGRAM FOR POPULATION

TABLE 4.14 DETAILS OF POPULATION IN STUDY AREA

Sl. No.	Name	Total Population	Make	Female	SC Male	SC Female	ST Male	ST Female	Others	
									Male	Female
1	Krishnarayapuram	165987	82676	83311	22527	23579	47	47	60102	59685
2	Thottiyam	63572	31625	31947	7742	7940	1	2	23882	24005
	TOTAL	**229559**	**114301**	**115258**	**30269**	**31519**	**48**	**49**	**83984**	**83690**

In the buffer zone, there are around 26 villages and hamlets. The total population in these villages is 229559 persons.(Ref Table 4.14 and fig 4.19)

It may be observed that there are only 6 villages with more than 5000 population. All the remaining villages, the population is less than 5000.

The SC & ST population constitute 26.92% and 0.04% of total population. The National average for SC & ST population is 16.33% and 8.01% respectively.SC population is more than National average whereas ST population is much lower than National average.

4.11.2 LITERACY :

The total literacy in the buffer zone is 65.30% of the population. The Male and Female literacy rate is 68.39% and 52.65% respectively,Where as the State average for Male and Female rate is 56.29 and 43.71% respectively as per 2011 census data. The diagram shows the breakup of literacy (Ref. Fig 4.20 and Table 4.15)

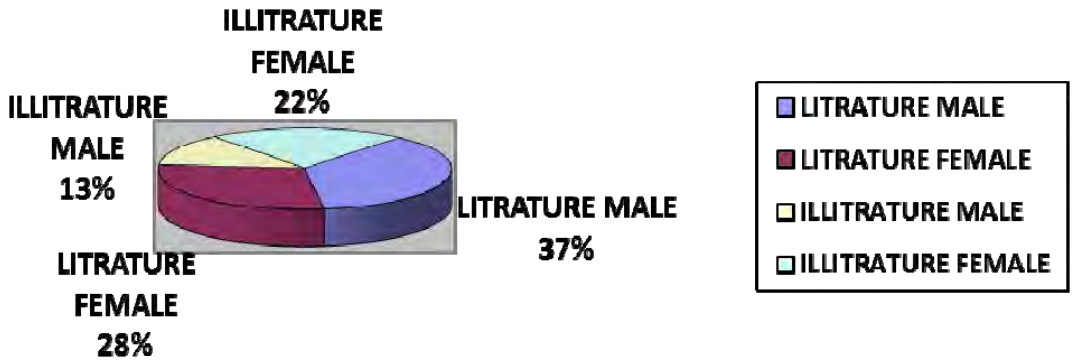


FIG 4.20 PIE DIAGRAM FOR LITRACY

TABLE 4.15 DETAILS OF LITERACY IN STUDY AREA

Sl. No.	Name	Total Population	Literature Male	Literature Female	Illiterature Male	Illiterature Female
1	Krishnarayapuram	165987	60613	46837	22063	36474
2	Thottiyam	63572	23758	18707	7867	13240
	TOTAL	**229559**	**84371**	**65544**	**29930**	**49714**

4.11.3 OCCUPATIONAL STRUCTURE:

The details about the occupation of the population involved in the buffer zone is tabulated in Table 4.16 and shown in the Pie diagram (Fig 4.21)

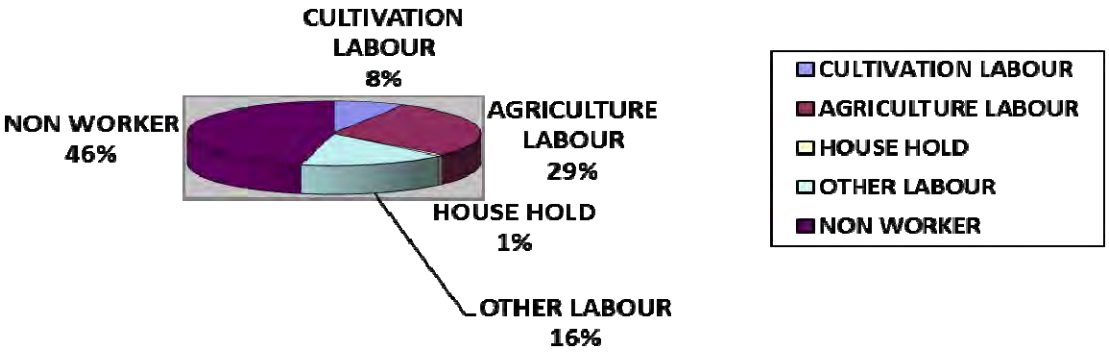


FIG 4.21 PIE DIAGRAM FOR OCCUPATION

TABLE 4.16 OCCUPATIONAL DETAILS IN STUDY AREA

Sl. No.	Name	Total Population	Total Workers	Cultivation Labour	Agriculture Labour	Household	Other Labour	Non worker
1	Krishnarayapuram	165987	87857	12799	45524	1224	28310	78130
2	Thottiyam	63572	35126	5294	20744	363	8725	28446
	TOTAL	**229559**	**122983**	**18093**	**66268**	**1587**	**37035**	**106576**

4.11.4 AMENITIES AVAILABLE IN BUFFER ZONE:-

The proposed project site bounded by Mayanur village in south eastern side, kattalai village in south western side, Silaipillayarputhur village in north eastern side and sriramasamudram village in North western side. In the above villages, the following salient social infrastructures are available within radius of 2 km.

(i) Mayanur panchayat office.
(ii) Mayanur Railway station.
(iii) Renganathapuram panchayat office.
(iv) Silaipillaiya puthur panchayat office.
(v) Sriramasamudaram panchayat office.
(vi) Public Health center at Mayanur and Sriramasamudram village.
(vii) High school, Mayanur.
(viii) Middle school, Sriramasamudaram.
(ix) Middle school, Silaipillaya puthur.

CHAPTER-5

ENVIRONMENTAL IMPACT ASSESSMENTS & MITIGATION MEASURES

5.1 PREAMBLE:

The commencement of the mining project has bearing on the surrounding environment which is likely to be quite significant. The impact due to mining activity will have both positive and negative effect on the surrounding. Sum of these changes is called impact. The net impact could be determined by evaluating the impact of various parameters, individually. The parameters which are likely to be affected by the mining activity was considered for evaluating the impact on the surrounding environment.

The EMP for this mining project has been proposed to take suitable measures for mitigating the adverse impacts as identified and prescribed due to the proposed sand quarry operation.

The basic environmental components that are likely to be affected due to mining activities are:

- Land Environment
- Water Environment
- Air Environment
- Noise Environment
- Biological Environment
- Socio-Economic Environment

5.1.1 LAND ENVIRONMENT:

The lease area of this project is upstream and downstream of barrage sand shoals in Cauvery river bed with an area of 196.25 Ha out of total area of 476.16 Ha in this SF Nos of Sriramasamuthiram and Silaippilayaputtur village. The area falls under river bed, classified as river poromboke owned by Public Works Department. The mining on sand shoals to make the river cross section hydro-logically safe and to restore the designed storage capacity of newly constructed barrage in upstream and to discharge the maximum flood in downstream. The sand mining on shoals itself is a reclamation measure of lease area in proposed project. In the buffer Zone area, land is used mainly for agricultural purpose. There are nearly 26 villages in the study area.

There may be some pollution affecting the soil adjacent to plant area if proper care is not taken. The anticipated pollution to soil environment due to plant activities is changes in soil texture due to settling of air borne dust.But proper mitigate measures like use of efficient pollution control systems, covering with tarpaulin of loaded vehicles while moving in study area, continuous sprinkling of water on haul roads and development of green belt to prevent dust generated by loaded trucks.

In the buffer zone area, land is used mainly for agricultural purpose. There are nearly 26 villages in the buffer zone.

5.1.2 WATER ENVIRONMENT:

In mining activity, water availability and water quality are two major aspects considered for base line status of water environment

5.1.2.1 SURFACE WATER:

In this sand mining project, the study on removal of excess sand shoals to restore the river hydrological regime will not cause any increase in suspended solids. It will also ensure that the overall drainage plan should be done in such way that the existing lean stream flow will not get affected by providing necessary number of pipes using sand and biodegradable materials to approach the sand shoals. Further quarrying shall not be carried out during rainy days or days of flood.

Natural gradient of the river bed shall be maintained for the free flow of water.

5.1.2.2 GROUND WATER:

The minimum quantity of water for drinking and domestic purpose for labours working in quarry needed from nearby community wells or bore wells. The process of sand mining does not required any water. The domestic waste water generated from Eco- Toilets outside the bank will be discharged safely in to septic tank.

The detailed Interpretation of water quality results for both core and buffer zone is done by comparing with drinking water specification IS: 10500.

5.1.3 AIR ENVIRONMENT:

In sand mining, various mining activities viz scooping of sand, loading and transportation is significant and may cause deterioration in air quality.The levels of ambient air quality within the buffer Zone and core Zone stations in general were found to be in permissible limits. However, in certain AAQ stations the values of PM10 and PM2.5 located near to village roads are slightly higher due to its worn out conditions. The local panchayats will be instructed to renew the mud roads with bituminous top before commencement of the project to keep the values within the norms while operation. Further, the high levels of dust concentration will be suppressed by water spraying on all the village roads and haul roads. It also proposed to develop the green belt through village panchayat by providing seinorage charge funds.

5.1.4 NOISE ENVIRONMENT:

The sources of Noise in mining area are due to excavation and trucks in the river bed.

In general, Noise generated by these sources will be within limit of 90 dB (A) prescribed by Director General of Mines Safety (DGMS), Dhanbad. The work persons shall not be exposed to more than 90 dB (A) level for more than one shift of 8 hrs.

The Department of civil Engineering, National Institute of Technology, Tiruchirapalli is carried out the monitoring noise level in the study area at the ambient air environment monitoring locations. Monitoring the noise levels (Leqs) is recorded by using sound level monitor.

Ambient equivalent noise levels (Leq) during day and night times, in general were found to be in compliance with the MoEF Norms. However, the locations of the monitoring stations nearby roads and railway tracks were recorded slightly higher values at a point of time while movement of vehicles and trains.

In the EMP, it is proposed to suggest noise protection measures for machinery and workers and also development of green belt will keep the noise levels well within the limits.

5.1.5 BIOLOGICAL ENVIRONMENT:

5.1.5.1 INTERPRETATION ON VEGETATION ANALYSIS:

The interpretations based on the above analysis and the floristic composition reveals that, the vegetation encountered in the study area is termed as the original characteristic of Thorn forests / Scrub forests intermingled with aquatic herbs and social forestry maintained by the State Forest Department.

The core zone comprises of small herbs, sedges and grasses with sparse distribution of trees that are well adapted to the sandy and fallow lands. The type of forest / vegetation found in the study area is Open scrub along with the representative elements of the aquatic and dry scrub forest types. Physiognomically it occurs in the shape of scrub woodland or thicket; the latter may be dense or discontinuous.

Floristically it is distinguished by some characteristic and preferential species (Braun-Blanquet, 1932), exclusively or mostly confined to this vegetation type, in relation to the types described by champion (1936) and champion and Seth (1968).

There is no endangered, threatened, or rare species of plants recorded in the study area.

5.1.5.2 INTERPRETATION ON FAUNA:

1. INVERTEBRATES

The insects in the study area are interrelated with each other and other organisms. They are in perfect balance in their existence. Some of them act as pests, while others are useful and beneficial to the environment and human beings.

2. PISCES

The lentic and lotic systems represent common fishes which supports the local people during the seasons.

3. AMPHIBIANS

The toads and frogs were the amphibians recorded in the study area. Many of them were seen along the Lentic water system and other areas.

4. REPTILES

The reptiles recorded in the study area include lizards, and snakes. Among the reptiles presence of Mugger Crocodile (*Crocodyluspalustris*) seems to be a concern, though their numbers a very low in the study area. They come under vulnerable category and need to be protected. These animals tend to live near UPPER & GRAND ANAICUT dam area. The Monitor Lizard (*Varanusbengalensis*) which is found in the banks of the river is also a near threatened reptile species.

5. BIRDS

Birds play an important role in understanding the ecological balance and its interrelationships. The occurrence of birds in various locations largely depends on the site characteristics and their presence in different study sites reveals that there is a good relationship between the birds and other organisms and the environment. The maintenance of the eco-balance could be seen in the selected study areas.

The avifauna seems to thrive very well supported by the wetlands, river and the agricultural land. The riverbed seems to be an idle feeding and roosting site for both wintering and resident birds. Presence of few near threatened species of birds is somewhat significant to this area, but all the four species are wide spread and locally common.

6. MAMMALS:

The distribution of mammals is largely dependent upon the environment of the respective areas. The mammals present in the study area include Mongoose, Indian palm Squirrel, etc. These mammals are spread over the study area. Mammal species recorded in the area are common species found all over the state/country. There is no immediate threat to them.

Based on the faunal study, this area seems to support a variety of diverse animal species.

The scheduled I & II animals were recorded in study area. These species would require both protection of water bodies and preventing the sources and causes of pollution. This may involve developing a conservation plan for safeguarding both

species and habitat in and around the quarry area.Thus, the detailed conservation plan has been prepared and discussed in chapter-7 and got approved by Chief Wildlife Warden vide Lr.No WL5/30163/2014 Dated 10.02.2015.

All other faunal species of Pisces, Amphibians, Molluscuns, insects, butterflies are common species only.

Hence quarrying will not have any direct negative impact on the faunal diversity.

CHAPTER-6

ENVIRONMENTAL MONITORING PROGRAMME

6.0 INTRODUCTION:

Monitoring is one of the most important components of a management system. The regular monitoring of environmental parameters is of immense importance to assess the status of environment during project operations. With the knowledge of baseline conditions, the monitoring programme will serve as an indicator for any deterioration in environmental conditions due to operation of the project, to enable taking up suitable mitigation steps in time to safeguard the environment. Monitoring is as important as that of control of pollution since the efficiency of control measures can only be determined by monitoring.

6.1 OBJECTIVES OF MONITORING:

The objectives of the monitoring plan are as follows:

- Verify effectiveness of planning decisions
- To check and assess the efficacy of pollution control equipment
- Measure effectiveness of operational procedures
- Confirm statutory and corporate compliance
- Identify unexpected changes

6.2 ENVIRONMENTAL MONITORING:

Environmental monitoring during operational phase will be carried out through outsource laboratory (NABL/MOEF/TNPCB approved). Environmental monitoring schedules are prepared covering various phases of project advancement, such as regular operational phase.

6.2.1 MONITORING SCHEDULE DURING OPERATION:

Monitoring is one of the most important components of a management system. Continuous monitoring needs to be carried out for regulatory requirements, environmental effects and performance of EMP implementation. Environmental monitoring programme is a vital process of any management plan of the development project. This helps in assessing the potential problems that resulting from the proposed project, changes in environmental conditions and effectiveness of implemented mitigation measures.

During operational stage, following activities will be undertaken:-

- Ambient air quality
- Ground water quality
- Water and waste water quality

- Soil quality
- Noise quality

The following routine monitoring programme as detailed will be implemented at site. Besides to this monitoring, the compliances to all environmental clearance conditions and regular permits from TNPCB/MoEF will be monitored and reported periodically.

Table 6.1: Environmental Monitoring during operational phase

S. No.	Potential Impact	Action to be followed	Parameters for monitoring	Frequency of monitoring	Location
1	Air emissions	Ambient air quality within the premises of the proposed unit and nearby habitationsto be monitored	PM_{10}, $PM_{2.5}$, SO_2, NO_X	As per CPCB/TNPCB norms	Two locations in Core area and six locations in buffer area.
		Exhaust from vehicles to be minimized by use of fuel efficient vehicles and well maintained vehicles having PUC certificate.	Vehicle logs to be maintained		
		Vehicle trips to be minimized to the extent possible	Vehicle logs	Daily records	Entrance
2	Noise	Noise generated from various operation areas, vehicles to be optimized and monitored	Spot Noise Level recording Leq (night) Leq (day)	Periodic during operation phase	Noise measurements at two locations in core area and six locations in buffer area.
		Generation of vehicular noise	Maintain records of vehicles	Periodic during operation phase	
3	Water quality and water levels	Monitoring surface water quality & ground water quality and levels	Comprehensive monitoring as per IS:10500 Groundwater level bgl	Periodic during operation phase	Two surface water locations in core area, four ground water locations in buffer area and seven water level monitoring locations maintained by the GWD

4	Maintenance of flora and fauna	Vegetation, greenbelt/green cover development	No plants, species	Periodic during operation phase	-
5	Soil quality	Maintenance of good soil quality	Physico-chemical parameters and metals	Periodical Monitoring	Plantation areas
6	Health	Employees and labour health checkups	All relevant parameters.	Regular checkups	Nearby Public Health centers.
7	Social Environment	Social monitoring of corporate social activities	Proper implementation of CSR activities from planning stage to its execution.	Periodical Monitoring (Quarterly)	At specific locations of the proposed activites under CSR

6.3 STAFF REQUIREMENTS FOR POST-PROJECT MONITORING

The Assistant Engineer, PWD have the responsibility of air, water and land environmental monitoring.

CHAPTER – 7
ADDITIONAL STUDIES

7.0 INTRODUCTION:-

The project has submitted before the 14th meeting of the Reconstituted Committee of the Expert Appraisal Committee for Environmental Appraisal of mining projects constituted under EIA Notification, 2006 on Nov'22 of 2013.The committee agreed to start the collection of base line data from winter season i.e. December 2013 – February 2014.

Based on the information furnished and presented, the Committee prescribed the TORs for undertaking detailed EIA study with additional TORs (studies)

(i) Details of replenishment studies.

(ii) Details of Transportation of mined out materials as per the Indian Road Congress for both the ways (loaded as well as unloaded trucks) load and its impact on Environment.

(iii) Proper species specific Conservation plan for Schedule-I and II species

(iv) Impact of mining on plankton.

(v) Details of mining activity to be provided.

(vi) Details of Gradient of river bed to be provided.

(vii) Details of excavation schedule and sequential mining plan to be indicated.

(viii) The base line data shall be collected so as to represent the whole mine lease area.

During the detailed EIA study on this winter season, the Tamil Nadu State Public Works Department carefully examined and conducted the detailed study on above subject with available datas of its different wings, Central Water Commission reports and the assistance of reputed institutes like National Institute of Technology, Trichy and Bishop Heber College, Trichy.

7.1 PUBLIC HEARING:-

The MoEF, in the ToR, had directed the project proponent to conduct Public Hearing/Consultation as per EIA Notification dated 14.9.2006. Accordingly, Tamil Nadu Pollution Control Board had issued Public Notices in major dailies (namely The New Indian Express and Dinamani) on 17.6.2014 disclosing the details of Public Hearing scheduled for this project.

The Public Hearing/Consultation was conducted on 18th July 2014 at Sriramasamuthiram panchayat office campus, Sriramasamuthiram village of Thottiyam tehsil in Trichy district in the presence of the District Revenue Officer/Additional District Magistrate, Trichy, District Environmental Engineer, Tamil Nadu Pollution Control Board along with the Executive Engineer, PWD, R.C.Division, Trichy, press fraternity and the public.

At the outset, the District Environmental Engineer welcomed the gathering and explained the objectives and procedure of public hearing. The District Revenue Officer in his capacity as Chairman of the Public Hearing Meeting welcomed the gathering and explained the purpose of the meeting and requested the public to give their opinion, one by one after the presentation by the project proponents.

On behalf of the project proponent, Thiru.C.Podupanithilagam, Assistant Executive Engineer, Public Works Department, R.C.Sub Division, Kulithalai , Karur District welcomed the public and explained the details related to the history of the Public Works Department, their functioning, aim of the proposed project including details like quantity of sand proposed to be quarried , method in which sand will be quarried , benefits of removing the silted sand , funds to be allotted for environmental protection, Air pollution control measures to be adapted while quarrying, water pollution control measures, existing flora and fauna and it's protection, storage of 1.04 TMC water on the upstream side of newly constructed barrage, interlinking of river Cauvery with other rivers in southern Tamil Nadu etc and to increase the functional efficiency of discharging the maximum flood in downstream side. He presented the results of the Environmental Impact Assessment study through visual presentation.

Totally about 191 numbers of people were present for public hearing of which about 9 person spoke about the project. Majority of public present appreciated the need and necessity of the project.

After the presentation by the project proponent, the public were invited to express their views and concern .The issues raised by the public and the replies of the applicant are summarized as below.

TABLE NO. 7.1 SUMMARY/DETAILS OF PUBLIC HEARING IN TABULAR FORM.

Sl. No.	Name of the Public	Issues Raised by the Public	Response/Commitment of project proponent	Suggestions made by the Public Hearing Panel	Remarks
1	**Thiru. A. Pugalanthi, Sri Rama samudram village**	He appreciated the project proponents for providing complete details of the project and at the same time requested clarification regarding the division of seniorage charges of 4.51 crores to the two village panchayats. He also raised his cocern towards the study of the villages during the movement of vehicles through the narrow village roads and the necessity of widening the roads before commencement of the project. He also expected assurance from the project proponent that the air quality is maintained and it should not be polluted otherwise village people may be affected. He also expected that project proponents to adhere to the number of machineries used , depth of excavation of sand and number of employees employed as stipulated in the proposal.	The proposed quantity of sand for both the panchayats are 15,01,247 Cubic meter and the total seniorage charges of Rs. 4.51 crores will be distributed to each panchayats as against the quantity taken from the concerned survey number of the village at the rate of rupees one hundred and seventy per load, ie., 200 cubic feet. He further stated that there are several routes suggested in the project proposal and the public will not experience any difficulties during the movement of vehicles. He also stated that the air quality and noise level will be monitored periodically and it will be ensured that they are within the norms. Use of machineries and the depth of mining will be strictly followed as stated in the proposal.	---	---
2	**Thiru.Sakthivel, DeputySecretaty, Karur District Viduthalai chiruthaikal Katchi**	He thanked the Government for constructing the barrage for the benefit of farmers and said he is infact one of the beneficiary of this barrage. He expressed his concern for the removal of shoals as they are acting as filter media to treat the dying effluent discharge from the upstream side and further said that the removal of shoal may endanger the safety of the barrage. He also requested not to quarry sand from that barrage area.	The concerns expressed will be taken in to account.	---	---

3	**Thiru.Srinivasan, Seelaipillaiyaputhur**	He has expressed that the proposed project will be essential to attain the designed storage capacity. He also stated that the sand shoals of more than 9 feet has been formed below the barrage and more than 6 feet of sand shoals formed above the barrage and he emphasised the need of the project. He told that the proposed project is part of the river linking project. He also expressed his anguish against the opposition of project by the person spoken previously from a political party and he kindly appealed that political motivation may be avoided in this regard. This project will lead a scope in future that the left bank canal off taking from barrage may be extended far away upto perambalur district as well as right bank canal may be extended to pudukottai district. He supported for quarrying without affecting the people and Environment.	His views will be considered during quarrying and thanked him.	---	---
4	**Thiru.Gandhi Pithan,Secretaty, Cauvery Delta farmers Association**	He whole heartedly welcomed the project . His concern was that how the stated 300 loads per day can be transported through the existing single road situated in Sri Rama samudram and Silaipillayaputhur Villages and suggested to improve the existing road. He also requested to carry out the quarrying the stipulated depth to remove the shoals only.	The suggestions given will be taken into account and the public will not experience any difficulties during the movement of vehicles.	---	---

5	**Thiru.K.Ajithan, secretary of Mohanur Channel Ayacuttar Association**	He welcomed the project as it is a very special project of PWD that the removal of shoals through quarrying operation will restore the storage capacity. It is the part of the project of linking of rivers in future. The project will benefit the farmers. He stated that the River Cauvery is deficit river in southern peninsular. Despite the orders of Supreme Court, Tamil Nadu peoples are fighting with Karnataka to get their share. In this juncture with available water, 50 barrages should be constructed across Cauvery from Mettur to Lower Anaicut to recharge the ground water. The expected seniorage charges from the project would be helpful for various infrastructural development activities of the two villages and suggested the revenue of the project may be utilised to renovate the old channels which are off taking from the barrage.	All of his views will be taken into account and shall be done strictly as per the statutory rules and regulation.	---	---
6	**Thiru. S.K.V.Arivazhagan, Seelaipillaiyaputhur**	He has demanded that the local people should only be engaged in quarrying operation and the quarrying should not be done more than one meter and permit slip should be issued for each load and the boundaries of the quarries should demarcated in the presence of village people and the quarry should be done only under the supervision of PWD officials and the quarrying operation should be done within the prescribed time and the vehicles should be loaded according to the prescribed limit and the operation of quarry will be done without disturbing the public particularly students, old agers, conceived women and differently abled. He told the excess quarrying will affect the nearby villages and also ground water table. He stated that he will approach the appropriate authority for any violations found in this regard.	The rules and regulations of the Government and the conditions imposed by the Environmental authorities will be strictly adhered during quarrying.	---	---

7	**Thiru.Subramanian, the secretary of vadakarai vaikkal pasanatharargal sangam**	He has stated that the project is important and benefits one for all and he has no objection for this project as it is a special sand quarry project of PWD. He also insisted the quarrying should not affect the smooth water flow in the channels and he expressed his concern regarding the renovation of existing roads and bridges.	All of his views will be taken into account while quarrying.	---	---
8	**Thiru.Harikrishnaan, Sriramasamuthiram**	He has thanked to the Government for this project as it is a part of river linking project. He has no objection for the sand quarry and at the same time he insisted that the rules and regulations should be followed during the quarrying operation and suggested some alternative routes for lorry transportation without disturbing the public and the revenue of the project may be utilised to renovate the old channels which are off taking from the barrage. Finally, he demanded one more check dam across River Cauvery to feed the kattuputhur channel which is situated 8 km upstream of kattalai barrage.	All of his views will be taken into account and shall be done strictly as per the statutory rules and regulation.	---	---
9	**Thiru.R.Chakravarthy, Sriramasamuthiram**	He has expressed his concerns for the safety of school students and he requested to make alternative routes for lorry transport.	His request will be taken into account while quarrying.	---	---

The minutes of public hearing is herewith enclosed as Annexure 7.1

7.2 REPLENISHMENT STUDY:-

"*Sand is composed of consolidated felsic compound Silica and Feldspar. The sand is formed by the action of water due to transportation and erosion of Rocks sand has become a very important mineral for the expansion of society. Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. River sand is on of the world's most plentiful resources (perhaps as much as 20% of the Earth's crust is sand).and has the ability to replenish itself. River sand is vital for infrastructure development and for sustenance of rivers".*

7.2.1 GEOGRAPHICAL DESCRIPTION OF THE BASIN

The Cauvery originates at Talakaveri in Coorg District of Karnataka in Brahmagiri Range of hills in the Western ghats at an elevation of 1341 m. (above MSL) and drains a total area of 81,155 Sq.Kms. of which 34,273 Sq. Kms lies in Karnataka, 43,856 Sq. Kms. in Tamil Nadu, 2,866 Sq.Kms. in Kerala and 160 Sq.Kms in Union Territory of Pondicherry. The Cauvery basin is bounded by Tungabhadra sub-basin of Krishna basin on the Northern side and Vaigai basin on the Southern side.

The Western ghats form the Western boundary. The Nilgiris, an offshore of Western ghats, extend Eastwards to the Eastern ghats and divide the basin into two natural and political regions i.e., Karnataka plateau in the North and the Tamil Nadu plateau in the South. In Tamil Nadu, the Eastern part of the basin is in the elevation range of 0 to 150 m sloping gently up from the sea.

In the initial reaches of the Basin there are four important reservoirs namely 1) Harangi, 2) Hemavathi, 3) Kabini and 4) Krishnaraja Sagara. In the reaches downstream of Krishnaraja Sagara, at Shivanasamudram, the river branches off into two parts and falls through a height of 91m. In a series of falls and rapids. The falls at this point is utilized for power generation. The power station at Shivanasamudram was built in as early as 1902. The two branches of the river join after the fall and flow through a wide gorge, which is known as “Mekedatu” (Goats leap) and continues its journey to form the boundary between Karnataka and Tamil Nadu States for a distance of 64 Kms.

At Hogenakkal Falls, it takes southernly direction and enters the Mettur Reservoir which was constructed in 1934. A tributary called Bhavani joins Cauvery on the Right bank about 45 Kms below Mettur Reservoir. Thereafter it takes easternly course to enter the plains of Tamil Nadu. Two more tributaries Noyyal and Amaravathi join on the right bank and here the river widens with sandy bed and flows as “Akhanda Cauvery”. In this chainage, at LS 85th mile from Mettur reservoir project, the kattalai Bed regulator is located to feed the canals in right at left bank of Cauvery in Karur and Trichy district.

Now the new kattalai barrage was constructed, 250m downstream side to divert the excess flood water in Cauvery river by excavating the new link canal to far southern rivers upto Gundar as a part of river linking projects. Immediately after crossing Tiruchirapalli district, the river divides into two parts, the Northern branch being called “The Coleron” and Sourthern branch remains as Cauvery and from here the Cauvery Delta begins. After flowing for about 16 Kms, the two branches join again to form “Srirangam Island”. On the Cauvery branch lies the “Grand Anicut” said to have been constructed by a Chola King in 2nd Century A.D. Below the Grand Anicut, the Cauvery branch splits into two Cauvery and Vennar. These branches divide and

sub-divide into small branches and form a network all over the delta. The total length of the river from the origin to its outfall into the sea is 800 Kms. of which 320 Kms. is in Karnataka, 416 Kms. in Tamil Nadu and 64 Kms. forms the common border between the Karnataka and Tamil Nadu states.

The Cauvery basin is fan shaped in Karnataka and leaf shaped in Tamil Nadu. The run-off does not drain off quickly because of its shape and therefore no fast rising floods occur in the basin.

There are 34 Nos. of Hydrological Observation Stations and 26 Nos. of Rainfall Stations in the basin being operated by CWC, out of which 7 Hydrological Observation stations and 3 Rainfall stations are under Karaikal Delta region. A basin map showing all these stations is enclosed as Fig 7.1. The details of classification of these sites are mentioned in the Table 7.2. A Tree Structure showing the Sites in Basin is also enclosed as Fig 7.2.

Table 7.2

STATEMENT SHOWING HO SITES IN CAUVERY BASIN			
Sl No	**Name of the site**	**River Name**	**Type**
1	GOPURAJAPURAM	Puravadaiyanar	GDQ
2	ANNAVASAL	Nattar	GDQ&RF
3	NALLATHUR	Nandalar	GDQ
4	MENANGUDI	Nular	GDQ
5	PORAKUDI	Arasalar	GDQ&RF
6	PERALAM	Vanjiyar	GDQ
7	THENGUDI	Thirumalairajanar	GDQ&RF
8	MUSIRI	Main Cauvery	GDQ&RF
9	NALAMMARANPATTI	Amaravathi	GDQ&RF
10	E-MANAGALAM	Noyyal	GDQ&RF
11	KODUMUDI	Main Cauvery	GDQ&RF
12	SAVANDAPUR	Bhavani	GDQ&RF
13	THENGUMARAHADA	Shavani/Moyar	GDQ&RF
14	NELLITHURAI	Bhavani	GDQ&RF
15	URACHIKOTTAI	Main Cauvery	GDQ&RF
16	THEVUR	Sarabenga	GDQ&RF
17	SEVANUR	Chittar	GDQ&RF
18	THOPPUR	Thoppaiyar	GDQ&RF
19	KUDLUR	Palar	GDQ&RF
20	HOGENAKKAL	Chinnar	GDQ
21	BILIGUNDULU	Main Cauvery	GDQ&RF
22	T.BEKUPPE	Arkavathi	GDQ&RF
23	T.K.HALLI	Shima	GDQ&RF

24	KOLLEGAL	Main Cauvery	GDQ&RF
25	BENDRAHALLI	Suvarnavathi	GDQ
26	T.NARASIPUR	Kabini	GDQ&RF
27	MUTHANKERA	Kabini	GDQ&RF
28	K.M.VADI	Lakshmana-thirtha	GDQ&RF
29	AKKIHEBBAL	Hemavathy	GDQ&RF
30	M.H.HALLI	Hemavathy	GDQ&RF
31	THIMMANAHALLI	Yagachi/Hemavathy	GDQ
32	SAKLESHPUR	Hemavathy	GDQ
33	CHUNCHUNKATTE	Main Cauvery	GDQ
34	KUDIGE	Main Cauvery	GDQ&RF
Index :	GD = Gauge & Discharge, RF = Rainfall Station GDQ = Gauge, Discharge & water Quality, GDSQ = Gauge, Discharge, Sediment & Water Quality		

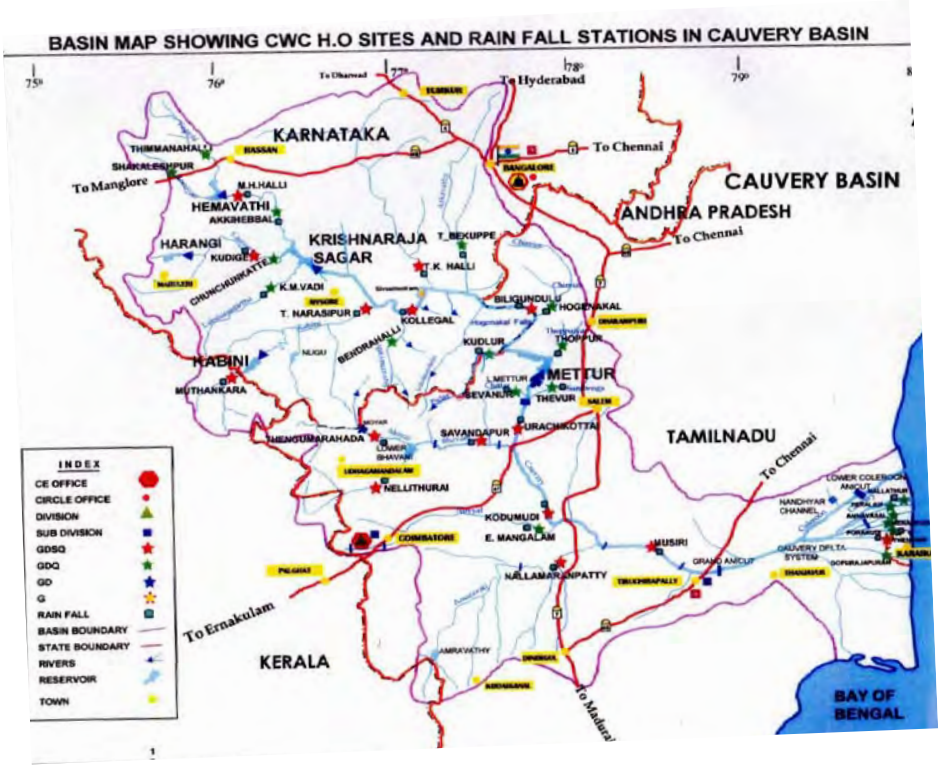


Figure 7.1

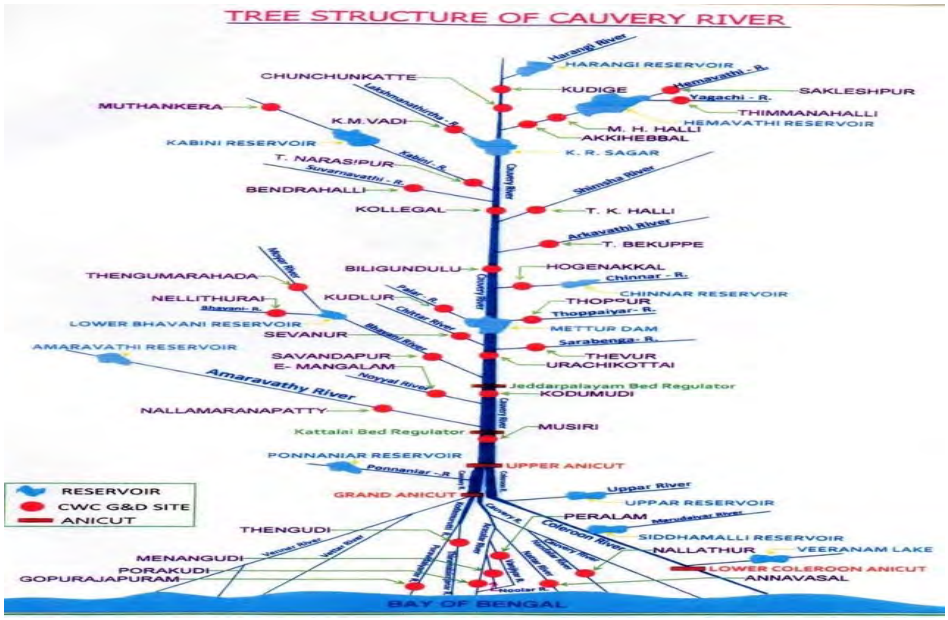


Figure 7.2

Regarding the Rainfall Stations in this Basin, apart from 26 Rainfall Stations operated by CWC, there are another 153 Rainfall Stations operated by concerned Stations operated by concerned State Governments spreading over the states of Karnataka, Tamil Nadu & Kerala. Further, there are 8 more Rainfall stations operated by India Meteorological Department (IMD). A Basin map indicating the location of Rainfall Stations operated by State Governments and IMD is enclosed as Fig 7.3. The details are mentioned in Table 7.3.

Table 7.3

RAINGAUGE STATIONS IN CAUVERY BASIN

Sl.No	Station	District	Latitude	Longitude	Abrivation
1	Bhagamandala	Coorg	12-33	75-31	BMD
2	Pulingoth	Coorg	12-20	78-34	PLG
3	Mercara	Coorg	12-25	75-44	MRC
4	Napoklu	Coorg	12-18	75-41	NPK
5	Sunticoopa	Coorg	12-27	75-50	SUN
6	Ammathi	Coorg	12-14	75-51	AMT
7	Fraserpet	Coorg	12-27	75-58	FZP
8	Dubare	Coorg	12-22	75-55	DBR
9	Hudugur	Coorg	12-29	75-56	HDG
10	K.R.Nagar	Mysore	12-16	76-25	KRN
11	Somvarpet	Coorg	12-36	75-51	SMP
12	Poonampet	Coorg	12-09	75-56	PMP
13	Karmad	Coorg	12-07	76-04	KRM

14	Thitimati	Coorg	12-13	76-00	TIT
15	Periyapatna	Mysore	12-20	76-06	PPT
16	Hunsur	Mysore	12-18	76-08	HUN
17	Mudigere	Chikmagalur	13-20	75-46	MDG
18	Chikmagalur	Chikmagalur	13-20	75-46	CMG
19	Belur	Hassan	12-10	75-51	BLR
20	Sanivrasarthi	Coorg	12-49	75-54	SVS
21	Alur	Hassan	12-58	75-59	ALR
22	Arkalgud	Hassan	12-46	76-03	ARK
23	Hassan	Hassan	13-00	76-09	HSN
24	Holenarsipur	Hassan	12-47	76-14	HNP
25	Chanarayapatna	Hassan	12-54	76-23	CRP
26	K.R.Pet	Mandya	12-40	76-29	KRP
27	Vyathiri	Kozikode	11-33	76-02	VAY
28	Manonthody	Cannanoor	11-48	76-01	NAN
29	Virajpet	Coorg	12-11	75-48	VRP
30	Srimangala	Coorg	12-01	45-59	SRI
31	Balecove	Coorg	11-59	76-05	BAL
32	Nagarhole	Coorg	12-02	76-07	NGH
33	Murkhal	Coorg	12-06	76-10	MKL
34	H.D.Kote	Mysore	12-05	76-20	HDK
35	Gundelpet	Mysore	11-48	76-41	GUN
36	Nanjungud	Mysore	12-08	76-41	NAN
37	Mysore	Mysore	12-18	76-42	MSR
38	T.Narsipur	Mysore	11-30	76-30	TNP
39	Talavadi	Coimbatore	11-55	76-56	TLV
40	Sakleshpur	Hassan	12-57	75-47	SKP
41	Chamarajnagar	Mysore	11-55	76-55	CRN
42	Yelandur	Mysore	12-03	77-02	YLN
43	Kollegal	Mysore	12-07	77-07	KLG
44	Tumkur	Tumkur	13-31	77-06	TUM
45	Tiptur	Tumkur	13-17	76-27	TIP
46	Thurvekere	Tumkur	13-10	76-40	TUK
47	Gubbi	Tumkur	13-19	76-56	GUB
48	Kunigal	Tumkur	13-01	77-01	KUN
49	Magadi	Bangalore	12-57	77-13	MGD
50	Nagamangala	Mandya	12-49	76-45	MGN
51	Mandya	Mandya	12-32	76-53	MDY
52	Maddur	Mandya	12-36	77-02	MAD
53	Chanapattana	Bangalore	12-33	77-12	CPT
54	Malvalli	Mandya	12-23	77-04	MVL

55	Dodbalallpura	Bangalore	13-17	77-33	DBL
56	Nelmangala	Bangalore	13-06	77-24	NML
57	Bangalore	Bangalore	12-58	77-35	BNG
58	Ramnagaram	Bangalore	12-43	77-17	RNR
59	Anekal	Bangalore	12-42	77-41	ANK
60	Kanakapura	Bangalore	12-33	77-25	KNP
61	Pandavapura	Mandya	12-30	76-40	PDV
62	Sringapatna	Mandya	12-25	76-41	SRP
63	Thally	Salem	12-35	77-39	TLY
64	Denkanikota	Salem	12-32	77-47	DNK
65	Pennagaram	Salem	12-08	77-44	PNG
66	Kailkundah	Niligiris	11-16	76-39	LK
67	Hullatty	Niligiris	11-23	76-39	HUI
68	Ootacamund	Niligiris	11-24	76-44	OTC
69	Perinayaickanpalayam	Coimbatore	11-00	76-57	PNP
70	Mettupalayam	Coimbatore	11-18	76-57	MTP
71	Conoor	Niligiris	11-21	76-48	COR
72	Ketty	Niligiris	11-23	76-46	KET
73	Kotagiri	Niligiris	11-35	76-30	KOT
74	Kodanad	Niligiris	11-30	76-55	KOD
75	Glenmorgan	Niligiris	11-35	76-30	GLM
76	Satayamangalam	Coimbatore	11-30	77-15	STM
77	Gopichettipalayam	Coimbatore	11-28	77-26	GOP
78	Coimbatore	Coimbatore	11-00	76-58	CMB
79	Salur	Coimbatore	11-02	77-08	SUL
80	Annur	Coimbatore	11-14	77-07	ANR
81	Sinnakallore	Coimbatore	11-15	77-11	SNK
82	Avanashi	Coimbatore	11-12	77-17	AVN
83	Palladam	Coimbatore	10-59	77-18	PLD
84	Thiruppur	Coimbatore	11-06	77-21	TPR
85	Kangayam	Coimbatore	11-00	77-34	KNG
86	Kodiumudi	Coimbatore	11-00	77-32	KDM
87	Marayur	Kottayam	10-16	77-00	MAR
88	Udamalpet	Coimbatore	10-35	77-15	UDM
89	Kodaikanl	Madurai	10-14	77-28	KDK
90	Palani	Madurai	10-27	77-31	PLN
91	Dharapuram	Coimbatore	10-44	77-32	DRM
92	Chatrapatti	Madurai	10-28	77-37	CTP
93	Mulanur	Coimbatore	10-47	77-42	MLN
94	Arvakuruchi	Tiruchirapalli	10-46	77-55	ARK
95	Vedasandur	Madurai	10-31	77-57	VDS

96	Dindigul	Madurai	10-21	77-58	DGL
97	Karur	Tiruchirapalli	10-58	78-05	KAR
98	Yercaud	Salem	11-47	78-13	YER
99	Omalur	Salem	11-45	78-03	OML
100	Salem	Salem	11-39	78-10	SLM
101	Sankari	Salem	11-28	77-52	SKD
102	Bhavani	Coimbatore	11-27	77-42	BHV
103	Rasipuram	Salem	11-27	78-11	RSP
104	Erode	Coimbatore	11-21	77-43	TRD
105	Perundurai	Coimbatore	11-17	77-55	PRD
106	Thiruchengoda	Salem	11-23	77-54	TRG
107	Sendamanagelam	Salem	11-17	78-14	SDM
108	Uppiliyapuram	Tiruchirapalli	11-16	78-31	UPP
109	Thuraiyur	Tiruchirapalli	11-09	78-36	TUR
110	Thathiangarpet	Tiruchirapalli	11-08	78-27	TTP
111	Namakkal	Salem	11-13	78-10	NMK
112	Paramathi	Salem	11-10	78-02	PRM
113	Musiri	Tiruchirapalli	10-57	78-27	MUS
114	Kulittalai	Tiruchirapalli	10-45	78-25	KLT
115	Palaviduthi	Tiruchirapalli	10-38	78-15	PVD
116	Manapparai	Tiruchirapalli	10-36	78-25	MNP
117	Vembavur	Tiruchirapalli	10-29	78-34	VMB
118	Illuppur	Tiruchirapalli	10-31	78-37	ILP
119	Viralimalai	Tiruchirapalli	10-36	78-33	VRL
120	Kulattuir	Tiruchirapalli	10-42	78-33	KTR
121	Tiruchirapalli	Tiruchirapalli	10-46	78-43	TRP
122	Vallam	Tanjore	10-43	79-04	VLM
123	Chettikulam	Tiruchirapalli	11-09	78-48	CTK
124	Ariyalur	Tiruchirapalli	11-08	79-05	ARL
125	Siruganur	Tiruchirapalli	11-02	78-48	SRG
126	Palambadi	Tiruchirapalli	10-58	78-55	PUL
127	Lalgudi	Tiruchirapalli	10-52	78-50	LLG
128	Jayankondam	Tiruchirapalli	11-13	79-22	JYK
129	Kattumannarkoil	S.Arcot	11-17	79-33	KMK
130	Chidambaram	S.Arcot	11-24	79-42	CDB
131	Porto Novo	S.Arcot	11-30	79-45	PNO
132	Sirkali	Tanjore	11-15	79-44	SIK
133	Grand Anicut	Tanjore	10-50	78-50	GA
134	Tirukkattupalli	Tanjore	10-51	78-58	TIR
135	Tiruvadi	Tanjore	10-53	79-06	TVD
136	Tanjore	Tanjore	10-47	79-08	TAN

137	Papanasam	Tanjore	10-55	79-16	PPN
138	Valangiman	Tanjore	10-52	79-23	VLM
139	Kumbakonam	Tanjore	10-58	79-22	KMB
140	Mayuram	Tanjore	11-06	79-39	MAY
141	Tranquebar	Tanjore	11-02	79-52	TQB
142	Nannilam	Tanjore	10-53	79-37	NLM
143	Kodavasal	Tanjore	10-51	79-29	KVL
144	Nagapattinam	Tanjore	10-46	79-51	NGP
145	Thiruvarur	Tanjore	10-46	79-39	TRV
146	Needamangalam	Tanjore	10-46	79-26	NGM
147	Mannargudi	Tanjore	10-40	79-27	MND
148	Tirupoondi	Tanjore	10-37	79-49	TRD
149	Tiruthuraipundi	Tanjore	10-32	79-39	TPD
150	Vedaranyam	Tanjore	10-22	79-58	VRM
151	Muthupet	Tanjore	10-24	79-30	MTP
152	Pattukottai	Tanjore	10-26	79-19	PTK
153	Adirampatnam	Tanjore	10-20	79-23	ARP

List of IMD Observatories in Cauvery Basin

Sl. No.	Station	District	Latitude	Longitude	Abrivation
1	Bangalore	Bangalore	12-58	77-35	BNG
2	Hassan	Hassan	13-00	76-09	HSN
3	Mercara	Coorg	12-25	75-44	MRC
4	Mysore	Mysore	12-18	76-42	MSR
5	Ootacamund	Niligiris	11-24	76-44	OTC
6	Coimbatore	Coimbatore	11-00	76-58	CMB
7	Tiruchirapalli	Tiruchirapalli	10-46	78-43	TRP
8	Tanjore	Tanjore	10-47	79-08	TAN

Fig 7.3 Basin Map showing State Govt. rainfall stations and IMD observatories in Cauvery basin

7.2.2 DESCRIPTION OF THE RIVER SYSTEM

The Cauvery river system consists of 21 principal tributaries each with Catchment Area exceeding 250 Sq.Kms. The largest of all of them are the Catchment Area Shimsha, lying wholly in Karnataka, the Amaravathi rising in Kerala but lying mostly in Tamil Nadu and the Kabini rising in both Kerala and Tamil Nadu but lying mostly in Karnataka. The Bhavani is the fourth largest and the second longest. It rises in Kerala and Karnataka but lies mostly in Tamil Nadu. The longest tributary, the Hemavathi (245 Kms.) is the fifth largest in Catchment Area and lies wholly in Karnataka.

From the point of view of flow contribution to the system, apart from the head reach of the Cauvery main, the most important tributaries are i) the Hemavathi, ii) the Kabini and iii) the Bhavani and are briefly described below.

THE HEMAVATHI

The Hemavathi rises in the Western ghats and runs South-East. After a stream from the West joins it, it turns East, receiving the Yagachi from the North. It then winds round Holenarasipur and runs South to the Cauvery near Yedatore.

THE KABINI

The Kabini is an important tributary of the Cauvery. It is a perennial river, 150 to 200 M. Wide and has a course of about 240 Kms. It rises in the Western ghats in North Wynad in Kerala State as two streams i.e. the Mannantoddypuzha and Panamarampuzha.

About 16 Kms. below their confluence, the Kabini forms border between Kerala and Karnataka for about 12 Kms. before entering Karnataka state. It joins the Cauvery at Tirumakudalu Narasipur (T.N.Pur) and this confluence point is being considered as a spot of great sanctity. The confluence point is also called as "Triveni Sangama".

THE BHAVANI

The Bhavani is a picturesque perennial river of South India, rising in Attappadi valley in Kerala. It enters Tamil Nadu near Mannar and traverses from West to East for 170 Kms. and joins the Cauvery near Bhavani Town. It principally receives runoff from the South-West monsoon and occasional floods during North-East Monsoon.

7.2.3 CLIMATIC CHARACTERISTICS

7.2.3.1 CLIMATE

In the Cauvery basin, four distinct seasons occur. They are i) Cold Weather, ii) Hot weather, iii) South-West Monsoon, and iv) North-East Monsoon.

In the cold season, the Western ghat is cooler than the rest of the basin and the climate is generally pleasant. In the hot weather season, the Central, Northern and Eastern regions are hotter than the Western most parts. The South-West monsoon sets by middle of June and ends by middle of September. During this season the basin receives mojar rainfall. The North-East monsoon is from October to December and is important particularly to Eastern part i.e. Tamil Nadu.

7.2.3.2 TEMPERATURE

The basin has a tropical climate. In the Upper reaches i.e., Kerala and Karnataka, the variation in temperature is very small. The mean temperature (Mean of Max. and Min.) in Kerala is below 20^0C and in Karnataka it ranges between 20^0C to 26^0C. The mean temperature in Tamil Nadu is between 26^0C to 30^0C.

7.2.3.3 RAINFALL

The basin is mainly influenced by South-West monsoon in the Karnataka & Kerala and North-East monsoon in Tamil Nadu. The normal annual rainfall in Kerala region is about 2400 mm. In the Western Ghats it ranges from 3800 mm to 1700 mm. In Karnataka, the average rainfall is between 600 mm to 800 mm. resulting into Semi-arid condition. In Tamil Nadu, the average rainfall is low ranging from 500 mm to 1000 mm and is semi-arid. Most of the parts in Tamil Nadu receive rainfall from the North-East Monsoon.

7.2.3.4 EVAPORATION

As per the evaporation data observed by India Meteorological Department and Government of Karnataka, the mean annual evaporation is in the order of 150 cm to 260 cm. in Karnataka state and is about 250 cm. in Tamil Nadu part of the basin. The mean daily evaporation varies from 4 mm to 6 mm increasing from East to West during January. The mean daily evaporation is increasing from North-West to South-East being about 8 to 9 mm in July and 5 to 6 mm in October. The mean annual evaporation is about 2500 mm.

7.2.4 GEOLOGY

The area falling in the Cauvery basin mainly comprises of Igneous and Metamorphic rocks of Pre Cambrian age, either exposed or covered by this mantle of residual and transported soils. The main component rock types are Dharwar Seluists, Granites and granitic gneisses and chromites. The Manjrabad area of Hassan district in Karnataka rests on the border of Western ghats and comprises some of the most beautiful scenery in the Karnataka state. The hills forming the Western limits of the district extend from the past at the "Bisley Ghat" to the South-West border rising to a height of 1715 m. Besides Jenkle betta at 1389 m, Devara Betta raises to a height of 1282 m. and Murukanagudda at 1300 m. Also Indra betta in Hassan district is 1020 m high and is noted for 52 feet colossal statue of "Gommateshwara" on its summit. The Melkote range forms a series of conspicuous hills marked by trignometrical status (Melkote peak) and these are composed of pink to light grey granite gneisses. Intruding all the rocks are several felsites and porphyry dykes. The porphyry dykes are situated in the neighbourhood of Mysore city. The delta area in Tamil Nadu is underlain of Quarternery, Tertiary and Cretaceous age. In the Western parts of the basin there are igneous and metamorphic rocks of Archalan age.

7.2.5 DESCRIPTION OF WATER STORAGE/DIVERSION STRUCTURES

There are about 22 Major and Medium Irrigation Projects in Karnataka and 25 in Tamil Nadu. Besides the above, there are series of 10 masonry Anicuts constructed across the main Cauvery River and some of its tributaries in Tamil Nadu. These Irrigation systems have been in operation prior to 1900 A.D.

The areas getting benefited from these channels in Karnataka lie mainly in Mysore, Mandya and Hassan districts and to a small extent in Kodagu and Bangalore districts. The irrigation to an extent of 77,172 hectares is confined to a narrow stretch hugging the banks of the river. Large areas in Tanjore and Tiruchirapalli districts of Tamil Nadu are benefited through the canal system taking off from Grand Anicut and Upper Anicut. The Grand Anicut, which was constructed around 2nd Century A.D, is considered to be an engineering marvel of anicient India.

7.2.6 SEDIMENT DATA

There are 15 Sediment observations Stations under this Basin and the Sediment data of all the 15 sites has been collected during the Year, out of which the Sediment Data in respect of 4 Sites viz. T.Narasipur, T.K.Halli, M.H.Halli and Kudige has been collected partially due to reduction in frequency of observations. The Sediment Data of all the 15 sites has been included in this Water Year Book. Bed Material Data of 13 sites has also been included. There is no Bed Material data in respect of sites Urachikottai & Nellithurai to rocky bed.

7.2.6.1 SOURCE OF INFORMATION

Suspended Sediment observation stations for which data for 2012-13 is presented in this volume are maintained by the i) Hydrology Division, Chennai ii) Southern rivers Division, Coimbatore iii) South Western Rivers Division, Kochi and iv) Cauvery Division, Bangalore and the names of the stations are given below:-

HYDROLOGY DIVISION, CHENNAI

1. Thirumalairajanar at Thengudi

SOUTHERN RIVERS DIVISION, COIMBATORE

1. Cauvery at Musiri
2. Amaravathi at Nallamaranpatti
3. Cauvery at Kodumudi
4. Bhavani at Savandapur
5. Moyar at Thengumarahada
6. Bhavani at Nellithurai
7. Cauvery at Urachikottai

CAUVERY DIVISION, BANGALORE

1. Cauvery at Biligundulu
2. Shimsha at T.K.Halli
3. Cauvery at Kollegal
4. Kabini at TNarasipur
5. Hemavathi at M.H.Halli
6. Cauvery at Kudige

SOUTH WESTERN RIVERS DIVISION, KOCHI

1. Kabini at Muthankera

7.2.6.2 OBSERVATION TECHNIQUE

Suspended sediment observations are conducted daily along with the discharge observations.

Sampling is done from boat or by wading. The Punjab type bottle sampler is used for collecting sediment samples. The sediment samples collected from flowing channels are analysed for the three grades of sediment viz. Coarse, Medium and Fine. Coarse and Medium grades are separated by sieved using standard sieves of 212 microns and 75 microns respectively and Fine grade sediment by filtration. Grade wise concentration is determined by gravimetric method.

Samples are generally collected at 0.6m depth from various verticals along the cross section of the river. These verticles are grouped into three or more composite sections for the purpose of analysis of Coarse and Medium grades of sediment. For Fine grade, the sediment samples, after removing the Coarse and Medium grade are combined into a single group and analysed. Selection of the composite sections is done in such a way so as to ensure that the discharges through each of the composite sections are nearly equal.

7.2.6.3 CLASSIFICATION OF SEDIMENT

Sediment is classified as Coarse, Medium and Fine according to the diameter as indicated below:

Coarse	:	Sediment above 0.20 mm diameter
Medium	:	Sediment between 0.20 and 0.075 mm diameter
Fine	:	Sediment below 0.075 mm diameter

The values given in the daily sediment data sheets are observed values. For Non-observed days the values are either taken from Discharge – Sediment Curves or from neighbourhood values.

7.2.6.4 METHOD OF PRESENTATION

The various data tables presented are generated from the validated SWDES Data base through SWDES software. Some of the features of the tables generated are briefky explained as below:

When the sediment samples analyzed give non-measurable sediment, it is presumed to be of “nil” value and recorded accordingly. The Table of Annual Sediment Load along with the season-wise Sediment Loads for the period from the Date of inception up to the Last Year is generated. A bar Chart for the same but including the Sediment load for current year is also generated separately. Separate tables showing Daily observed sediment data & Pie Charts are also generated.

7.2.7 BED MATERIAL DATA

The Bed Material Survey and Analysis data used to be published separately as Bed material analysis data book till the year 1990. Since Bed material survey and analysis work also from a part of the sediment observation work, it was decided to publish the Sediment data and the Bed material survey and analysis data in a single

volume from the year 1990-91 onwards. With the revision of format of Water Year Book, the Sediment and Bed Material data is included with Water Year Book itself from 2006-07 onwards.

7.2.7.1 OBSERVATION TECHNIQUES

Bed material survey is conducted at the station gauge line three times in a Water Year i.e during Monsoon, Post monsoon and Pre-monsoon seasons. Samples at the required intervals from the dry as well as the flowing part of the river bed are collected and the river cross section on the date of survey is also taken.

Sampling segments are fixed as per the standard requirements, subject to a minimum of three samples. Samples from the flowing channel are collected by means of a scoop type bed material sampler. For the dry part, the bed is cleared off the vegetation etc. By removing about 10 to 15 cm. of the top layer with a scraper and a suitable pit of about 30 to 40 cm. is dug out and representative samples are collected. These samples are reduced to the required quantity by the cone and quartering process. The samples thus reduced are put into polythene covers and packed into thick cloth bags. The cloth bags are then labelled with the relevant particulars of the river and the samples are sent to the divisional laboratory for analysis.

7.2.7.2 THE ANALYSIS

The bed material samples are analyzed at the divisional laboratory for the particles size distribution in two stages. First, the sample is weighed and then placed in the top 40.0 mm dia. Sieve of a set of Sieves having diameter ranging from 0.6 mm to 40 mm. Shaking the Sieve is done with the help of a mechanical Sieve is collected and weighed. The total weight of various fractions must be equal to the initial weight of the sample used for analysis.

The material passing through the last 0.6 mm dia. Sieve is again analyzed by means of the Puri's Siltometer. From the result of the above analysis, Summation Curves are drawn as per the standard procedure and the mean diameter of each example is worked out. From this the Silt Factor can be calculated using the Formula $f = 1.76\ m^{½}$ where 'm' is the mean diameter of the sample in mm. The mean diameter of the sample, maximum diameter of the sample, details of the sample collected and the general data of the river are furnished in this publication.

In the data of the sample collected, the RD from which the sample is collected, RL of dry bed (in case sample is collected from dry bed), RL of bed level (in case sample is collected from flowing channel), Water level, Depth of water, Segment width, Velocity at the RD and the Segment discharge on the date of sampling are furnished.

7.2.8 GENERAL DATA OF RIVER

In the general data of the river the Hydraulic mean depth, Mean velocity, Surface water slope and the discharge on the date of sampling etc. are shown.

7.2.9 BED MATERIAL COMPOSITION

Under bed material composition, the maximum size and mean size of each sample and also the maximum size and the mean size for the entire cross section for each season are recorded. The minimum size for each sample has been assumed as 0.06 mm since this has been observed uniformly in every sample.

7.2.10 SEDIMENT DATA PERTAINING TO KATTALAI BED REGULATOR:-

The proposed project site is in between the two GDSQ (Gauge,Discharge,Sediment & Water Quality) stations namely Kodumudi (at LS 60 mile from Mettur Reservoir Project) and Musiri (at LS 100 mile from Mettur Reservoir Project). The annual sediment load and bed material composition characteristics of the above two stations will reflect the sediment load characteristics of river bed in Kattalai bed Regulator. The Musiri station which is maintained by CWC is just 15 miles below the kattalai Bed Regulator, where the characteristics of river bed i.e. gradient, width, velocity, discharge, depth of water and bed material composition are quite same.

The stream flow and suspended sediment datas of above stations and the entire Cauvery River shared with TNPWD by CWC for every water year i.e. starts from 1st June to 31st May.

The annual sediment load for period 1973 – 2013 for the station Musiri and Kodumudi represented in table 7.4 and 7.5. The average annual sediment load is 558000 Metric Tonnes. The annual sediment load is 51357 Metric Tonnes for the year 2012-13 where the peak observed discharge is only 24600 cusecs due to shortage of monsoon represented for Musiri Station in Table 7.4 and fig 7.4.

Table 7.4 Annual Sediment Load for Period : 1973-2013

Year	Monsoon (M.T.)	Non - Monsoon (M.T.)	Annual Load (M.T.)	Annual Run Off (MCM)
1973-1974	907720	55641	963361	11650
1974-1975	442845	43339	486184	8885
1975-1976	604524	49274	653798	13359
1976-1977	182434	61841	244274	3979
1977-1978	3399864	210641	3610505	14310
1978-1979	1676954	455996	2132950	14397
1979-1980	2055737	69634	2125371	13568
1980-1981	1064037	50818	1114856	13179
1981-1982	1188991	61478	1250470	12442
1982-1983	388850	37219	426069	6187
1983-1984	246673	101981	348654	5719
1984-1985	401417	69835	471252	8973
1985-1986	174798	24239	199037	4827
1986-1987	192144	30882	223025	4890

1987-1988	62969	63016	125985	2432
1988-1989	171821	23465	195286	5172
1989-1990	138397	89454	227851	4548
1990-1991	72645	13642	86287	3774
1991-1992	381621	35828	417449	7768
1992-1993	455657	42245	497903	10450
1993-1994	875212	80350	955562	7622
1994-1995	561469	78623	640092	12672
1995-1996	158563	43516	202079	6582
1996-1997	203097	126681	329779	6595
1997-1998	267785	122259	390044	9754
1998-1999	227294	51379	278672	8538
1999-2000	209120	72397	281518	7539
2000-2001	833079	90794	923873	9719
2001-2002	147902	48056	195959	5898
2002-2003	38989	18935	57924	2062
2003-2004	27821	14337	42158	1590
2004-2005	146208	71940	218148	4860
2005-2006	558850	110703	669553	12558
2006-2007	291602	34026	325628	9010
2007-2008	387284	87038	474322	12248
2008-2009	169592	37977	207569	9372
2009-2010	106925	21810	128735	6947
2010-2011	131921	47601	179522	5755
2011-2012	104947	33699	138646	8327
2012-2013	42990	8367	51357	2911

Table 7.5 Annual Sediment Load for Period : 1973-2013

Year	Monsoon (M.T.)	Non - Monsoon (M.T.)	Annual Load (M.T.)	Annual Run Off (MCM)
1973-1974	364275	35592	399867	11271
1974-1975	365514	35061	400575	9418
1975-1976	643561	50305	693866	13593
1976-1977	251460	31797	283257	4511
1977-1978	440222	62147	502369	10585
1978-1979	1455964	75641	1531604	12663
1979-1980	1246410	73068	1319477	12691
1980-1981	707634	71443	779077	15023
1981-1982	664989	45709	710698	13235
1982-1983	359729	27563	387292	6476
1983-1984	179945	33635	213580	6629
1984-1985	243116	28099	271215	9804
1985-1986	120275	24992	145268	5034
1986-1987	154292	26318	180610	5484
1987-1988	58695	33094	91789	3157
1988-1989	214747	31223	245969	6226

1989-1990	123467	38417	161884	5641
1990-1991	91614	21299	112913	4522
1991-1992	385428	43219	428647	9350
1992-1993	398786	50794	449580	11359
1993-1994	136495	50939	187434	7807
1994-1995	563161	38993	602154	13070
1995-1996	172135	36560	208696	7202
1996-1997	326649	37242	363891	6304
1997-1998	230896	58746	289642	8948
1998-1999	123170	34050	157219	8962
1999-2000	161133	38585	199718	7848
2000-2001	236606	46239	282846	9604
2001-2002	91214	33590	124805	6817
2002-2003	31346	18800	50146	2836
2003-2004	20558	17265	37822	1875
2004-2005	48753	34356	83109	4927
2005-2006	442972	38334	481306	11316
2006-2007	135796	56326	192123	9339
2007-2008	675213	54014	729227	11172
2008-2009	190708	44493	235201	8972
2009-2010	167505	38217	205722	7261
2010-2011	108216	41921	150137	6609
2011-2012	199082	58530	257612	9820
2012-2013	63730	16667	80397	3697

Table 7.6

HISTORY SHEET

			Water Year	:	2012-2013
Site	:	MUSIRI	Code	:	CC000G4
State	:	Tamil Nadu	District	:	Thiruchirappalli
Basin	:	Cauvery	Independent River	:	Cauvery
Tributary	:	-	Sub Tributary	:	
Sub - Sub Tributary	:		Local River	:	Cauvery
Division	:	SR Division, Coimbatore	Sub - Division	:	Lower Cauvery SD, Trichi
Drainage Area	:	66243 Sq. km.	Bank	:	Left
Latitude	:	$10^0$56'36"	Longitude	:	$78^0$26'06"
Zero of Gauge	:	82.000(m.s.l)	26/02/1971	:	
	:	Opening Date	Closing Date	:	
Gauge	:	26/02/1971			
Discharge	:	01/06/1972			
Sediment	:	31/03/1973			
Water Quality	:	01/06/1978			

Annual Maximum / Minimum discharge with corresponding Water Level (M.S.L)

Year	Maximum			Minimum		
	Q (cumecs)	WL (m)	Date	Q (cumecs)	WL (m)	Date
1973-1974	2115	84.455	15/10/1973	4.900	83.005	30/04/1974
1974-1975	1334	84.580	16/09/1974	1.200	82.825	24/04/1975
1975-1976	2494	85.265	23/09/1975	2.200	82.845	16/06/1975
1976-1977	590.4	84.220	18/08/1976	2.900	83.200	28/05/1977
1977-1978	4510	86.175	13/11/1977	2.500	83.200	26/06/1977
1978-1979	3595	85.313	06/11/1978	5.200	83.110	23/05/1979
1979-1980	4050	86.050	20/11/1979	4.600	83.100	29/03/1980
1980-1981	4383	85.825	07/07/1980	5.500	83.000	16/05/1981
1981-1982	4150	85.800	13/09/1981	4.000	82.910	14/04/1982
1982-1983	665.6	84.145	16/09/1982	2.000	83.055	13/02/1983
1983-1984	1012	84.515	25/12/1983	1.000	83.140	03/07/1983
1984-1985	967.7	84.530	28/10/1984	6.500	83.120	18/04/1985
1985-1986	556.0	84.190	27/09/1985	4.200	83.070	26/03/1986
1986-1987	697.8	84.300	09/10/1986	2.500	83.060	09/06/1986
1987-1988	533.2	84.250	21/11/1987	0.350	83.030	12/07/1987
1988-1989	778.9	84.390	12/10/88	2.714	83.220	17/06/1988
1989-1990	684.8	84.325	18/09/1989	0.491	83.040	28/06/1989
1990-1991	636.3	84.180	10/09/1990	1.789	83.160	05/07/1990
1991-1992	1856	85.033	18/11/1991	0.449	83.170	29/05/1992
1992-1993	2456	85.239	23/08/1992	7.662	83.245	01/06/1992
1993-1994	6400	86.065	10/11/93	2.102	83.020	03/06/1993
1994-1995	2561	85.380	03/08/1994	2.707	82.850	19/05/1995
1995-1996	668.7	84.200	22/10/1995	4.897	83.135	17/05/1996
1996-1997	796.2	84.270	11/10/96	7.000	82.940	18/04/1997
1997-1998	1477	84.750	08/12/1997	16.46	83.130	05/06/1997
1998-1999	981.2	84.480	13/12/1998	6.500	83.090	30/05/1999
1999-2000	1324	84.650	25/11/1999	4.400	82.940	21/05/2000
2000-2001	4232	85.845	12/10/00	4.218	83.050	25/03/2001
2001-2002	638.4	84.080	20/07/2001	1.003	82.940	08/04/2002
2002-2003	453.7	83.930	25/12/2002	0.000	82.640	19/05/2003
2003-2004	594.2	84.005	13/10/2003	0.000	Dry Bed	08/05/2004
2004-2005	632.3	83.985	16/10/2004	0.000	Dry Bed	30/06/2004
2005-2006	7690	86.650	25/10/2005	0.632	82.760	26/06/2005
2006-2007	1717	84.640	21/08/2006	4.491	82.650	20/05/2007
2007-2008	3940	85.750	13/08/2007	2.858	82.590	02/03/2008
2008-2009	984.9	83.960	23/10/2008	3.349	82.630	31/05/2009
2009-2010	1283	84.020	14/10/2009	3.179	82.610	19/06/2009
2010-2011	870.6	83.900	24/11/2010	4.160	82.560	03/06/2010
2011-2012	693.6	83.490	19/08/2011	10.57	81.810	10/05/2012

Station: Musiri

Day	Jun		Jul		Aug		Sep		oct		Nov	
	W.L	Q	W.L	Q	W.L	Q	W.L	Q	W.L	Q	W.L	Q
1	81.840	17.67	81.810	13.94	81.720	6.760	81.905	31.27	83.085	443.8	82.325	73.08
2	81.840	17.48	81.870	18.58	81.710	5.749	81.900	28.66	83.070	436.4	82.310	66.79
3	81.840	16.96	81.840	15.50	81.730	7.009	81.890	28.24	83.060	414.8	82.200	42.79
4	81.805	13.51	81.790	9.890	81.720	6.461	81.890	28.04	83.070	416.7	82.110	16.47
5	81.780	9.151	81.825	20.24	81.730	6.947	81.890	25.30	83.080	421.6	82.120	20.04
6	81.820	15.74	81.840	22.89	81.740	7.772	81.875	20.44	83.100	437.0	82.120	18.49
7	81.780	10.04	81.800	17.97	81.760	8.555	81.860	19.05	83.120	465.1	82.090	12.66
8	81.810	14.89	81.760	8.674	81.765	8.787	81.850	19.76	83.105	475.3	82.300	66.41
9	81.800	15.72	81.740	6.012	81.850	18.15	81.850	22.18	83.200	521.5	82.615	209.4
10	81.800	12.99	81.735	5.416	81.880	21.34	81.860	23.42	83.360	659.3	82.780	277.5
11	81.830	19.76	81.725	4.309	81.840	17.71	81.870	24.40	83.400	674.8	82.790	273.6
12	81.840	20.58	81.715	3.318	81.820	18.71	81.850	20.32	83.330	588.6	82.790	273.8
13	81.820	17.48	81.720	3.670	81.800	13.65	81.900	26.71	83.290	554.0	82.820	289.1

14	81.830	17.76	81.710	3.200	81.800	13.71	81.900	26.91	83.340	602.9	83.010	390.3
15	81.870	22.78	81.730	4.849	81.840	20.99	81.910	30.35	83.340	616.8	83.000	390.5
16	81.890	25.32	81.755	7.029	81.940	41.22	81.900	28.66	83.425	698.6	82.990	402.6
17	81.870	20.17	81.760	7.444	81.980	48.21	81.900	32.69	83.265	554.5	82.970	362.8
18	82.050	43.90	81.760	7.417	82.000	50.99	81.920	37.28	83.205	559.6	82.960	365.3
19	82.060	47.62	81.810	21.44	82.010	45.95	81.950	36.00	83.100	483.7	82.970	360.1
20	82.035	39.65	81.865	30.64	82.100	63.25	83.375	573.4	82.925	347.1	82.990	394.3
21	81.985	31.48	81.930	42.78	82.010	51.43	83.350	565.6	82.570	169.0	83.010	392.4
22	81.950	28.17	81.950	54.20	81.980	39.05	83.330	513.1	82.600	182.2	82.990	390.5
23	81.960	30.53	81.810	17.19	81.930	36.59	83.240	538.0	82.500	139.4	82.990	390.6
24	81.955	30.28	81.760	9.489	81.950	42.95	83.270	564.8	82.370	89.90	83.070	422.6
25	81.940	28.29	81.720	3.755	81.920	36.11	83.160	469.7	82.385	98.66	83.050	417.3
26	81.940	28.31	81.670	0.386	81.950	36.00	83.180	514.2	82.300	54.05	83.035	403.2
27	81.910	24.08	81.650	3.013	81.940	39.82	83.190	484.0	82.240	48.28	82.890	342.8
28	81.870	18.21	81.670	3.358	82.000	51.56	83.190	488.3	82.180	32.21	82.750	253.3
29	81.820	12.30	81.660	3.235	81.960	41.42	83.220	495.8	82.130	20.71	82.400	79.13
30	81.800	10.02	81.690	4.209	81.920	36.87	83.120	465.1	82.120	19.58	82.320	57.37
31			81.715	6.337	81.900	30.57			82.120	19.66		
Ten - Daily Mean												
I Ten - Daily	81.811	14.42	81.801	13.91	81.760	9.753	81.877	24.64	83.125	469.2	82.297	80.36
II Ten - Daily	81.910	27.50	81.755	9.331	81.913	33.44	82.048	83.67	83.262	568.1	82.929	350.2
III Ten - Daily	81.913	24.17	81.748	13.45	81.951	40.22	83.225	509.8	82.320	79.42	82.851	314.9
Monthly												
Min	81.780	9.151	81.650	0.386	81.710	5.749	81.850	19.05	82.120	19.58	82.090	12.66
Max	82.060	47.62	81.950	54.20	82.100	63.25	83.375	573.4	83.425	698.6	83.070	422.6
Mean	81.878	22.03	81.767	12.27	81.877	28.2	82.383	206	82.883	362.8	82.692	248.5

Stage - Discharge Data for the period 2012-2013

Station Name : Musiri

Day	Dec		Jan		Feb		Mar		Apr		May	
	W.L	Q	W.L	Q	W.L	Q	W.L	Q	W.L	Q	W.L	W.L
1	82.195	33.08	81.970	8.127	81.880	4.168	81.840	3.596	81.560	0.721	81.250	0.000
2	82.100	22.87	81.960	7.256	81.850	4.080	82.305	66.51	81.560	0.721	81.250	0.000
3	82.040	13.39	81.950	6.961	81.850	4.080	82.460	134.4	81.570	0.790	81.240	0.000
4	82.020	14.36	81.950	6.400	81.850	4.080	82.510	172.5	81.570	0.801	81.230	0.000
5	82.005	12.96	81.950	6.920	81.850	4.080	82.335	81.56	81.560	0.721	81.230	0.000
6	81.970	8.795	81.930	5.964	81.850	4.080	82.020	23.18	81.540	0.577	81.230	0.000
7	81.950	7.298	81.920	5.290	82.100	24.82	81.890	13.43	81.560	0.721	81.220	0.000
8	82.840	292.6	81.920	5.377	82.450	101.6	81.820	8.164	81.600	1.070	81.220	0.000
9	82.850	302.7	81.910	4.734	82.310	73.90	81.790	6.314	81.550	0.646	81.220	0.000
10	82.880	325.3	81.920	5.439	82.210	41.30	81.770	5.485	81.500	0.342	81.220	0.000
11	82.850	308.7	81.910	4.452	82.080	20.53	81.750	4.430	81.450	0.145	81.220	0.000
12	82.830	301.0	81.990	9.861	82.050	18.24	81.730	4.107	81.450	0.145	81.210	0.000
13	82.940	365.1	81.990	10.46	81.980	10.90	81.730	4.082	81.460	0.177	81.210	0.000
14	82.970	394.7	81.970	8.795	81.940	8.112	81.710	3.498	81.480	0.251	81.200	0.000
15	82.980	405.4	81.960	7.114	81.920	6.575	81.700	3.253	81.490	0.295	81.200	0.000
16	82.980	393.7	81.940	6.985	81.890	5.487	81.690	2.785	81.500	0.342	81.200	0.000
17	82.950	369.1	81.930	5.830	81.870	5.002	81.690	2.798	81.490	0.257	81.200	0.000
18	82.910	364.7	81.910	5.846	81.860	4.571	81.670	2.206	81.490	0.329	81.190	0.000
19	82.925	376.2	81.910	5.582	81.850	4.135	81.670	2.213	81.490	0.317	81.180	0.000
20	82.920	371.4	81.910	4.787	81.860	4.554	81.660	2.023	81.470	0.206	81.180	0.000
21	82.860	342.3	81.900	4.858	81.860	4.989	81.660	1.919	81.460	0.247	81.180	0.000
22	82.840	317.5	81.900	4.817	81.850	4.220	81.650	1.779	81.450	0.236	81.180	0.000
23	82.700	214.7	81.900	4.736	81.820	3.351	81.650	1.801	81.440	0.232	81.180	0.000
24	82.415	76.06	81.890	4.325	81.820	2.904	81.640	1.667	81.310	0.116	81.175	0.000
25	82.240	47.56	81.900	4.255	81.810	3.062	81.630	1.535	81.310	0.112	81.175	0.000
26	82.120	22.38	81.900	4.255	81.810	3.070	81.625	1.470	81.310	0.108	81.170	0.000
27	82.070	15.91	81.900	4.255	81.820	2.928	81.620	1.330	81.280	0.105	81.170	0.000
28	82.030	12.41	81.900	4.407	81.820	3.043	81.620	1.286	81.260	0.000	81.165	0.000
29	82.010	10.61	81.900	4.349			81.610	1.170	81.260	0.000	81.165	0.000
30	81.990	10.46	81.890	4.144			81.610	1.109	81.260	0.000	81.165	0.000

31	81.980	8.950	81.890	4.154			81.610	1.170			81.200	0.000
Ten - Daily Mean												
I Ten - Daily	82.285	103.3	81.938	6.247	82.020	26.61	82.074	51.52	81.557	0.711	81.231	0.000
II Ten - Daily	82.925	365.0	81.942	6.971	81.930	8.810	81.700	3.139	81.477	0.246	81.199	0.000
III Ten - Daily	82.296	98.08	81.897	4.414	81.826	3.446	81.630	1.476	81.334	0.116	81.175	0.000
Monthly												
Min	81.950	7.298	81.890	4.144	81.810	2.904	81.610	1.110	81.260	0.000	81.165	0.000
Max	82.980	405.4	81.990	10.46	82.450	101.6	82.510	172.5	81.600	1.070	81.250	0.000
Mean	82.495	185.9	81.925	5.83	81.933	13.64	81.796	18.15	81.456	0.358	81.201	0

Annual Run off in MCM = 2911 Annual Run off in mm = 44
Peak Observed Discharge = 698.6 cumecs on 16/10/2012 Corres. Water Level : 83.425m
Lowest Observed Discharge = 0.000 cumecs on 28/04/2013 Corres. Water Level : 81.26m

Q : Observed/Computed Discharge in cumecs
WL : Corresponding Mean Water Level (m.s.l)in m
* Computed Discharge
# Discarded Discharge (Values changed as per rating curve)
Note : Missing values ignored while arriving at Annual Runoff

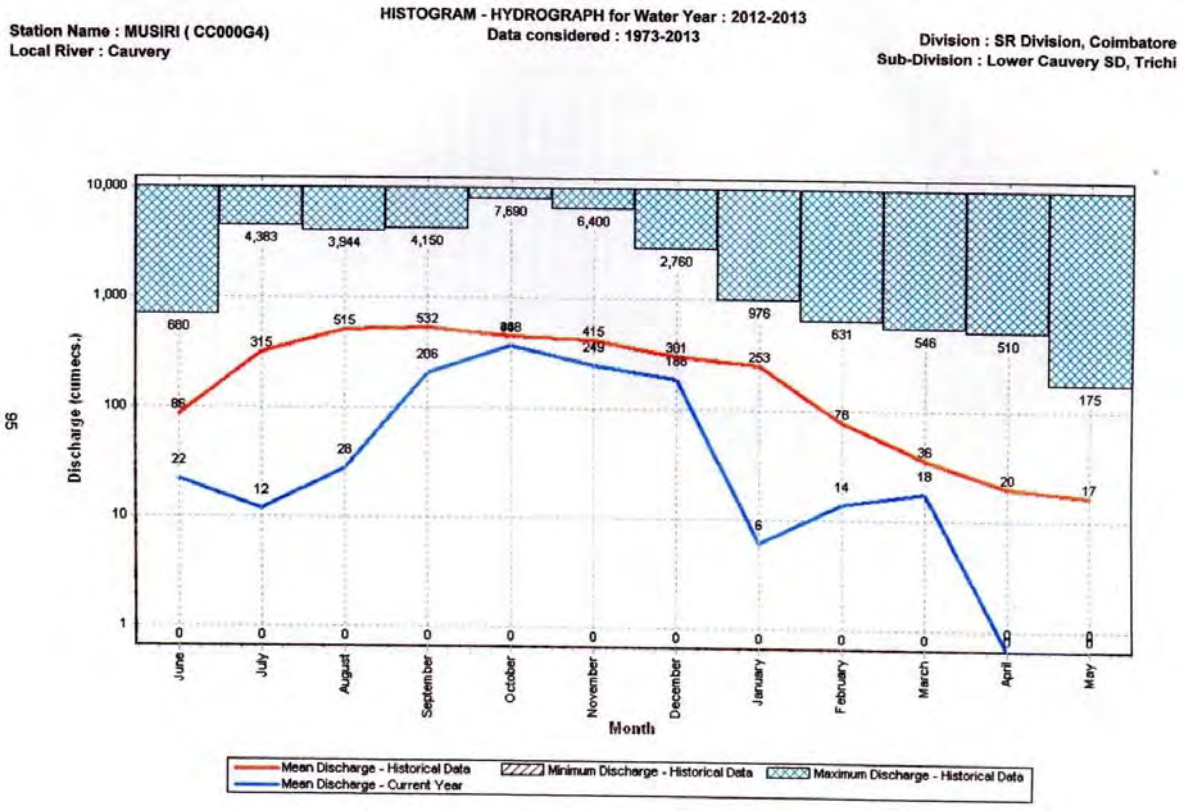


Fig 7.4

The daily observed sediment data sheet for period 2012-13 for the above two stations are represented in table 7.7 and 7.8.The annual sediment load for the period 1973-2013 depicts in bar chart for the above stations vide fig 7.5 and 7.6.

Table 7.7

Daily Observed Sediment Datasheet for period : 2012 – 2013

Station Name : Musiri

Day	Jun						Jul						Aug					
	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/ day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day
1	17.67	0.00	0.00	0.014	0.014	22	13.94	0.00	0.00	0.016	0.016	20	6.760	0.00	0.00	0.019	0.019	11
2	17.48	0.00	0.00	0.014	0.014	21	18.58	0.00	0.00	0.020	0.020	32	5.749	0.00	0.00	0.017	0.017	8
3	16.96	0.00	0.00	0.014	0.014	20	15.50	0.00	0.00	0.016	0.016	22	7.009	0.00	0.00	0.019	0.019	12
4	13.51	0.00	0.00	0.013	0.013	15	9.890	0.00	0.00	0.013	0.013	11	6.461	0.00	0.00	0.016	0.016	9
5	9.151	0.00	0.00	0.013	0.013	10	20.24	0.00	0.00	0.016	0.016	28	6.947	0.00	0.00	0.014	0.014	8
6	15.74	0.00	0.00	0.017	0.017	23	22.89	0.00	0.00	0.014	0.014	27	7.772	0.00	0.00	0.015	0.015	10
7	10.04	0.00	0.00	0.018	0.018	16	17.97	0.00	0.00	0.012	0.012	19	8.555	0.00	0.00	0.016	0.016	11
8	14.89	0.00	0.00	0.019	0.019	24	8.674	0.00	0.00	0.010	0.010	8	8.787	0.00	0.00	0.018	0.018	13
9	15.72	0.00	0.00	0.015	0.015	20	6.012	0.00	0.00	0.010	0.010	5	18.15	0.00	0.00	0.026	0.026	41
10	12.99	0.00	0.00	0.011	0.011	13	5.416	0.00	0.00	0.011	0.011	5	21.34	0.00	0.00	0.022	0.022	40
11	19.76	0.00	0.00	0.017	0.017	29	4.309	0.00	0.00	0.010	0.010	4	17.71	0.00	0.00	0.015	0.015	23
12	20.58	0.00	0.00	0.018	0.018	32	3.318	0.00	0.00	0.010	0.010	3	18.71	0.00	0.00	0.016	0.016	25
13	17.48	0.00	0.00	0.017	0.017	25	3.670	0.00	0.00	0.009	0.009	3	13.65	0.00	0.00	0.013	0.013	16
14	17.76	0.00	0.00	0.014	0.014	22	3.200	0.00	0.00	0.019	0.019	5	13.71	0.00	0.00	0.014	0.014	16
15	22.78	0.00	0.00	0.021	0.021	41	4.849	0.00	0.00	0.011	0.011	4	20.99	0.00	0.00	0.014	0.014	25
16	25.32	0.00	0.00	0.015	0.015	32	7.029	0.00	0.00	0.016	0.016	9	41.22	0.00	0.00	0.014	0.014	49
17	20.17	0.00	0.00	0.012	0.012	20	7.444	0.00	0.00	0.016	0.016	11	48.21	0.00	0.00	0.014	0.014	58
18	43.90	0.00	0.00	0.025	0.025	94	7.417	0.00	0.00	0.017	0.017	11	50.99	0.00	0.00	0.014	0.014	59
19	47.62	0.00	0.00	0.015	0.015	60	21.44	0.00	0.00	0.025	0.025	46	45.95	0.00	0.00	0.012	0.012	49
20	39.65	0.00	0.00	0.015	0.015	51	30.64	0.00	0.00	0.012	0.012	32	63.25	0.00	0.00	0.016	0.016	89
21	31.48	0.00	0.00	0.014	0.014	38	42.78	0.00	0.00	0.023	0.023	85	51.43	0.00	0.00	0.014	0.014	60
22	28.17	0.00	0.00	0.012	0.012	29	54.20	0.00	0.00	0.026	0.026	120	39.05	0.00	0.00	0.019	0.019	62
23	30.53	0.00	0.00	0.013	0.013	34	17.19	0.00	0.00	0.017	0.017	26	36.59	0.00	0.00	0.008	0.008	26
24	30.28	0.00	0.00	0.013	0.013	33	9.489	0.00	0.00	0.010	0.010	8	42.95	0.00	0.00	0.011	0.011	40
25	28.29	0.00	0.00	0.014	0.014	33	3.755	0.00	0.00	0.021	0.021	7	36.11	0.00	0.00	0.009	0.009	29
26	28.31	0.00	0.00	0.013	0.013	33	0.386	0.00	0.00	0.016	0.016	1	36.00	0.00	0.00	0.009	0.009	29
27	24.08	0.00	0.00	0.014	0.014	29	3.013	0.00	0.00	0.024	0.024	6	39.82	0.00	0.00	0.010	0.010	36
28	18.21	0.00	0.00	0.016	0.016	25	3.358	0.00	0.00	0.024	0.024	7	51.56	0.00	0.00	0.010	0.010	46
29	12.30	0.00	0.00	0.014	0.014	15	3.235	0.00	0.00	0.023	0.023	6	41.42	0.00	0.00	0.016	0.016	58
30	10.02	0.00	0.00	0.014	0.014	12	4.209	0.00	0.00	0.025	0.025	9	36.87	0.00	0.00	0.018	0.018	57
31							6.337	0.00	0.00	0.018	0.018	10	30.57	0.00	0.00	0.015	0.015	40
Ten - Daily Mean																		
Ten - Daily I	14.42	0.00	0.00	0.015	0.015	18	13.91	0.00	0.000	0.014	0.014	18	9.753	0.00	0.00	0.018	0.018	16
Ten - Daily II	27.50	0.00	0.00	0.017	0.017	41	9.331	0.00	0.000	0.014	0.014	13	33.440	0.00	0.00	0.014	0.014	41
Ten - Daily III	24.17	0.00	0.00	0.014	0.014	28	13.45	0.00	0.000	0.021	0.021	26	40.22	0.00	0.00	0.013	0.013	44

Annual Sediment Load (Metric Tonnes) : 51357

Station Name : Musiri

Day	Sep						**Oct**						**Nov**					
	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day
1	31.27	0.000	0.000	0.019	0.019	52	443.8	0.002	0.003	0.002	0.007	249	73.08	0.002	0.002	0.005	.009	
2	28.66	0.000	0.000	0.019	0.019	47	436.4	0.001	0.002	0.003	0.006	241	66.79	0.002	0.002	0.005	0.009	
3	28.24	0.000	0.000	0.019	0.019	46	414.8	0.001	0.002	0.002	0.005	176	42.79	0.003	0.001	0.005	0.09	
4	28.04	0.000	0.000	0.014	0.014	33	416.7	0.001	0.002	0.003	0.006	220	16.47	0.000	0.000	0.002	0.002	
5	25.30	0.000	0.000	0.038	0.038	82	421.6	0.001	0.002	0.029	0.032	1173	20.04	0.000	0.000	0.002	0.002	
6	20.44	0.000	0.000	0.038	0.038	67	437.0	0.001	0.002	0.026	0.030	1114	18.49	0.000	0.000	0.004	0.004	
7	19.05	0.000	0.000	0.031	0.031	51	465.1	0.000	0.002	0.015	0.017	687	12.66	0.000	0.000	0.002	.002	
8	19.76	0.000	0.000	0.032	0.032	55	475.3	0.000	0.002	0.015	0.018	719	66.41	0.003	0.001	0.003	0.007	
9	22.18	0.000	0.000	0.013	0.013	25	521.5	0.002	0.002	0.012	0.016	703	209.4	0.001	0.002	0.014	0.016	297
10	23.42	0.000	0.000	0.014	0.014	28	659.3	0.002	0.002	0.047	0.050	2865	277.5	0.002	0.003	0.019	0.024	573
11	24.40	0.000	0.000	0.016	0.016	34	674.8	0.002	0.002	0.047	0.051	2968	273.6	0.001	0.002	0.017	0.020	482
12	20.32	0.000	0.000	0.021	0.021	37	588.6	0.000	0.002	0.053	0.055	2802	273.8	0.001	0.002	0.017	0.020	483
13	26.71	0.000	0.000	0.018	0.018	42	554.0	0.002	0.002	0.001	0.005	235	289.1	0.001	0.002	0.018	0.022	540
14	26.91	0.000	0.000	0.024	0.024	55	602.9	0.001	0.002	0.005	0.007	385	390.3	0.001	0.002	0.018	0.020	685
15	30.35	0.000	0.000	0.016	0.016	41	616.8	0.000	0.002	0.001	0.003	160	390.5	0.004	0.004	0.012	0.020	658
16	28.66	0.000	0.000	0.015	0.015	37	698.6	0.002	0.002	0.005	0.009	513	402.6	0.002	0.003	0.016	.021	727
17	32.69	0.000	0.000	0.036	0.036	100	554.5	0.001	0.002	0.003	0.006	278	362.8	0.001	0.002	0.015	0.018	561
18	37.28	0.000	0.000	0.012	0.012	38	559.6	0.001	0.001	0.002	0.004	193	365.3	0.001	0.002	0.013	0.016	518
19	36.00	0.000	0.000	0.011	0.011	35	483.7	0.001	0.001	0.002	0.003	121	360.1	0.001	0.002	0.013	0.016	504
20	573.4	0.002	0.003	0.030	0.036	1778	347.1	0.001	0.001	0.002	0.004	132	394.3	0.001	0.002	0.015	0.018	606
21	565.6	0.002	0.002	0.037	0.041	1989	169.0	0.001	0.001	0.007	0.009	130	392.4	0.003	0.005	0.020	0.028	959
22	513.1	0.001	0.003	0.030	0.034	1507	182.2	0.001	0.001	0.007	0.010	151	390.5	0.001	0.002	0.018	0.022	732
23	538.0	0.001	0.001	0.016	0.018	837	139.4	0.001	0.001	0.005	0.007	88	390.6	0.000	0.001	0.018	0.019	634
24	564.8	0.001	0.001	0.017	0.019	927	89.90	0.001	0.001	0.004	0.005	37	422.6	0.001	0.001	0.012	0.014	518
25	469.7	0.001	0.002	0.022	0.025	994	98.66	0.001	0.001	0.002	0.003	27	417.3	0.001	0.001	0.012	0.014	508
26	514.2	0.001	0.002	0.013	0.016	698	54.05	0.001	0.000	0.002	0.003	15	403.2	0.002	0.002	0.013	0.017	578
27	484.0	0.001	0.002	0.016	0.019	803	48.28	0.000	0.000	0.005	0.005	21	342.8	0.001	0.002	0.014	0.017	489
28	488.3	0.001	0.002	0.019	0.022	932	32.21	0.000	0.000	0.003	0.003	9	253.3	0.001	0.001	0.010	0.012	267
29	495.8	0.002	0.002	0.009	0.013	535	20.71	0.000	0.000	0.002	0.002	4	79.13	0.002	0.003	0.006	0.011	72
30	465.1	0.002	0.002	0.008	0.012	474	19.58	0.000	0.000	0.006	0.006	11	57.37	0.000	0.000	0.014	0.014	69
31							19.66	0.000	0.000	0.005	0.005	8						
Ten - Daily Mean																		

Ten - Daily I	24.64	0.000	0.000	0.024	0.024	49	469.2	0.001	0.002	0.015	0.019	815	80.36	0.001	0.001	0.006	0.008	107
Ten - Daily II	83.67	0.000	0.000	0.020	0.020	220	568.1	0.001	0.002	0.012	0.015	779	350.2	0.002	0.002	0.016	0.019	576
Ten - Daily III	509.8	0.001	0.002	0.018	0.022	970	79.42	0.000	0.001	0.004	0.005	46	314.9	0.001	0.002	0.014	0.017	483

Annual Sediment Load (Metric Tonnes) : 51357

Station Name : Musiri

Day	Dec						Jan						Feb					
	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day
1	33.08	0.000	0.000	0.004	0.004	10	8.127	0.000	0.000	0.001	0.001	1	4.168	0.000	0.000	0.004	0.004	1
2	22.87	0.000	0.000	0.002	0.002	5	7.256	0.000	0.000	0.014	0.014	9	4.080	0.000	0.000	0.003	0.003	1
3	13.39	0.000	0.000	0.007	0.007	8	6.961	0.000	0.000	0.003	0.003	2	4.080	0.000	0.000	0.003	0.003	1
4	14.36	0.000	0.000	0.009	0.009	11	6.400	0.000	0.000	0.011	0.011	6	4.080	0.000	0.000	0.003	0.003	1
5	12.96	0.000	0.000	0.007	0.007	8	6.920	0.000	0.000	0.003	0.003	2	4.080	0.000	0.000	0.004	0.004	1
6	8.795	0.000	0.000	0.013	0.013	10	5.964	0.000	0.000	0.003	0.003	1	4.080	0.000	0.000	0.003	0.003	1
7	7.298	0.000	0.000	0.019	0.019	12	5.290	0.000	0.000	0.002	0.002	1	24.82	0.005	0.006	0.129	0.140	300
8	292.6	0.003	0.004	0.018	0.025	619	5.377	0.000	0.000	0.003	0.003	1	101.6	0.004	0.008	0.014	0.026	225
9	302.7	0.002	0.002	0.010	0.013	343	4.734	0.000	0.000	0.006	0.006	3	73.90	0.003	0.005	0.009	0.017	109
10	325.3	0.002	0.002	0.010	0.014	394	5.439	0.000	0.000	0.001	0.001	0	41.30	0.002	0.003	0.005	0.010	34
11	308.7	0.002	0.002	0.008	0.012	325	4.452	0.000	0.000	0.001	0.001	1	20.53	0.006	0.011	0.016	0.033	59
12	301.0	0.001	0.001	0.010	0.012	309	9.861	0.000	0.000	0.003	0.003	3	18.24	0.006	0.007	0.013	0.027	42
13	365.1	0.002	0.002	0.013	0.017	533	10.46	0.000	0.000	0.004	0.004	3	10.90	0.000	0.000	0.017	0.017	16
14	394.7	0.002	0.002	0.019	0.023	798	8.795	0.000	0.000	0.003	0.003	2	8.112	0.000	0.000	0.011	0.011	7
15	405.4	0.002	0.002	0.008	0.012	410	7.114	0.000	0.000	0.001	0.001	1	0.575	0.000	0.000	0.019	0.019	11
16	393.7	0.002	0.002	0.007	0.011	384	6.985	0.000	0.000	0.002	0.002	1	5.487	0.000	0.000	0.003	0.003	1
17	369.1	0.002	0.002	0.014	0.019	600	5.830	0.000	0.000	0.009	0.009	4	5.002	0.000	0.000	0.003	0.003	1
18	364.7	0.002	0.002	0.013	0.016	514	5.846	0.000	0.000	0.010	0.010	5	4.571	0.000	0.000	0.003	0.003	1
19	376.2	0.001	0.001	0.015	0.017	543	5.582	0.000	0.000	0.011	0.011	5	4.135	0.000	0.000	0.001	0.001	0
20	371.4	0.001	0.001	0.009	0.010	315	4.787	0.000	0.000	0.002	0.002	1	4.554	0.000	0.000	0.001	0.001	0
21	342.3	0.001	0.001	0.007	0.009	260	4.858	0.000	0.000	0.002	0.002	1	4.989	0.000	0.000	0.004	0.004	2
22	317.5	0.001	0.001	0.001	0.002	66	4.817	0.000	0.000	0.001	0.001	0	4.220	0.000	0.000	0.006	0.006	2
23	214.7	0.001	0.001	0.011	0.012	228	4.736	0.000	0.000	0.007	0.007	3	3.351	0.000	0.000	0.001	0.001	0
24	76.06	0.000	0.001	0.010	0.011	72	4.325	0.000	0.000	0.003	0.003	1	2.904	0.000	0.000	0.001	0.001	0
25	47.56	0.000	0.000	0.008	0.008	32	4.255	0.000	0.000	0.002	0.002	1	3.062	0.000	0.000	0.002	0.002	1
26	22.38	0.000	0.000	0.007	0.007	14	4.255	0.000	0.000	0.002	0.002	1	3.070	0.000	0.000	0.008	0.008	2
27	15.91	0.000	0.000	0.006	0.006	8	4.255	0.000	0.000	0.002	0.002	1	2.928	0.000	0.000	0.009	0.009	2
28	12.41	0.000	0.000	0.009	0.009	10	4.407	0.000	0.000	0.002	0.002	1	3.043	0.000	0.000	0.005	0.005	1
29	10.61	0.000	0.000	0.006	0.006	5	4.349	0.000	0.000	0.003	0.003	1						
30	10.46	0.000	0.000	0.005	0.005	5	4.144	0.000	0.000	0.003	0.003	1						
31	8.950	0.000	0.000	0.001	0.001	1	4.154	0.000	0.000	0.004	0.004	1						
Ten - Daily Mean																		
Ten - Daily I	103.3	0.001	0.001	0.010	0.011	142	6.247	0.000	0.000	0.005	0.005	3	26.61	0.001	0.002	0.018	0.021	68
Ten - Daily II	365.0	0.002	0.002	0.012	0.015	473	6.971	0.000	0.000	0.005	0.005	3	8.810	0.001	0.002	0.008	0.012	14
Ten - Daily III	98.08	0.000	0.000	0.006	0.007	64	4.414	0.000	0.000	0.003	0.003	1	3.446	0.000	0.000	0.004	0.004	1
Monthly Total						6851						62						825

Annual Sediment Load (Metric Tonnes) : 51357

Station Name : Musiri

Day	Mar						Apr						May					
	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day
1	3.596	0.000	0.000	0.011	0.011	3	0.721	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
2	66.51	0.002	0.002	0.025	0.028	163	0.721	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
3	134.4	0.001	0.002	0.009	0.012	134	0.790	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
4	172.5	0.001	0.003	0.011	0.015	221	0.801	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
5	81.56	0.002	0.003	0.009	0.013	89	0.721	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
6	23.18	0.000	0.000	0.004	0.004	9	0.577	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
7	13.43	0.000	0.000	0.000	0.000	0	0.721	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
8	8.164	0.000	0.000	0.001	0.001	0	1.070	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
9	6.314	0.000	0.000	0.002	0.002	1	0.646	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
10	5.485	0.000	0.000	0.002	0.002	1	0.342	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
11	4.430	0.000	0.000	0.002	0.002	1	0.145	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
12	4.107	0.000	0.000	0.001	0.001	0	0.145	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
13	4.082	0.000	0.000	0.010	0.010	4	0.177	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
14	3.498	0.000	0.000	0.004	0.004	1	0.251	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
15	3.253	0.000	0.000	0.005	0.005	1	0.295	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
16	2.785	0.000	0.000	0.001	0.001	0	0.342	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
17	2.798	0.000	0.000	0.001	0.001	0	0.257	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
18	2.206	0.000	0.000	0.000	0.000	0	0.329	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
19	2.213	0.000	0.000	0.000	0.000	0	0.317	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
20	2.023	0.000	0.000	0.000	0.000	0	0.206	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
21	1.919	0.000	0.000	0.000	0.000	0	0.247	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
22	1.779	0.000	0.000	0.000	0.000	0	0.236	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
23	1.801	0.000	0.000	0.000	0.000	0	0.232	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
24	1.667	0.000	0.000	0.000	0.000	0	0.116	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
25	1.535	0.000	0.000	0.000	0.000	0	0.112	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
26	1.470	0.000	0.000	0.000	0.000	0	0.108	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
27	1.330	0.000	0.000	0.000	0.000	0	0.105	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
28	1.286	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0

29	1.170	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
30	1.109	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
31	1.170	0.000	0.000	0.000	0.000	0							0.000	0.000	0.000	0.000	0.000	0
Ten - Daily Mean																		
Ten - Daily I	51.52	0.001	0.001	0.007	0.009	62	0.711	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
Ten - Daily II	3.139	0.000	0.000	0.002	0.002	1	0.246	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0
Ten - Daily III	1.476	0.000	0.000	0.000	0.000	0	0.116	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0

Table 7.8

Daily Observed Sediment Datasheet for period : 2012 – 2013

Station Name : Kodumudi

Day	June						July						Aug					
	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day
1	65.57	0.000	0.000	0.016	0.016	91	52.77	0.000	0.000	0.014	0.014	63	58.31	0.000	0.000	0.017	0.017	85
2	77.45	0.000	0.000	0.017	0.017	116	53.82	0.000	0.000	0.015	0.015	67	52.91	0.000	0.000	0.016	0.016	71
3	72.80	0.000	0.000	0.015	0.015	95	54.04	0.000	0.000	0.015	0.015	70	55.25	0.000	0.000	0.016	0.016	78
4	87.03	0.000	0.000	0.018	0.018	135	50.32	0.000	0.000	0.014	0.014	60	56.53	0.000	0.000	0.017	0.017	83
5	84.28	0.000	0.000	0.018	0.018	127	54.45	0.000	0.000	0.014	0.014	68	59.08	0.000	0.000	0.018	0.018	91
6	74.93	0.000	0.000	0.017	0.017	108	50.62	0.000	0.000	0.014	0.014	61	55.98	0.000	0.000	0.017	0.017	81
7	77.43	0.000	0.000	0.017	0.017	116	54.96	0.000	0.000	0.015	0.015	69	56.78	0.000	0.000	0.016	0.016	78
8	89.14	0.000	0.000	0.018	0.018	139	57.47	0.000	0.000	0.015	0.015	74	58.52	0.000	0.000	0.017	0.017	84
9	95.62	0.000	0.000	0.019	0.019	156	49.13	0.000	0.000	0.013	0.013	56	58.93	0.000	0.000	0.016	0.016	81
10	78.32	0.000	0.000	0.016	0.016	107	55.05	0.000	0.000	0.016	0.016	76	56.19	0.000	0.000	0.017	0.017	81
11	87.27	0.000	0.000	0.017	0.017	131	50.87	0.000	0.000	0.015	0.015	64	59.65	0.000	0.000	0.017	0.017	88
12	83.15	0.000	0.000	0.017	0.017	121	55.99	0.000	0.000	0.016	0.016	78	74.62	0.000	0.000	0.018	0.018	115
13	84.16	0.000	0.000	0.017	0.017	124	49.78	0.000	0.000	0.013	0.013	57	110.4	0.000	0.000	0.019	0.019	185
14	87.25	0.000	0.000	0.018	0.018	138	55.31	0.000	0.000	0.015	0.015	70	111.5	0.000	0.000	0.018	0.018	177
15	91.27	0.000	0.000	0.019	0.019	151	67.49	0.000	0.000	0.017	0.017	97	106.8	0.000	0.000	0.018	0.018	162
16	91.06	0.000	0.000	0.018	0.018	145	56.14	0.000	0.000	0.016	0.016	76	108.2	0.000	0.000	0.019	0.019	179
17	82.11	0.000	0.000	0.017	0.017	121	76.06	0.000	0.000	0.017	0.017	109	196.8	0.000	0.000	0.020	0.020	338
18	63.51	0.000	0.000	0.015	0.015	80	96.73	0.000	0.000	0.017	0.017	145	108.4	0.000	0.000	0.018	0.018	172
19	53.08	0.000	0.000	0.014	0.014	65	94.97	0.000	0.000	0.017	0.017	138	94.04	0.000	0.000	0.015	0.015	125
20	66.80	0.000	0.000	0.015	0.015	88	56.22	0.000	0.000	0.016	0.016	77	104.6	0.000	0.000	0.017	0.017	155
21	53.47	0.000	0.000	0.014	0.014	64	55.99	0.000	0.000	0.015	0.015	75	107.9	0.000	0.000	0.018	0.018	165
22	56.71	0.000	0.000	0.014	0.014	70	51.25	0.000	0.000	0.014	0.014	62	110.8	0.000	0.000	0.018	0.018	173
23	56.04	0.000	0.000	0.015	0.015	70	56.00	0.000	0.000	0.016	0.016	78	97.70	0.000	0.000	0.018	0.018	149
24	49.75	0.000	0.000	0.013	0.013	55	50.38	0.000	0.000	0.015	0.015	65	112.1	0.000	0.000	0.019	0.019	181
25	57.07	0.000	0.000	0.015	0.015	74	50.45	0.000	0.000	0.014	0.014	63	113.2	0.000	0.000	0.018	0.018	175
26	32.26	0.000	0.000	0.014	0.014	40	53.28	0.000	0.000	0.015	0.015	69	94.04	0.000	0.000	0.015	0.015	121
27	32.46	0.000	0.000	0.014	0.014	39	52.80	0.000	0.000	0.014	0.014	66	108.0	0.000	0.000	0.018	0.018	172
28	32.90	0.000	0.000	0.014	0.014	40	55.31	0.000	0.000	0.016	0.016	76	95.71	0.000	0.000	0.016	0.016	134
29	33.13	0.000	0.000	0.014	0.014	39	54.31	0.000	0.000	0.015	0.015	70	101.0	0.000	0.000	0.017	0.017	152
30	53.53	0.000	0.000	0.014	0.014	65	55.05	0.000	0.000	0.016	0.016	77	109.1	0.000	0.000	0.018	0.018	171
31							54.45	0.000	0.000	0.016	0.016	74	95.89	0.000	0.000	0.017	0.017	140
Ten - Daily Mean																		
Ten - Daily I	80.26	0.000	0.000	0.017	0.017	119	53.26	0.000	0.000	0.014	0.014	67	56.85	0.000	0.000	0.017	0.017	81
Ten - Daily II	78.97	0.000	0.000	0.017	0.017	116	65.96	0.000	0.000	0.016	0.016	91	107.5	0.000	0.000	0.018	0.018	170
Ten - Daily III	45.73	0.000	0.000	0.014	0.014	56	53.57	0.000	0.000	0.015	0.015	70	104.1	0.000	0.000	0.017	0.017	158
Monthly Total						2913						2349						4245

Annual Sediment Load (Metric Tonnes) : 80397

Station Name : Kodumudi

Day	Sep						Oct						Nov					
	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day
1	95.09	0.000	0.000	0.016	0.016	130	438.9	0.002	0.004	0.021	0.027	1016	54.11	0.000	0.000	0.014	0.014	
2	94.04	0.000	0.000	0.016	0.016	127	428.4	0.002	0.003	0.021	0.026	955	32.46	0.000	0.000	0.013	0.013	
3	97.84	0.000	0.000	0.016	0.016	139	418.6	0.002	0.003	0.020	0.025	904	57.87	0.000	0.000	0.015	0.015	
4	91.26	0.000	0.000	0.016	0.016	124	442.2	0.002	0.004	0.022	0.029	1089	96.11	0.000	0.000	0.018	0.018	
5	92.03	0.000	0.000	0.016	0.016	128	453.3	0.003	0.005	0.023	0.030	1191	92.33	0.000	0.000	0.017	0.017	
6	98.20	0.000	0.000	0.017	0.017	148	513.8	0.003	0.005	0.024	0.032	1416	119.8	0.000	0.000	0.018	0.018	
7	91.45	0.000	0.000	0.017	0.017	131	441.8	0.002	0.003	0.020	0.025	943	132.4	0.000	0.000	0.018	0.018	
8	95.89	0.000	0.000	0.017	0.017	142	470.5	0.002	0.004	0.022	0.028	1122	290.1	0.000	0.000	0.019	0.019	
9	92.00	0.000	0.000	0.017	0.017	131	575.6	0.003	0.006	0.025	0.033	1646	219.9	0.000	0.000	0.017	0.017	
10	124.3	0.000	0.000	0.018	0.018	198	646.5	0.003	0.006	0.025	0.034	1882	219.9	0.000	0.000	0.017	0.017	
11	111.4	0.000	0.000	0.017	0.017	161	585.6	0.003	0.005	0.022	0.030	1533	290.8	0.000	0.000	0.019	0.019	
12	111.8	0.000	0.000	0.017	0.017	167	536.3	0.003	0.005	0.020	0.027	1265	219.9	0.000	0.000	0.017	0.017	
13	108.5	0.000	0.000	0.017	0.017	157	587.9	0.003	0.006	0.021	0.030	1519	410.8	0.000	0.000	0.020	0.020	
14	107.3	0.000	0.000	0.016	0.016	147	567.2	0.003	0.005	0.021	0.029	1411	387.8	0.000	0.000	0.018	0.018	
15	112.2	0.000	0.000	0.017	0.017	169	726.5	0.003	0.006	0.024	0.033	2090	387.8	0.000	0.000	0.018	0.018	
16	118.1	0.000	0.000	0.018	0.018	185	597.3	0.003	0.005	0.021	0.028	1435	387.8	0.000	0.000	0.019	0.019	
17	118.2	0.000	0.000	0.018	0.018	185	542.7	0.002	0.004	0.020	0.026	1214	384.0	0.000	0.000	0.019	0.019	
18	194.1	0.000	0.000	0.018	0.018	297	440.9	0.002	0.003	0.020	0.025	960	402.2	0.000	0.000	0.019	0.019	
19	526.9	0.002	0.003	0.022	0.027	1225	258.6	0.000	0.000	0.018	0.018	407	401.9	0.000	0.000	0.019	0.019	
20	498.8	0.002	0.003	0.020	0.025	1095	119.4	0.000	0.000	0.016	0.016	169	411.2	0.000	0.000	0.020	0.020	
21	513.4	0.002	0.003	0.021	0.026	1136	87.98	0.000	0.000	0.014	0.014	107	387.8	0.000	0.000	0.018	0.018	

22	425.1	0.001	0.003	0.021	0.026	937	96.54	0.000	0.000	0.016	0.016	129	392.5	0.000	0.000	0.018	0.018	
23	526.9	0.002	0.003	0.022	0.027	1225	80.21	0.000	0.000	0.013	0.013	89	397.2	0.000	0.000	0.019	0.019	
24	431.8	0.002	0.003	0.024	0.028	1059	100.3	0.000	0.000	0.016	0.016	140	392.5	0.000	0.000	0.019	0.019	
25	527.7	0.002	0.004	0.025	0.031	1418	66.09	0.000	0.000	0.015	0.015	84	406.5	0.000	0.000	0.020	0.020	
26	523.4	0.002	0.004	0.024	0.030	1370	57.58	0.000	0.000	0.015	0.015	75	296.8	0.000	0.000	0.018	0.018	
27	492.7	0.002	0.003	0.023	0.028	1200	48.27	0.000	0.000	0.013	0.013	53	262.2	0.000	0.000	0.017	0.017	
28	502.3	0.003	0.005	0.024	0.031	1363	46.82	0.000	0.000	0.012	0.012	50	82.11	0.000	0.000	0.016	0.016	
29	459.2	0.002	0.004	0.020	0.026	1032	60.13	0.000	0.000	0.017	0.017	86	64.33	0.000	0.000	0.016	0.016	
30	432.9	0.002	0.004	0.019	0.025	916	66.07	0.000	0.000	0.016	0.016	90	29.01	0.000	0.000	0.015	0.015	
31							61.56	0.000	0.000	0.014	0.014	77						
Ten - Daily Mean																		
Ten - Daily I	97.21	0.000	0.000	0.017	0.017	140	483.0	0.002	0.004	0.022	0.029	1216	131.5	0.000	0.000	0.017	0.017	
Ten - Daily II	200.7	0.000	0.001	0.018	0.019	379	496.2	0.002	0.004	0.020	0.026	1200	368.4	0.000	0.000	0.019	0.019	
Ten - Daily III	483.5	0.002	0.003	0.022	0.028	1166	70.14	0.000	0.000	0.015	0.015	89	271.1	0.000	0.000	0.017	0.017	
Monthly Total																		

Station Name : Kodumudi

Day	Dec						Jan						Feb					
	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day
1	30.27	0.000	0.000	0.015	0.015	39	33.41	0.000	0.000	0.016	0.016	46	16.08	0.000	0.000	0.015	0.015	20
2	53.36	0.000	0.000	0.016	0.016	75	33.31	0.000	0.000	0.015	0.015	43	13.64	0.000	0.000	0.013	0.013	16
3	30.25	0.000	0.000	0.015	0.015	39	30.60	0.000	0.000	0.016	0.016	41	11.04	0.000	0.000	0.011	0.011	10
4	52.91	0.000	0.000	0.016	0.016	74	20.83	0.000	0.000	0.015	0.015	27	16.33	0.000	0.000	0.014	0.014	20
5	54.18	0.000	0.000	0.017	0.017	80	17.10	0.000	0.000	0.014	0.014	21	16.66	0.000	0.000	0.014	0.014	20
6	253.4	0.000	0.000	0.018	0.018	403	22.81	0.000	0.000	0.015	0.015	29	262.5	0.000	0.000	0.018	0.018	417
7	307.6	0.000	0.000	0.019	0.019	508	56.84	0.000	0.000	0.017	0.017	85	208.5	0.000	0.000	0.018	0.018	322
8	354.7	0.000	0.000	0.020	0.020	625	55.18	0.000	0.000	0.017	0.017	79	87.95	0.000	0.000	0.018	0.018	134
9	347.1	0.000	0.000	0.020	0.020	603	56.94	0.000	0.000	0.017	0.017	84	49.13	0.000	0.000	0.016	0.016	66
10	307.6	0.000	0.000	0.018	0.018	489	63.33	0.000	0.000	0.018	0.018	99	20.56	0.000	0.000	0.015	0.015	26
11	319.9	0.000	0.000	0.019	0.019	528	62.74	0.000	0.000	0.017	0.017	94	17.67	0.000	0.000	0.015	0.015	22
12	352.1	0.000	0.000	0.019	0.019	572	67.26	0.000	0.000	0.018	0.018	105	17.55	0.000	0.000	0.014	0.014	21
13	418.9	0.001	0.002	0.020	0.023	840	28.94	0.000	0.000	0.017	0.017	43	13.66	0.000	0.000	0.014	0.014	17
14	403.0	0.002	0.003	0.018	0.023	787	22.81	0.000	0.000	0.017	0.017	33	13.64	0.000	0.000	0.014	0.014	17
15	401.7	0.001	0.003	0.019	0.023	795	12.96	0.000	0.000	0.017	0.017	19	13.90	0.000	0.000	0.014	0.014	17
16	402.1	0.001	0.003	0.019	0.023	799	13.19	0.000	0.000	0.016	0.016	18	13.65	0.000	0.000	0.014	0.014	17
17	393.1	0.001	0.002	0.018	0.021	723	13.04	0.000	0.000	0.016	0.016	18	12.71	0.000	0.000	0.014	0.014	15
18	412.1	0.002	0.003	0.018	0.023	805	12.81	0.000	0.000	0.016	0.016	17	12.77	0.000	0.000	0.014	0.014	15
19	404.6	0.002	0.003	0.018	0.023	790	35.26	0.000	0.000	0.017	0.017	51	12.62	0.000	0.000	0.013	0.013	14
20	343.9	0.001	0.003	0.017	0.021	609	44.94	0.000	0.000	0.014	0.014	55	13.66	0.000	0.000	0.014	0.014	17
21	344.3	0.002	0.002	0.016	0.020	586	35.67	0.000	0.000	0.016	0.016	49	14.37	0.000	0.000	0.012	0.012	15
22	305.4	0.000	0.000	0.016	0.016	430	32.59	0.000	0.000	0.016	0.016	45	14.79	0.000	0.000	0.013	0.013	17
23	118.8	0.000	0.000	0.015	0.015	157	32.95	0.000	0.000	0.016	0.016	44	10.15	0.000	0.000	0.020	0.020	18
24	49.13	0.000	0.000	0.016	0.016	66	35.88	0.000	0.000	0.016	0.016	50	8.750	0.000	0.000	0.016	0.016	12
25	35.78	0.000	0.000	0.015	0.015	46	22.81	0.000	0.000	0.015	0.015	30	9.484	0.000	0.000	0.017	0.017	14
26	30.60	0.000	0.000	0.015	0.015	39	20.56	0.000	0.000	0.015	0.015	27	5.518	0.000	0.000	0.016	0.016	7
27	31.27	0.000	0.000	0.015	0.015	41	17.40	0.000	0.000	0.015	0.015	22	5.518	0.000	0.000	0.016	0.016	8
28	29.27	0.000	0.000	0.015	0.015	37	17.33	0.000	0.000	0.015	0.015	22	191.5	0.000	0.000	0.019	0.019	316
29	52.35	0.000	0.000	0.017	0.017	75	17.48	0.000	0.000	0.015	0.015	23						
30	28.94	0.000	0.000	0.014	0.014	35	17.39	0.000	0.000	0.014	0.014	22						
31	34.41	0.000	0.000	0.016	0.016	49	16.28	0.000	0.000	0.015	0.015	21						
Ten - Daily Mean																		
Ten - Daily I	179.1	0.000	0.000	0.018	0.018	293	39.03	0.000	0.000	0.016	0.016	55	70.23	0.000	0.000	0.015	0.015	105
Ten - Daily II	385.1	0.001	0.002	0.018	0.022	725	31.40	0.000	0.000	0.016	0.016	45	14.18	0.000	0.000	0.014	0.014	17
Ten - Daily III	96.38	0.000	0.000	0.015	0.016	142	24.21	0.000	0.000	0.015	0.015	32	32.51	0.000	0.000	0.016	0.016	51
Monthly Total						11743						1362						1629

Station Name : Kodumudi

Day	Mar						Apr						May					
	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day	Q Cumecs	Coarse g/l	Medium g/l	Fine g/l	Total g/l	Total M.T/day
1	208.5	0.000	0.000	0.019	0.019	339	4.426	0.000	0.000	0.016	0.016	6	0.000	0.000	0.000	0.000	0.000	
2	191.5	0.000	0.000	0.018	0.018	293	16.40	0.000	0.000	0.014	0.014	20	0.000	0.000	0.000	0.000	0.000	
3	192.6	0.000	0.000	0.018	0.018	296	16.40	0.000	0.000	0.015	0.015	21	0.000	0.000	0.000	0.000	0.000	
4	29.84	0.000	0.000	0.017	0.017	43	14.50	0.000	0.000	0.015	0.015	19	20.56	0.000	0.000	0.017	0.017	
5	8.321	0.000	0.000	0.015	0.015	11	10.25	0.000	0.000	0.011	0.011	10	15.44	0.000	0.000	0.013	0.013	
6	7.470	0.000	0.000	0.015	0.015	9	8.750	0.000	0.000	0.009	0.009	7	7.369	0.000	0.000	0.006	0.006	
7	7.784	0.000	0.000	0.015	0.015	10	7.369	0.000	0.000	0.008	0.008	5	35.78	0.000	0.000	0.014	0.014	
8	7.597	0.000	0.000	0.016	0.016	11	5.518	0.000	0.000	0.006	0.006	3	14.50	0.000	0.000	0.015	0.015	
9	7.842	0.000	0.000	0.016	0.016	11	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	
10	9.484	0.000	0.000	0.017	0.017	14	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	
11	7.710	0.000	0.000	0.017	0.017	11	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	
12	7.084	0.000	0.000	0.015	0.015	9	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	
13	6.964	0.000	0.000	0.016	0.016	9	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	
14	6.798	0.000	0.000	0.016	0.016	9	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	
15	6.579	0.000	0.000	0.016	0.016	9	11.81	0.000	0.000	0.016	0.016	16	43.35	0.000	0.000	0.023	0.023	
16	6.758	0.000	0.000	0.016	0.016	10	11.72	0.000	0.000	0.015	0.015	15	43.35	0.000	0.000	0.022	0.022	
17	7.369	0.000	0.000	0.018	0.018	11	9.692	0.000	0.000	0.014	0.014	12	43.35	0.000	0.000	0.022	0.022	
18	5.264	0.000	0.000	0.015	0.015	7	8.045	0.000	0.000	0.012	0.012	8	32.96	0.000	0.000	0.023	0.023	
19	4.280	0.000	0.000	0.017	0.017	6	7.369	0.000	0.000	0.011	0.011	7	22.81	0.000	0.000	0.017	0.017	
20	4.328	0.000	0.000	0.016	0.016	6	5.518	0.000	0.000	0.008	0.008	4	15.44	0.000	0.000	0.013	0.013	
21	4.391	0.000	0.000	0.016	0.016	6	0.000	0.000	0.000	0.000	0.000	0	6.105	0.000	0.000	0.014	0.014	
22	14.82	0.000	0.000	0.016	0.016	20	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	
23	13.81	0.000	0.000	0.017	0.017	20	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	
24	12.71	0.000	0.000	0.015	0.015	17	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	

25	13.38	0.000	0.000	0.016	0.016	19	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	
26	13.63	0.000	0.000	0.017	0.017	20	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	
27	3.617	0.000	0.000	0.016	0.016	5	0.000	0.000	0.000	0.000	0.000	0	8.045	0.000	0.000	0.013	0.013	
28	7.244	0.000	0.000	0.017	0.017	11	0.000	0.000	0.000	0.000	0.000	0	1.876	0.000	0.000	0.003	0.003	
29	8.750	0.000	0.000	0.016	0.016	12	0.000	0.000	0.000	0.000	0.000	0	8.045	0.000	0.000	0.013	0.013	
30	7.107	0.000	0.000	0.017	0.017	10	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	
31	7.369	0.000	0.000	0.017	0.017	11							0.000	0.000	0.000	0.000	0.000	
Ten - Daily Mean																		
Ten - Daily I	67.09	0.000	0.000	0.016	0.016	104	8.361	0.000	0.000	0.009	0.009	9	9.365	0.000	0.000	0.006	0.006	
Ten - Daily II	6.313	0.000	0.000	0.016	0.016	9	5.416	0.000	0.000	0.007	0.007	6	20.13	0.000	0.000	0.012	0.012	
Ten - Daily III	9.711	0.000	0.000	0.016	0.016	14	0.00	0.000	0.000	0.000	0.000	0	2.188	0.000	0.000	0.004	0.004	
Monthly																		

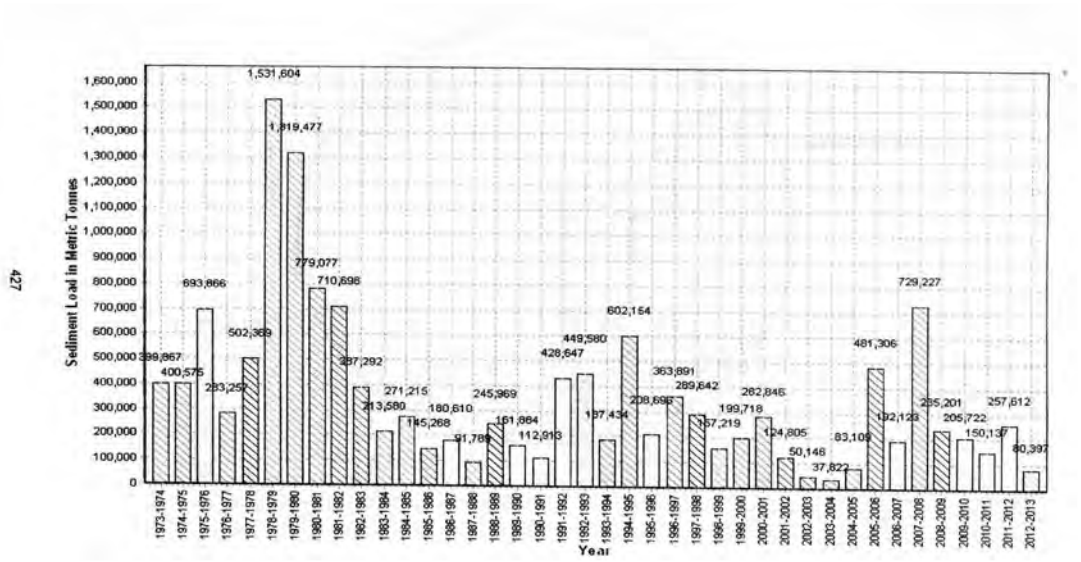


Fig 7.5 Annual Sediment Load for the period 1973 to 2013 at Kodumudi, Cauvery

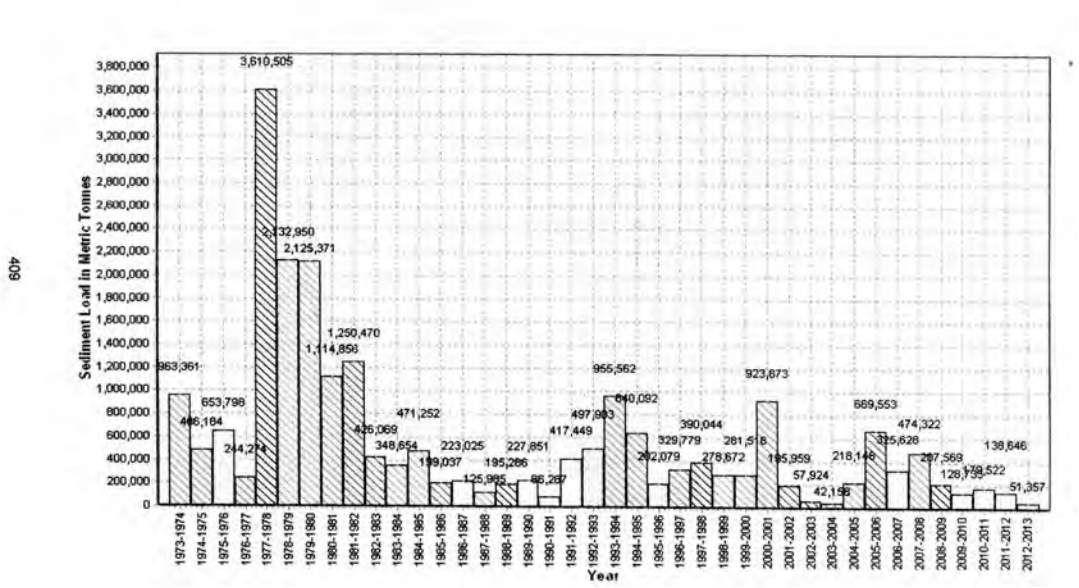


Fig 7.6 Annual Sediment Load for the period 1973 to 2013 at Musiri, Cauvery

The bed material data and general data of the river is enclosed in table 7.9 and 7.10 for Musiri station and Kodumudi station which reveals that maximum and minimum size of particle, mean velocity, hydraulic mean depth and surface water slope.

TABLE NO: 7.9 BED MATERIALS ANALYSIS DATA

River : Cauvery Code No. : CC 000G4

Site : Musiri Cross Section :SGL

Sl. No	Data for Sample Collected										General Data of the river						
	R.D (m)	R.L OF DRY BED (m)	R.L OF BED LEVEL (m)	W.L(GTS) OF THE SAMPLING DEPTH (m)	DEPTH OF WATER (m)	WIDTH (m)	VELOCITY (m/s)	DISCHARGE (m³/s)	Bed Material Composition		WETTED PERIMETER (m)	HYDRAULIC MEAN DEPTH (m)	MEAN VELOCITY (m/s)	WATER SURFACE SLOPE	DISCHARGE (m³/s)	Bed Material Composition	
									Max Size (mm)	Mean Size (mm)						Max Size (mm)	Mean Size (mm)
	MONSOON 2012						DATE OF COLLECTION								05/11/2012		
1	150	82.360	-	-	-	150	-	-	8.0	0.75							
2	300	-	81.840	82.120	0.28	150	0.416	0.1165	8.0	0.80							
3	450	81.605	-	-	-	150	-	-	7.0	0.57							
4	600	82.120	-	-	-	150	-	-	24.0	2.87							
5	750	81.720	-	-	-	150	-	-	3.0	0.53							
6	900	83.100	-	-	-	150	-	-	24.0	2.98							
7	1050	82.26.0	-	-	-	150	-	-	10.0	1.51							
8	1200	83.52.0	-	-	-	150	-	-	5.0	0.50	175.31	0.263	0.435	0.00066	20.844	24.0	1.31
	POST MONSOON 2012						DATE OF COLLECTION								11/04/2013		
1	150	82.475	-	-	-	150	-	-	8.0	0.82							
2	300	81.790	-	-	-	150	-	-	7.0	0.85							
3	450	82.070	-	-	-	150	-	-	8.0	0.75							
4	600	81.870	-	-	-	150	-	-	10.0	1.01							
5	750	82.105	-	-	-	150	-	-	3.0	0.92							
6	900	83.405	-	-	-	150	-	-	10.0	0.88							
7	1050	81.880	-	-	-	150	-	-	9.0	0.97							
8	1200	83.555	-	-	-	150	-	-	8.0	0.67	-	-	-	-	-	10.0	0.86
	PRE MONSOON 2013						DATE OF COLLECTION								16/05/2013		
1	150	82.405	-	-	-	150	-	-	5.0	0.76							
2	300	81.775	-	-	-	150	-	-	2.2	0.65							
3	450	81.890	-	-	-	150	-	-	10	1.02							
4	600	80.035	-	-	-	150	-	-	16.0	1.58							
5	750	80.105	-	-	-	150	-	-	6.0	0.77							
6	900	83.085	-	-	-	150	-	-	16.0	3.24							
7	1050	81.796	-	-	-	150	-	-	12.0	1.59							
8	1200	83.485	-	-	-	150	-	-	16.0	0.80	-	-	-	-	-	16.0	1.26
		LOW DEPTH															
		NO FLOW															

TABLE NO: 7.10 BED MATERIALS ANALYSIS DATA

River : Cauvery Code No. : CC 000I7

Site : Kodumudy Cross Section :SGL

Sl. No	Data for Sample Collected										General Data of the river						
	R.D (m)	R.L OF DRY BED (m)	R.L OF BED LEVEL (m)	W.L(GTS) OF THE SAMPLING DEPTH (m)	DEPTH OF WATER (m)	WIDTH (m)	VELOCITY (m/s)	DISCHARGE (m^3/s)	Bed Material Composition		WETTED PERIMETER (m)	HYDRAULIC MEAN DEPTH (m)	MEAN VELOCITY (m/s)	SURFACE WATER SLOPE	DISCHARGE (m^3/s)	Bed Material Composition	
									Max Size (mm)	Mean Size (mm)						Max Size (mm)	Mean Size (mm)
MONSOON 2012									DATE OF COLLECTION								
1	SAMPLES HAVE NOT BEEN COLLECTED.																
2																	
3																	
4																	
5																	
6																	
POST MONSOON 2012									DATE OF COLLECTION						21/03/2013		
1	100	123.55	-	-	-	100	-	-	14.0	0.95							
2	200	124.10	-	-	-	100	-	-	25.0	1.79							
3	300	-	122.21	122.37	0.16	100	0.000	0.0000	17.0	2.50							
4	400	-	122.22	122.37	0.15	100	0.113	0.0170	14.0	1.83							
5	500	-	122.22	122.37	0.15	100	0.160	0.0240	8.0	1.50							
6	600	121.92	-	-	-	100	-	-	18.0	2.89	234.03	0.196	0.096	0.0093	4.391	25.0	1.91
PRE MONSOON 2013									DATE OF COLLECTION						13/05/2013		
1	100	123.455	-	-	-	100	-	-	16.0	0.97							
2	200	124.150	-	-	-	100	-	-	18.0	1.46							
3	300	122.150	-	-	-	100	-	-	23.0	2.34							
4	400	122.120	-	-	-	100	-	-	18.0	1.24							
5	500	122.210	-	-	-	100	-	-	15.0	1.69							
6	600	121.780	-	-	-	100	-	-	18.0	2.86	-	-	-	-	-	23.0	1.76
NO FLOW																	

7.2.11 ANALYSIS OF SEDIMENT LOAD IN CAUVERY RIVER AT PROJECT SITE

The normal irrigation season is starts from 1st June to 28th January. The maximum flow in Cauvery river below the Mettur reservoir project falls in these eight months. The flow due to north east monsoon also falls in these periods ie., October to December. The GDSQ station datas of above and below this project site reveals that more than 80% of sediment load transported in this period.

Here the width of the Cauvery river is 1300 Meter. The gradient of the river bed is 1 in 1800. The average rate of flow including flood due to northeast monsoon period is arrived as 15000 Cusecs. The effective particle size of sand in river bed ie., D50 is 0.40mm.

With the above available parameters, a theoritical method of approach (ie., Meyer-peter approach) is adopted to calculate the sediment load in river bed of this project site.

ESTIMATION OF SEDIMENT LOAD IN CAUVERY RIVER AT PROJECT SITE

DETAILS OF FIELD DATA ADOPTED

Discharge	:15000 cusecs
Bed slope	: 1/1800 (tan θ)
Width of water way	: 1300 m
Effective size D_{50}	: 0.40 mm
Mass density of sediment	: Kg / m^3
Transport parameter (θ_b) and bed load (q_b)relation	:3.053q_b (Calculated from field data)
Estimation of (q_b) in force units	:0.30N/s/m (Calculated adopting Meyer-Peter approach)
Estimation of bed load for 8 months (June to January)for 1.3 km width for a flow of 15000 cusecs in volumetric units	: 0.49 * 10^6 m^3 (for the period June to January)

ie., 4,90,000 M^3

The analytical method adopted at Musiri station reveals the annual average sediment load is 5,58,000 Metric tonnes ie., **3,39,000 M^3** which is close to the value calculated by the theoritical method.

Here the object of the project is to remove the excess sand shoals above the sill of the bed regulator ie., 15,01,247 M^3 over an extent of 196.25 Ha., to restore the designed storage capacity of 1.04 TMC. The depth of sand available in upstream and downstream of the bed regulator is 14 meter and 9.5 meter below the river bed respectively. The mining will not be carried out below the theoretical river bed. The study on sedimentation analysis through theoretical and analytical method of calculation reveals the replenishment. But the object of sand mining project is to remove the excess sand shoals as a one-time operation for effective functioning of the newly constructed barrage and improve the river hydrology of this project site.

7.3 STUDIES ON TRANSPORTATION OF MINED OUT MATERIALS AS PER THE IRC ANDITS IMPACT ON ENVIRONMENT.

7.3.1 METHOD OF MINING AND LOADING OF SAND:

The excess sand shoals above the theoretical bed are scooped using excavator and loaded directly in to the public carrier trucks. The travel distance is optimized between the quarry site and NH/SH bypassing the settlements. The entire mining operation is simple, opencast and eco friendly. The road worthy and RTO certified public carrier vehicles are permitted.

7.3.2 TYPE OF TRUCKS USED:

In Government operated sand quarries, the public carrier trucks can be loaded 2 units(200 Cuft) or 3 units(300 Cuft) according to the vehicle size i.e., single axis or multi axis directly in the river bed after paying charges through demand draft to concern Assistant Engineer.The maximum tonnage is 9 tonnes and 14 tonnes respectively. The PCU(Passenger Car Unit) value of the above two axle and three axle trucks are 3.The proposed number of trucks per day is 282 nos.

7.3.3 IMPACT ON EXISTING ROADS:

In left bank side of the proposed quarry site is connected to the Major District road (Selaipillayaputhur – Kattuputhur road) and further connected to State Highways (ie., SH-25,Trichy – Namakkal road) and in right bank side, it directly connects to the National Highway(ie., NH-67, Trichy-Karur road).

The existing PCU values of MDR,SH and NH are 6828,19036,15828 respectively(vide Annexure 7.2). The proposed rise of PCU value due to movement of trucks is 846 0nly.The increased PCU value is evenly distributed to MDR,SH and NH in both the side of project. The study reveals that the level of the service of existing road does not alter due to proposed movement of loaded and unloaded trucks. It also reveals that the width of the existing roads(ie., MDR) and river bank connecting between project site and roads are more than sufficient to carry the proposed traffic of trucks during the operation of quarry.

7.3.4 STUDY OF IMPACT ON ENVIRONMENT DUE TO PROPOSED TRAFFIC:

The National Institute of Technology, Tiruchirapalli conducted the emission test of trucks of similar categories with loaded and unloaded condition of other PWD operated quarries. The test results are depicted in table 7.11.

Table 7.11 Vehicle is Empty

Sl. No.	Type of vehicle	Registration No.	Parameters						
			O_2 ppm	CO_2 ppm	NO ppm	NO_2 ppm	NO_x ppm	SO_2 ppm	C_xH_y ppm
1	1616 x L /Tipper (2 units)	TN 37 BT 0097	20.4	1.3	81	0	81	0	25
2	1616 x L /Tipper (2 units)	TN 30 AL 2579	20.9	0	0	0	0	0	8
3	1616 x L /Tipper (2 units)	TN 40 B 8799	20.8	0.5	0	0	0	1	44
4	1616 x L /Tipper (2 units)	TN 39 AV 2535	20.9	1.5	273	1	274	78	27
5	1616 x L /Tipper (2 units)	TN 34 K 9898	20.8	1.5	233	2	235	0	45
6	25 Tons multi Axle Goods vehicle (Tarus)	TN 75 K 1200	20.9	1.1	57	0	57	2	34
7	25 Tons multi Axle Goods vehicle (Tarus)	TN 31 AD 8627	20.8	0.7	0	0	0	1	21
8	25 Tons multi Axle Goods vehicle (Tarus)	TN 48 U 0352	20.9	1.2	123	0	123	0	5
9	25 Tons multi Axle Goods vehicle (Tarus)	TN 33 BD 8329	20.8	1.2	115	0	115	1	1
10	25 Tons multi Axle Goods vehicle (Tarus)	TN 33 BD 8389	20.7	0.9	62	0	62	2	5

Vehicle is loaded fully

Sl. No.	Type of vehicle	Registration No.	Parameters						
			O_2 ppm	CO_2 ppm	NO ppm	NO_2 ppm	NO_x ppm	SO_2 ppm	C_xH_y ppm
1	1616 x L /Tipper (2 units)	TN 37 BT 0097	20.4	1	159	0	159	0	12
2	1616 x L /Tipper (2 units)	TN 30 AL 2579	20.9	0.8	88	0	88	2	6
3	1616 x L /Tipper (2 units)	TN 40 B 8799	20.8	1	80	0	80	3	23
4	1616 x L /Tipper (2 units)	TN 39 AV 2535	20.9	1.2	166	0	166	0	25
5	1616 x L /Tipper (2 units)	TN 34 K 9898	20.8	1	176	0	176	0	38
6	25 Tons multi Axle Goods vehicle (Tarus)	TN 75 K 1200	20.9	1	117	0	117	1	5
7	25 Tons multi Axle Goods vehicle (Tarus)	TN 31 AD 8627	20.8	0.4	12	0	12	2	36
8	25 Tons multi Axle Goods vehicle (Tarus)	TN 48 U 0352	20.9	0.8	88	0	88	3	46
9	25 Tons multi Axle Goods vehicle (Tarus)	TN 33 BD 8329	20.8	0.6	66	0	66	1	39
10	25 Tons multi Axle Goods vehicle (Tarus)	TN 33 BD 8389	20.7	0.6	38	0	38	2	48

Figure : 7.7 Depicting the testing of loaded and unloaded vehicles

7.3.5 ADDITIONAL PARTICULARS ON MOVEMENT OF TRANSPORT

The proposal for Environmental Clearance was considered by the Expert Appraisal Committee in its 22nd meeting held during August 26-27, 2014. The committee was of the view that the proponent needs to submit the plan to bypass the villages during the transportation of sand, arrangements proposed to avoid accident during movement of trucks and display of sign boards on the transport routes.

7.3.5.1 TRANSPORT PLANS TO BYPASS THE VILLAGES

The detailed alternate route map is shown in fig.7.8 to bypass the village settlement in either side of river bank. The river bank road is under the control of PWD will be used to bypass the village settlement and directly enter into NH-65 and SH-25 through other district roads.

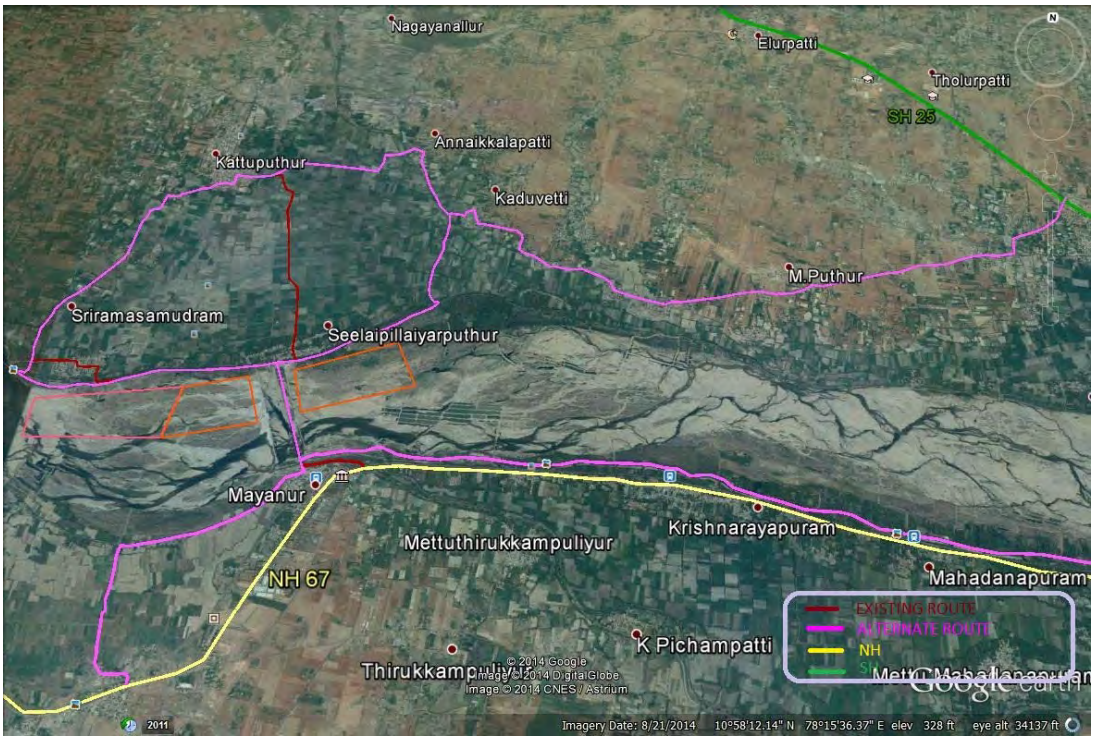


Figure 7.8 Alternative Route Map to bypass the village settlement

7.3.5.2 ACTION PLAN ON MOVEMENT OF TRUCKS TO AVOID ACCIDENT:

(i) Trucks carrying sand shall be covered using tarpaulin to avoid spilling.

(ii) Water sprinkling in quarry sites and the unpaved sections of the road in a regular interval.

(iii) Ensure that only trained, authorized and licensed drivers operate the vehicles

(iv) Enlist the help of another worker before reversing the vehicle

(v) Switch-off the engine when not in use to save fuel, prevent accidents and unnecessary noise and air pollution.

(vi) Lower the tipping bodies when the machine is unattended, but if it is necessary to leave them in the raised position they should be blocked to prevent their fall by fixing a sturdy support below.

(vii) Carryout periodic servicing to the manufacturer's requirements. All records of maintenance and repairs should be in writing or kept on site.

(viii) Keep the vehicle tidy and the cabin free from clumsy utilities, which might obstruct the controls and create hazards.

(ix) Display of sign boards on the transport routes.

(x) Avoid carrying additional passengers in the cabin or on the body of the dumper, while in field operation other than the connected workers.

(xi) Follow safe driving principles and avoid running the vehicle across the slopes on uneven ground.

(xii) Provide stop blocks when the vehicle is tipping into or running alongside excavations or when it is parked.

(xiii) Avoid overload the vehicle.

(xiv) Carry only well secured loads, which are likely to pollute the air and spill over to pollute the soil and water through proper use of covers and fasteners.

7.3.5.3 DISPLAY OF SIGNBOARDS ON THE TRANSPORT ROUTE

Signs are one of the most important elements in an effective traffic control plan. It is proposed to develop, install and maintain signs on haul roads. The necessary sign boards are proposed to install in haul roads and roads leads to MDR, SH and NH.

7.4 SPECIES SPECIFIC CONSERVATION PLAN FOR SCHEDULE-I & II SPECIES.

7.4.1 INTRODUCTION

The current pace of biodiversity loss demands that we review our conservation strategies, revive or build upon some of the old ones and develop new ones. The simple way to maintain a population of a particular species is to guarantee the existence of a sufficient habitat that can be kept free of alien competitors, predators, and diseases.

In practice, the design of such preserves must take into account the population requirements of the species and the minimum size of a population that can sustain itself in the face of environmental variation. Several measures have been taken and continue to be taken at different levels to preserve the native species like in-situ conservation efforts, documenting of indigenous knowledge, and the application of science and technology.

The conservation strategy for schedule –I species as proposed by the Prof.A.Alagappa Moses., Associate Professor and Head., Principal Investigator and Chief Consultant., Post Graduate and Research department of Environmental Sciences, Bishop Heber College (Autonomous) (Nationally Reaccredited at the A^+ level by NAAC) (Recognized as "College with Potential for Excellence" by UGC) Trichirappalli-620 017.

7.4.2 STATUS OF FAUNA

The Kattalai Bed Regulator in River Cauvery, Mayanur and its surroundings supports diverse faunal elements falling under a wide array of status and schedule as prescribed by The Wildlife (Protection) Act (1972). The schedule animals recorded in the core and buffer zone of the study area is as follows:

Table – 7.12 List of Fauna falling under Schedule of the Wildlife (Protection) Act, 1972

Sl.No	Common Name	Scientific Name	Status	WPA Schedule
	BIRDS			
1	**Peafowl**	*Pavocristatus*	Common, Resident Breeding	Schedule I
2	OSPREY	*Pandionhaliaetus*	Rare	Schedule I
	REPTILES			
3	Montior Lizard	*Varanusbengalensis*	Common	Schedule I
	Mammals			
4	Bonnet Macaque	*Macacaradiata*	*Lower risk*	Schedule II
5	Jackal	*Canisaureus*	*Lower risk*	Schedule II
6	Grey mongoose	*Herpestesedwardsii*	*Lower risk*	Schedule II

This requires enhancement of habitat features such as platforms / abandoned poles / trees / dead tree trunks for perching, roosting and nesting. Many of the species recorded are also water dependent.

These species would require both protection of water bodies and preventing the sources and causes of pollution. This may involve developing a conservation plan for safeguarding both species and their habitat in and around the quarry area. Thus it is

imperative to prepare a conservation strategy incorporating measures for conservation of fauna.

The Conservation plan along with the budget and implementation schedule for the above species has been prepared by the Prof.A.Alagappa Moses., Associate Professor and Head., Principal Investigator and Chief Consultant., Post Graduate and Research department of Environmental Sciences, Bishop Heber College (Autonomous) (Nationally Reaccredited at the A^+ level by NAAC) (Recognized as "College with Potential for Excellence" by UGC) Trichirappalli-620 017 in consultation with the Forest Department. The Conservation Plan has been approved by the Chief Wild Life Warden of the State Government vide letter No WL5/30163/2014 Dated 10.02.2015 is enclosed herewith and discussed in detail as Annexure 7.3.

The budgetary provision and implementation schedule for the above species is shown in Table No.7.13.

Table- 7.13 Budgetary provision and Implementation Schedule

Sl. No	Strategies for conservation				Budget in Rupees
	Proposal	**Description**	**Implementing Agency**	**Funding Agency**	
1.	**Conservation of wildlife Fauna**				
	a) Osprey nest	Providing Nest arrangements in two places of PWD river poramboke land @125000/each including cost of trenches, fencing arrangements, maintenance and other amenities etc.,	PWD	PWD	250000
	b) Pea Fowl nest	Providing Nest arrangements in two places of PWD river poramboke land @ 50000/each including cost of trenches, fencing arrangements,maintenance and other amenities etc.,	PWD	PWD	100000
2.	**Awareness Programme**				
	a) Peoples Bio-diversity Register	PBR is the great resource which will be developed by involving school children. The PBR methodology manual developed by	Forest Department (Funds may be provided to the	PWD	500000

		Dr.Madhar Gadgil (2005) will be used.	Forest Department and work will be executed by the Department of Environmental Sciences, Bishop Heber College, Trichy (Consent letter enclosed)		
	b) Awareness programme to forest fringe villages for conservation of Jackal, Monitor Lizard and Mangoose.	10 villages 4 programmes once in three months @ Rs. 30000/-	Forest Department	PWD	360000
Total					**1210000**

7.5 STUDIES ON IMPACT OF MINING ON PLANKTON:

7.5.1 PLANKTON

The studies on the aquatic biological environment were carried out in selected sites. The analysis of Phyto and Zoo-plankton was carried out as per the procedures of APHA 1987. The concentrated samples were analyzed by Sedge wick rafter cell for plankton density and diversity, Shannon Weaver Index calculations were applied to find out the diversity of Plankton groups and the status of water body (Welch, 1964; Prema Michael, 1972).

The term plankton refers to unattached organisms that are dispersed individually or in colonies in water. Phytoplanktons are plant plankton, and zooplanktons are animal plankton. Water samples were collected using standard methods and analyzed for plankton diversity.

7.5.2 SHANNON WEAVER INDEX (SWI)

The SWI is a measure of diversity, it may be considered as an overall index of diversity as it concedes a true picture of the information theory. The species diversity of such a community may be computed by employing the SWI of diversity by applying the Index.

$$H = - \Sigma n/N \log n/N$$

Or

$$H = - \Sigma pi \log pi$$

Where,

n = Number of individual species

N = Total number of individual species

Pi = Importance value for each species n/N

The SWI can be interpreted based on the SWI-H values obtained by computing the values of quantitative plankton analysis. Based on the H-values of SWI, the quality of water can be classified into the following three categories.

SWI – STANDARD TABLE

SWI – H VALUE	QUALITY OF WATER
X > 3	Clear
1 to 3	Moderately polluted
X < 1	Heavily polluted

The list of plankton present in the water body is given in Table – 7.14 along with its SWI values.

Table – 7.14 List of Plankton

S. No.	Plankton	Kattalai Bed Regulator	Veerarackiyam	Thirumukkodalur	Unniyur
1	Calamus	✔	✔	✔	✔
2	Cyclops	✔	✔	✔	✔
3	Daphnia	✔	✔	✔	✔
4	Moina	✔	✔	✔	
5	Nauplius	✔			✔
6	Rotifer	✔	✔	✔	✔
7	Notonecta	✔	✔		✔
8	Streptocephalus	✔	✔	✔	✔
9	Conocostrachan	✔	✔	✔	✔
10	Dysticus		✔	✔	✔
11	Dragonfly nymph	✔	✔	✔	✔
12	Chironomous		✔		
	H - Value	3.278	3.548	2.256	3.385
	Status	Clear	Clear	Clear	Clear

The results indicate that the water is clear and free from pollution. The sand quarrying activity will not affect the life plankton as they are well adapted with their locomotive ability to move fast to ensure their survival. The abundance of fishes also indicates that the plankton distribution is uniform across the aquatic habitats.

7.6 GRADIENT OF RIVER BED:

The River Cauvery originates at Talakaveri in Coorg District of Karnataka in Brahmagiri Range of hills in the Western ghats at an elevation of 1341 m (above MSL). The total length of the river from the origin to its outfall into the sea is 800 Kms. Of which 320 Kms is in Karnataka, 416 Kms in Tamil Nadu and 64 Kms forms the common border between the Karnataka and Tamil Nadu states. The Cauvery basin is in fan shaped in Karnataka and leaf shaped in Tamil Nadu.

The Mettur Reservoir Project is situated at 474th Km from Gudagu.From Mettur Reservoir the Cauvery river almost reaches the plain in Tamil Nadu state. A tributary called Bhavani joins Cauvery on the Right bank about 45 Kms below Mettur Reservoir. Thereafter it takes easternly course to enters the plains of Tamil Nadu. Two more Noyyal and Amaravathi join on the right bank and here the river widens with sandy bed and flows as “Akhanda Cauvery”

The project site Kattalai Bed Regulator is located at mile 85 from Mettur Reservoir and its sill is 97.93 m from MSL. Above that the Jeddarpalayam Anicut is located at mile 51 from Mettur and its sill from MSL is 127.405 m. Below the Kattalai Bed Regulator at mile 115 from Mettur Upper Anicut is situated and its sill is 72.00 m from MSL. The general gradient of river in this stretch is 1 in 1800. The table 7.15 and fig 7.9 depicts the general gradient and theoretical bed level between Jeddarpalayam and Upper Anicut.

TABLE -7.15

Mileage	**Gradient Level**	**Theoretical Bed Level**
51.00	127.405	127.405
68.00	114.425	112.675
85.00	97.930	97.930
98.75	86.150	84.900
115.00	72.000	72.000

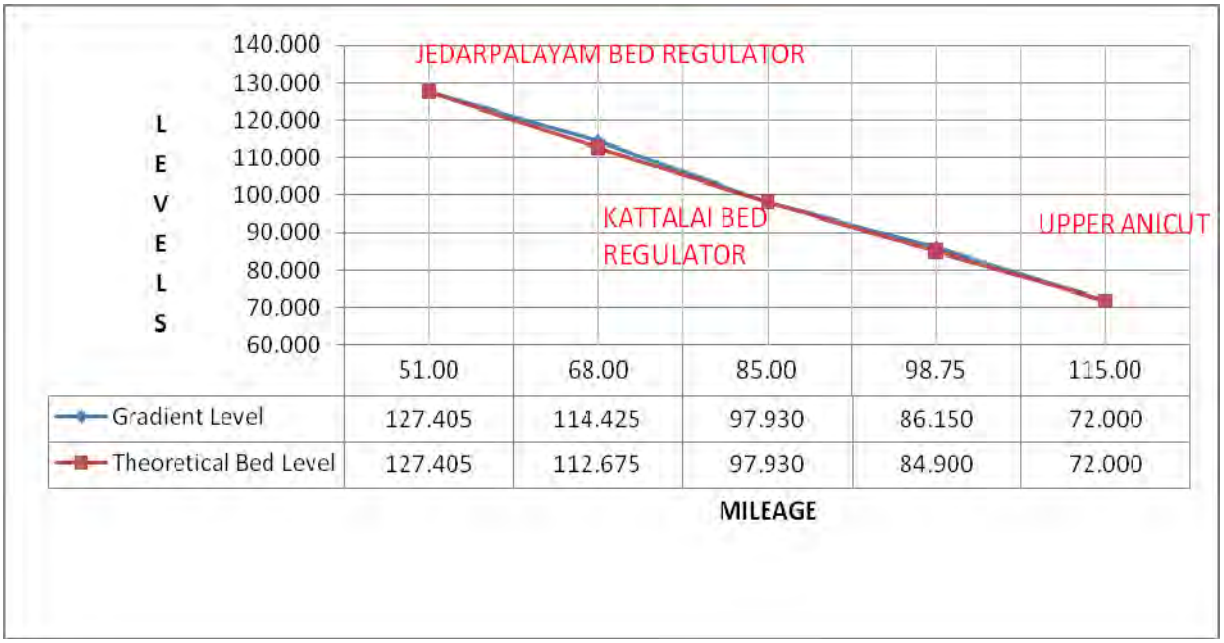


Figure : 7.9 Gradient of River Cauvery

The average velocity of flow varies between 2.22 m/sec to 0.416 m/sec from monsoon season to non monsoon season.Because of reducing velocity, the river attains its mature stage, tends to drop the sediment load below the Jeddarpalayam anicut.Here the river widens with sandy bed and flows as “Akhanda Cauvery”. Above the Jeddarpalayam anicut, up to Mettur Reservoir the river bed varies with pebbles to rock boulders.

7.7 RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN:

7.7.1 INTRODUCTION:

Risk assessment is a process whereby risks are analyzed, assessed and risk management priorities are evaluated. It is defined as the characterization of the potential adverse effect to human health & environment due to environmental hazards

7.7.2 OBJECTIVES OF RISK ASSESSMENT:

- Identifying hazardous activities
- Assessment of risk level and severity in different operations
- Identification of control measures
- Setting monitoring process
- Reduce the impact of mishaps of all kinds
- Reduce the inherent potential for major accidents

7.7.3 METHODOLOGY OF RISK ASSESSMENT:

- Collection of information & identification of hazard
- Classify their severity and probability of occurrence
- Identification of exposed risks

- Assess the risk and risk rating based on
  - Probability
  - Exposure
  - Consequence
- Prioritization of the risks
- Implementation of control measures
- Monitoring risk assessment
- Evaluation and correction

Risk assessment is mainly based on the environmental impact of various parameters. The project is open cast method of shallow mining without drilling and blasting. It is a conventional eco-friendly quarrying operation. By using the earth moving machineries on natural slope of sand shoals above the river bed, sand will be loaded directly to the trucks/lorries for transportation to the needy customers.

7.7.4 SURFACE WATER CONTAMINATION:

The potential for contamination during operation of mine site is obstruction of flow in river which will lead to water contamination. In this project, during formation of the approach road and grid, necessary temporary hume pipes will be provided wherever necessary for free flow of lean stream water to downstream. Hence, the surface water will not contaminate during the operation of mining.

7.7.5 GROUND WATER CONTAMINATION:

The minimum quantity of water for drinking and domestic purpose for labours working in quarry needed from nearby community wells or bore wells. The process of sand mining does not required any water. The domestic waste water generated from Eco-toilets outside the bank will be discharged safely into septic tank.

7.7.6 PHYSICAL HAZARDS:

Injuries during project operation are typically related to collision with earth excavators and moving trucks with persons. In this process contract labours from neighbouring villages are engaged for the purpose of maintaining the approaches, regulating the vehicle movement, assisting to take levels, and issuing of permits etc. The workers engaged in quarry site have been provided with personal protective equipments like helmets, hand gloves, masks, safety shoes, goggles, and ear plugs etc.

It is proposed to use very limited machineries as follows.

List of Mining Machineries and other to be deployed

S.No.	Name of Machinery	Nos.	M^3/Hr.	Capacity
1.	Excavator 200-220	2	80	0.90 cu.m.
2.	Water sprinkler	2		10000 Ltr.

The operation hour is between 7.00 AM to 5.00 PM during day time using excavators driven by diesel. No electrically operated mining machinery are proposed.

The labour engaged including the site supervisor under the direct supervision Assistant Engineer, PWD is very minimum and limited to 18 numbers only.

Employment Potential

Technically Skilled		
2. PWD Engineers	:	1 No.
Total	**:**	**1 No.**
Skilled		
1. Excavator Operator	:	2 Nos
2. Co-operator	:	2 Nos
Total	**:**	**4 Nos.**
Semi-Skilled		
2. Supervisors / clerks	:	2 **Nos.**
Un-Skilled		
8 Helpers	:	8 Nos.
9 Watchman	:	2 Nos.
10 Office boy	:	1 No.
Total	**:**	**11 Nos.**
Grand Total	:	**18 Nos.**

7.7.7 EXPOSURE TO RISK OF FLOOD IN RAINY REASON:

The quarrying operation shall not be carried out during days of rain and days of flood. The operation hour is between 7 AM to 5 PM and no activities in night hours. The Public Works Department is custodian of river and operate the dams in upstream.

So, there will be a good coordination between quarry operation and how much of water released during monsoon season in upstream dams. Hence, the necessary precaution will be issued.

Other factors that might cause risk and its control measures.

Sl. o.	Factors	Causes of risks	Control measures
1.	Excavation of Sand	a) Loading equipment ie. poclain are in such proximity while excavation.	Operator shall not operate the machine when persons & vehicles are in proximity.
		b) Swinging of bucket over the body of tipper.	Shall not swing the bucket over the cab and operator leaves the machine after ensuring the bucket is on ground.
		c) Driving by unauthorized person.	Shall not allow any unauthorized person to operate the machine by effective supervision.
2.	Transportation of Sand	a) Operating the vehicle nose to tail.	It will be assured that all these causes will be nullified by giving training to the operators.
		b) Overloading of material	No over loading
		c) While reversal and overtaking of vehicle	Audio visual reverse horn will be provided.
		d) Operator of truck leaving his cabin when it is loaded.	Proper training will be given.
3.	Water inundation	a) In rush to flood water due to heavy rain	PWD will keep a continuous watch on water level and pre communication will be given before opening of dam in upstream side.
		b) Unprecedented of the river	Flood warning will be given.
4.	Natural calamities	Unexpected happenings	The mine management is capable to deal with the situation.

7.7.8 DISASTER MANAGEMENT PLAN:

The Public Works Department is able to deal with situation efficiently to reduce confusion keeping in view of the likely sources of danger in the mine.

7.7.8.1 STRUCTURE OF THE DISASTER MANAGEMENT PLAN:

OUTLINE OF DISASTER MANAGEMENT PLAN:

The purpose of disaster management plan is to restore the normal for early resumption of mining operation due to an unexpected, sudden occurrence resulting to an abnormalities in the course of mining activity leading to a danger to workers or any machinery or the environment.

(I) SYSTEM OF COMMUNICATION:

We have an internal communication system for the Department Head and to their line of command with telephone. And also we are having the telephone numbers

and addresses of adjoining mines, rescue station, police station, Fire service station and local hospitals.

(II) FACILITIES & ACCOMMODATION:

The rest shed will be provided for labours with adequate basic amenities. The workers engaged in quarry site have been provided with personal protective equipments like helmets, hand gloves, masks, safety shoes, goggles, ear plugs etc.

(III) FIRST AID & MEDICAL FACILITIES:

The department is having first aid facilities at quarry site and having nearby Public Health Center for use in emergency situation. The centre will have facilities for first aid & minor treatment, resuscitation, ambulance and transport. It will have proper communication network with hospitals where the complicated cases are to be sent.

(IV) TRANSPORT SERVICES:

A well defined transport control system will be provided to deal with the situation.

(V) FUNCTION OF PUBLIC RELATIONS BY DEPARTMENT:

To make a cordial relation with general public, working groups, social service organization and other line organization of Government. To liaise with representatives of the mine to ameliorate the situation of panic, tension, sentiments, grievances, and misgivings created if any.

(VI) SECURITY:

Manning of security posts.

CHAPTER-8
PROJECT BENEFITS

8.1 IMPROVEMENTS IN THE PHYSICAL INFRASTRUCTURE

Roads and other infrastructure in the area will be developed. The village roads in the either side of river bank connecting the NH-67 and SH-25 to quarry site will be improved.

8.2 IMPROVEMENTS IN THE SOCIAL INFRASTRUCTURE

Out of collecting the cost of sand Rs. 800/- per 2 units, Rs. 170.00 (nearby 20% of net revenue of project) will be remitted to the local panchayat administration to improve the socio-economic development of the village. It is nearly twenty percent of total cost of the project will be given by the State Govt. to concern village panchayat as a corporate Social Responsibility while operating the sand quarry.The fund will be used to develop the social infrastructures like constructing the community hall, improving the road, providing drinking water facilities, improving drainage facilities, improving minor irrigation systems, improving the health system in village panchayat, improving the education infrastructure facilities, developing the green belts in available poromboke land and other facilities to the village panchayat. It is necessary to say that the State Government is voluntarily fixed this amount to ensure the CSR to local people while operating the sand quarry.

8.3 EMPLOYMENT POTENTIAL

The proposed project will generate employment opportunity, which will have beneficial impact.The PWD have provided direct employment for 18 persons and about thousands of persons will get employment through various constructions activity indirectly.The employment of local people shall upgrade the prosperity of the region.These in turn will improve the socioeconomic conditions of the area.

8.4 OTHER BENEFITS

- The removal of sand will restore the storage capacity i.e., 1.04 TMC of water during non Mettur season in upstream side and to increase the functional efficiency of discharging the maximum flood in downstream side.
- To influence the better recharge of sandy bed by storing water during non Mettur season. It will be useful for number of existing and proposed drinking water schemes during summer season when the flow in the river is minimum. It is estimated that the tapping of subsurface water in this chainage of river is about 135 MLD, will benefit 22 lakhs people up to District of Madurai.
- Uninterrupted supply of sand to the common public at affordable prices for reducing the construction cost.
- Augmentation of the revenue to the State exchequer.

CHAPTER 9

ENVIRONMENTAL MANAGEMENT PLAN

9.1 GENERAL

The Environmental Management Plan (EMP) presented in this chapter is intended to allow the proposed mining operation keeping with the proposed requirement. The EMP is prepared for formulation, implementation and monitoring of all local developmental and environmental protection measures during the mining.

This chapter focuses at ensuring that the industrial and domestic activities remain within the permissible limits by controlling the pollution at the source level to the possible extent with the available and affordable technology.

Environmental Management measures are suggested to mitigate the possible negative impacts that may be caused to the various attributes of environment due to the proposed mining operations at Mayanur village of U/S and D/S of newly constructed barrage across Cauvery.

9.2 CONTROL ON MICRO – METEOROLOGICAL ASPECTS.

Since the area of mining operation is confined to a limited extent of 196.25Ha., there will be no appreciable change or adverse effect on the rainfall, temperature, humidity and wind direction / velocity, at any point of time. This project is not expected to hear any change on the expected to hear any change on the meteorological aspects.

9.3 MANAGEMENT MEASURES FOR AIR QUALITY.

9.3.1 PAVED SURFACES

Paved surfaces have less dust generation potential. Dust pick-up by wind depends on the wind speed and is usually significant at wind speeds above 5 meters per second. However slight speed of vehicle can cause higher dust generation. Dust emissions from paved surfaces can be minimized by adopting following measures:

- Prevent spillages of materials on the paved surfaces during materials transportation.
- Speed controls on vehicle movements.
- Wind reduction control by plantation.

9.3.2 UNPAVED SURFACES

Dust emissions from unpaved surfaces are caused than from paved surfaces are usually much greater. Dust emissions can be controlled by using the following methods:-

- Water sprinkling on unpaved areas during dry wind periods, using a water tanker/or fixed sprinklers.
- Speed controls on vehicle movements to limit speeds.
- Wind reduction control by plantation.
- Wet suppression of unpaved areas can achieve dust emission reductions of about 70 percent or more.

9.3.3 VEHICLE

Vehicles travelling over paved or unpaved surfaces tend to crush surface particles and other debris. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents due to turbulent shear between the wheels and the surface.

Dust particles are also sucked into the turbulent wave created behind the moving vehicles. The loads carried by trucks are also potential source of dust, either through wind entrainment or spillages. Mud and dust carry out from unpaved surfaces is another potential problem. Dust emissions due to vehicles can be minimized by:

- Avoid spillage from the loaded trucks.
- Optimize travel distances through appropriate site layout and design.
- Speed controls on vehicles have an approximately linear effect on dust emissions. In other words, a speed reduction from 30 km/hr to 15 km/hr. will achieve about 50 per cent reduction in dust emissions.
- Allowing, the road worthy, vehicles (i.e. certified by Regional Transport Officer) to minimize the vehicular emission of particulates SO_2, NO_X and Hydrocarbons.

9.4 MANAGEMENT MEASURES FOR WATER QUALITY

As mentioned earlier the water that is encountered in the project is rain water as well as flood water during monsoon station. The following measures are advocated.

1) The overall drainage plan should be done in such a manner that the exiting lean stream thus will not get affected by providing necessary number of pipelines using sand and bio gradable materials to approach the sand shoals.

2) Quarrying shall not be carried out during rainy days or days of flood and it shall be ensured that the quarrying operation shall not disturb the flow of river at any point of quarrying.

3) Natural Gradient of the river bed shall be maintained for the free flow of water.

9.5 MANAGEMENT MEASURES FOR NOISE QUALITY:-

Noise levels increase due to mining activities such as excavation loading and transportation of sand.

The following measures are advocated.

1) Regular preventive maintenance of excavators and road worthy, Regional transport officer certified Public carrier trucks are permitted to enter the quarry site.
2) Provision of the silencers to modulate the noise generated by the machines shall be made wherever required.
3) Provision of ear muffs/ear plugs to HEMM operators. This is a statutory requirement from DGMS under MMR-1961.
4) Planting of trees with thick foliage along roads to act an acoustic barrier.

9.6 LAND RESTORATION

The main intention of land reclamation is to restore the pristine ecological condition in the region that is prevailing because of mining.

In this project of mining, the excess sand shoals deposited above the sill in upstream and downstream of newly constructed barrage to restore the river hydrology to pass the flood safely. Here, the removal of sand shoals itself is a reclamation, since the lease area is river bed.

9.6.1 GREEN BELT AND AFFORESTATION

The optimum size of green belt is usually determined on the basis of expected pollution loads from the mine, wind direction, mine surroundings, availability of land and the economics of green belt development and maintenance.

The development of the green belt is mainly for buffering the air borne dust and for attenuation of noise levels. By planting a combination of trees which can grow fast and with denser foliage the desired effect of trapping the air borne dust, noise reduction and increasing the aesthetic appeal will be largely achieved.

Here, the lease area is in the riverbed. There is a thick vegetational cover in either side of river bank. However, the seinorage charges given to local panchayat (i.e. nearly twenty percent of revenue of sand sale) as a corporate social responsibility will be instructed to staple the plants wherever the Government poromboke land available.

The green belt shall be developed in consultation with the local forest authorities regarding the selection of site specific species, seeding management, plantation techniques and their up keep by deseeding, manuring and regular watering.

9.7 OCCUPATIONAL HEALTH AND HYGIENE

The care has been taken to maintain continuous water supply in water spraying system to suppress the dust in approach roads at quarry site and village roads.

The workers engaged in quarry site have been provided with personal protective equipments like helmets, hand gloves, masks, safety shoes, goggles, ear plugs etc. Besides that, the rest shed will be provided at site for workers with first aid kits. It is proposed to engage only 18 numbers of skilled and unskilled persons including Assistant Engineer, PWD for entire quarry operation.

The authorities have to provide the required facilities at the Public Health Center at Sriramasamudram to conduct medical examination for pre-entry level workmen and staff and provide for periodic examination of target groups as per the requirement stipulated by the Directorate General of Mines Safely, Dhanbad who is the monitoring agency for occupational health of miners.

Noise levels shall be measured in and around mining areas and ensured that the noise levels are within the permissible limits.

Adequate measures shall be taken to keep noise levels below 85 db (A) wherever the noise level exceeds 85 db (A), workers shall be provided with ear muffs and ear plugs etc. The mining area and its surroundings shall be kept clean to ensure overall health and safety problems.

The medical examinations as mentioned above shall be conducted in respect of persons engaged in the operations of HEMM, tippers, and other machines involved in the opencast mine. The above examinations include persons engaged in the above operations.

The periodically of the above examinations shall be as stipulated by DGMS.

The occupational health services shall aim at

i. Identification of assessment of risk from health hazards at work place

ii. Surveillance of the factors in working environment and work practices which may affect workers health.

iii. Surveillance of workers health in relation to work.

iv. Education of workers on sanitation, cleanliness, hygiene and health care.

v. Collaborating in providing information, training and retraining of first aiders.

vi. Preparing quarterly status reports on occupational health and industrial hygiene noting information on medical examinations, noticeable disease, status of first aid, results of status of air borne dust surveys, noise, temperature, and sanitation in work places.

The project authorities have provided personal protection equipment such as respirators and ear muffs to guard the work persons from dust and noise.

These equipments are of approved make duly certified by DGMS, Dhanbad.

9.8 PROPOSED BUDGETARY PROVISIONS FOR EMP

Adequate budgetary provisions have been made by PWD for execution of environmental management plans. The details of total capital and recurring (per annum) for environmental pollution control measures are given in following table 9.1

TABLE: 9.1 Total Capital and Recurring Cost
(For environmental pollution control measures)

Sl. No.		Capital cost (in Rs. Lakhs)		Annual recurring cost (in Rs. Lakhs)	
		Existing	Proposed	Existing	Proposed
1.	Pollution Control	--	20.00	--	8.00
2.	Pollution Monitoring	--	2.00	--	1.00
3.	Occupational Health	--	5.00	--	1.00
4.	Green Belt	--	10.00	--	2.00
5.	Eco-Toilet	--	0.65	--	0.20
6.	Water Spraying	--	3.00	--	1.00
7.	Conservation Plan for Schedule I & Schedule II species	--	12.10	--	--
	TOTAL		**52.75 Lakhs**		**13.20 Lakhs**

Out of collecting the cost of sand Rs. 800/- per 2 units, Rs. 170.00 (nearby 20% of net revenue of project) will be remitted to the local panchayat administration to improve the socio-economic development of the village. It is nearly twenty percent of total cost of the project will be given by the State Govt. to concern village panchayat as a corporate Social Responsibility while operating the sand quarry.

The fund will be used to develop the social infrastructures like constructing the community hall, improving the road, providing drinking water facilities, improving drainage facilities, improving minor irrigation systems, improving the health system in village panchayat, improving the education infrastructure facilities, developing the green belts in available poromboke land and other facilities to the village panchayat. It is necessary to say that the State Government is voluntarily fixed this amount to ensure the CSR to local people while operating the sand quarry.

CHAPTER 10

SUMMARY AND CONCLUSION

10.1 INTRODUCTION:-

The Public Works Department has proposed to set up a sand quarry operation over an extent of 196.25 Ha. in River Cauvery at upstream and downstream of the above Barrage in SF No.293 of Sriramasamuthiram village and SF No. 288 of Silaipillayaputtur village in Thottiyam tehsil of Trichy District in Tamil Nadu to increase the functional efficiency of the newly constructed Kattalai Barrage. As per the approved mining plan, the total production capacity of the project is 15,01,247 m^3 of sand.

As per EIA Notification dated 14th Sep, 2006 as amended on 1st December 2009, the project falls under category "A" project or Activity 1(a).

The precise area communication has been approved by the District Collector, Trichy vide Lr. Nos.291/Kanimam/2013/ dt.18.6.2013. The mining plan has been prepared for production of 15,01,247 m^3 for three years period and it was approved by the Assistant Director, Geology and Mining, Trichy vide letter No. 291/Kanimam/2013 Dt.19.7.2013

Public Works Department submitted Form-I and prefeasibility report to MOE&F on 02.09.2013. This proposal was submitted before the 14th meeting of the Reconstituted Expert Appraisal Committee on 22.11.2013 for Environmental Appraisal of Mining projects constituted under EIA notification 2006 for issuing ToR. The committee issued the ToR vide the Letter No. J-11015/343/2013-IA.II(M) dt.31st March 2014 to carry out the Rapid Environmental Impact Assessment (REIA) studies spanning one season Viz December 2013 to February 2014 , so as to delineate Environmental Management Plans (EMP) to mitigate any adverse impacts due to mining activity caused by the quarrying operation to remove the sand shoals in upstream and downstream of Kattalai Barrage.

The public hearing for the above project was conducted on 18.7.2014 at Sriramasamuthiram village of Thottiam tahsil under the chairmanship of Additional District Magistrate of Trichirapalli after giving the vide publicity through English and local vernacular daily.

The above proposal for seeking Environmental Clearance was considered by the Expert Appraisal Committee in its 22nd meeting held during August 26-27, 2014. The committee mentioned some remarks vide the Letter No. J-11015/343/2013.IA-II(M) dt.17.9.2014 and the clarifications for the above remarks has also been incorporated in this final EIA/EMP Report.

10.2 PROJECT DESCRIPTION

The project is to remove the shoals above the sill in U/S and D/S of newly constructed barrage through quarrying. The removal of Sand will restore the storage capacity ie. 1.04 TMC of water during non Mettur season in upstream side and to increase the functional efficiency of discharging the maximum flood in downstream side. The sand shoals above the river bed are to be quarried to make the river section hydro logically safe.

10.2.1 SALIENT FEATURES OF THE PROJECT

Sl. No.	Particulars		Details
A.	**Location Details:**		
1.	Location		Sriramasamuthiram and Sillaipillayaputhur Village, Thottiyam Tehsil
	A. District		Trichy
	B. State		Tamil Nadu
2.	Co-ordinates of four corners of proposed project site		
	NW	Latitude	10°57' 46.0" N
		Longitude	78°12' 28.9" E
	NE	Latitude	10°58' 02.1" N
		Longitude	78°13' 38.7" E
	SW	Latitude	10°57' 29.4" N
		Longitude	78°12' 28.5" E
	SE	Latitude	10°57' 57.5" N
		Longitude	78°14' 28.0" E
B.	**Proposed Project Area:**		
3.	Total Proposed Area		196.25 Ha.
4.	Government Land		Govt. River Poromboke land owned by PWD
5.	Private Land		N.A.
C.	**Production Capacity:**		15,01,247 m^3
D.	**Environmental settings:**		
6.	Nearest Railway Station		Mayanur (a KM away in southern side)
7.	Nearest Village		Sriramasamuthiram, Silaipillayaputtur, Mayanur, Kattalai.
8.	Nearest Town/City		Karur – 21 KM, Kulithalai – 20 KM Musiri – 25 KM, Thottiyam – 15 KM
9.	Nearest Highway		NH 67 in Southern Side SH 25 in Northern Side
10.	Nearest Airport (By road-Appx.)		Trichy – 65 KM

11.	Nearest River/Canal (By road-Appx.)	Lease area is river bed of Cauvery. The North Bank Canal, South Bank Canal, Kattalai High Level Canal, New Kattalai High Level Canal and Krishnarayapuram Canal runs along the bank.
12.	Nearest Hill Ranges	Nil
13.	Source of Water in the area	River, Bore well and Community wells.
14.	Soil Type	Sand shoals
15.	Ground Water Level	(i) Pre-monsoon (April/May) Core Zone - 2.00 mbgl Buffer Zone - 6.05 mbgl (ii)Post-monsoon (November) Core Zone - 2.10 mbgl Buffer Zone - 4.17 mbgl
16.	A. Temperature	Min: 10.40°C Max: 35.40°C
17.	B. Relative Humidity	
	At 08.30 hrs	Min: 76% Max: 96%
	At 17.30 hrs	Min: 37% Max: 100%
18.	C. Mean Annual Rainfall	630mm
E.	**Cost Details:**	
19.	Cost of the Project	Rs. 6.66 Crores
20.	Cost for Environmental Protection	Rs. 92.35 Lakhs
21.	Cost of Socio-Economic Development	Rs. 4.51 Crores

10.2.2. MAJOR REQUIREMENTS FOR THE PROJECT:

(a) RAW MATERIAL REQUIREMENT:

It is open cast, semi mechanized shallow mining on shoals without drilling and blasting. The sand is directly loaded into needy consumer's vehicles (lorries/tippers) by using earth excavators in river bed itself.

(b) OTHER REQUIREMENTS:

Other requirements is as under

REQUIREMENT OF LAND

Sl. No.	Land	Source
1.	196.25 Ha (93.95 Ha in Sriramasamuthiram village and 102.30 Ha in Silaipillayaputhur village)	Land is Govt. River Poromboke land owned by PWD

REQUIREMENT OF WATER

Sl. No.	Purpose	Quantity	Source
1	Drinking	0.1 KLD	Brought from the nearby community wells.
2	Domestic Purpose	0.3 KLD	For Domestic purpose will be brought from well owned by PWD.
3	Dust Suppression	10 KLD	For dust suppression will be brought from River.

REQUIREMENT OF LOADING EQUIPMENTS:

Sl. No.	Name of Machinery	Nos.	M^3/Hr.	Capacity
1.	Excavator 200 -220	2	80	0.90 cu. m.
2.	Water sprinkler	2	-	10000 Lit.

EMPLOYMENT POTENTIAL:

Technically Skilled:	
1. PWD Engineers	1 No.
Total	**1 No.**
Skilled:	
1. Excavator Operators	2 Nos.
2. Co-Operator	2 Nos.
Total	**4 Nos.**
Semi-Skilled:	
1. Supervisors / Clerks	2 Nos.
Un-Skilled:	
1. Helpers	8 Nos.
2. Watchman	2 Nos.
3. Office Boy	1 No.
Total	**11 Nos.**
Grand Total	**18 Nos.**

Source: Prefeasibility Report

10.2.3. PROCESS DESCRIPTION:

- Approach road to mine area will be formed using sand and Bio-degradable materials like sugarcane leaves.
- Necessary pipes will be provided across the lean flow.
- Directly scooping of sand shoals on the river bed using Poclains.
- Loading directly into consumers lorry/trucks after getting the demand draft for sand cost as fixed by the State Government.
- Transport permit will be issued at the exit point.
- Transported to needy customers.

10.3 ANALYSIS OF ALTERNATIVES (TECHNOLOGY AND SITE)

- The removal of Sand will restore the storage capacity of the Barrage ie. 1.04 TMC of water during non Mettur season in upstream side and to increase the functional efficiency of discharging the maximum flood in downstream side during monsoon.
- To influence the better recharge of sandy bed by storing water during non Mettur season. It will be useful for number of existing and proposed drinking water schemes during summer season when the flow in the river is minimum.
- To ensure the proper gradient of river.
- To protect the flood bank by restoring the flood carrying capacity.
- To make available the sand in the open market at a reasonable price.
- To optimize the use of the natural resources.
- Augmentation of the revenue to the State exchequer by quarrying the sand instead of spending huge amount to quarry sand shoals.
- Site is well connected with NH-67 which is at a distances of 1.0 KM away from the project site.
- No eco-sensitive areas within 10 KM of the project site.
- The proposed project will generate employment opportunity, which will have beneficial impact.
- It is a simple open cost semi mechanised shallow mining on shoals above the river bed.
- Excavators are used to quarry the sand shoals on river bed and directly loaded in to Public carrier trucks.
- Temporary biodegradable pathways are provided using sugarcane leaves and sand Bucket elevators are provided for raw material lifting.
- Waste water from Eco-Toilet will be discharged safely into septic outside the river bank.

10.4 DESCRIPTION OF ENVIRONMENT

Baseline study of the area (i.e., 10 km radius from the project boundary) was conducted during Winter Season, from Dec 2013 to Feb 2014). Monitoring for air quality, ambient noise levels, water quality and soil quality was conducted at respective sampling locations. The study for land use pattern, study for demography, flora & fauna has also been conducted.

The climate of the area varies moderately. Predominant wind direction during this period was from South East quadrants, with 16.12% of the total time with calm winds. Wind velocity readings were recorded in the range 0 to 6 KM/Hour with a mean value of 2.39 KM/Hour.

According to All Weather Station, Mayanur, datas of December 2013 to February 2014, Maximum temperature is 35.4°C and minimum temperature is 10.4°C. Total rainfall recorded is 49mm with four rainy days and average relative humidity is 71.24% during the study period.

Ambient air quality was monitored at eight locations for PM10, PM2.5, Sulphurdioxide (SO2) and Nitrogen oxides (NOx). The sampling was carried out for 8 hrs per day in three shifts. The freqency of sampling at each station is twice in a week.

The PM_{10} concentration for all the 8 AAQ monitoring stations ranges between 64 **µg/m³** and 147 **µg/m³**. The PM_{10} values in location like Mayanur VAO office has been found to be slightly higher side, because the factors like wornout BT surface village road to Mayanur, adjacent NH 67 and railway track. The necessary mitigation measures such as renewing BT road and continuous wetting in adjacent pavement to avoid any dust generation due to proposed quarry operation to keep the values with in standard limit.

The $PM_{2.5}$ ranges between 0 **µg/m³** to 128 **µg/m³**.The values of $PM_{2.5}$ in Sriramasamudram village panchayat office, Sillaipillaiyaputtur village panchayat office and Mayanur drinking water scheme has been found to be slightly higher side, because the factors like worn out BT surface village roads.The necessary mitigation measures such as renewing BT road and continuous wetting in adjacent pavement to avoid any dust generation due to proposed quarry operation to keep the values with in standard limit.

The SO_2 ranges between Below Detectable Limit (BDL) and 1.51 **µg/m³**. The NO_2 ranges between BDL and 2.56 **µg/m³**. The above values of AAQ stations are well within the prescribed limit.

The Noise levels of the above monitoring stations vary from 53.2 Leq to 79 Leq during day time and 42.3 Leq to 64.3 Leq during night hours. The average noise levels at all locations were observed to be within the prescribed limits.

The main water source in the study area is river Cauvery and bore wells. Six water samples were collected from various locations within the 10 KM radial distance in which 2 samples are taken from surface water (river) and 4 samples are taken from bore wells (Ground Water) in the nearby villages.

The analysis shown that PH varies from 8 to 8.07 for surface water and 7.61 to 7.77 for ground water. Total Hardness varies from 230 mg/l to 245 mg/l for surface water and 275 mg/l to 360 mg/l of ground water. Total Dissolved Solids are in the range of 277 mg/l to 291 mg/l for surface water and 268 mg/l to 437 mg/l for ground water.

The analysis results for soil shows that soil is purely sand. The percentage of Silica is predominant. The percentage of Fe, Ca and Mg are found to be small. The Mica and other rare metals are below detectable limit and found to be ignored.

FLORA:

The plant species were classified into agricultural crops, commercial crops, plantation, natural vegetation, endangered and endemic plants and medicinal plants. Based on the study carried out in core and buffer zones, 134 plant species were recorded in the study area. The detailed study reveals that none of these zones possess endangered and endemic plants.

FAUNA:

Both direct and indirect observation methods were used to survey the fauna. Visual encounter (search) method was employed to record vertebrate species. Additionally, survey of relevant literature was also done to consolidate the list of vertebrate fauna distributed in the study area.

The detailed conservation plan and its budget allocation for identified schedule-I and II species is approved by Chief Wild Life Warden, Govt. of Tamil Nadu vide Letter No WL5/30163/2014 Dated 10.02.2015.

The population of the study area(for 10 km radius of project site) as per 2011 census records is 229559.Scheduled Caste fraction of the study area (10 km) is 26.92% and Scheduled Tribe 0.04%. Percentage of literacy is 65.30% and that of workers those actually engaged in occupation is 54%.

10.5 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES.

10.5.1 AIR ENVIRONMENT

In sand mining, various mining activities viz scooping of sand, loading and transportation is significant. The levels of ambient air quality (i.e.,PM_{10},$PM_{2.5}$,SO_X,and NO_X)within the buffer zone and core zone stations are well within the permissible limits. However, with proper management, reduction in high levels of dust concentration is suppressed by water spraying on all the haul roads.It also proposed to develop the green belt through village panchayat by providing seinorage charge funds.

10.5.2 NOISE ENVIRONMENT

The sources of Noise in mining area are due to excavation and trucks in the river bed.In the EMP, it is proposed to suggest Noise protection measures for machinery and workers and also development of green belt will keep the Noise levels well within the limits.

10.5.3 WATER ENVIRONMENT

In mining activity, water availability and water quality are two major aspects considered for base line status of water environment. In this sand mining project, the study on removal of excess sand shoals to restore the river hydrological regime will not cause any increase in suspended solids in surface water. It will also ensure that the overall drainage plan should be done in such way that the existing lean stream flow will not get affected by providing necessary number of pipes using sand and biodegradable materials to approach the sand shoals.

Natural gradient of the river bed shall be maintained for the free flow of water. The minimum quantity of water for drinking and domestic purpose for labours working in quarry needed from nearby community wells or bore wells. The process of sand mining does not require any water. The domestic waste water generated from Eco- Toilets outside the bank will be discharged safely in to septic tank.

10.5.4 LAND ENVIRONMENT

Regarding land environment, the area falls under river bed, classified as river poromboke owned by Public Works Department. The mining on sand shoals to make the river cross section hydrologically safe and to restore the designed storage capacity of newly constructed barrage in upstream and to discharge the maximum flood in downstream. The sand mining on shoals itself is a reclamation measure of lease area in proposed project. In the buffer Zone area, land is used mainly for agricultural purpose.

10.5.5 BIOLOGICAL ENVIRONMENT

Regarding biological environment of flora, the study reveals that, the vegetation encountered in the study area is termed as the original characteristic of Thorn forests / Scrub forests intermingled with aquatic herbs and social forestry maintained by the State Forest Department. The core zone comprises of small herbs, sedges and grasses with sparse distribution of trees that are well adapted to the sandy and fallow lands.

Based on the faunal study, this area seems to support a variety of diverse animal species.All other faunal species of Pisces, Amphibians Molluscans, insects, butterflies are common species only. The detailed conservation plan and its budget allocation is discussed in detail for identified schedule-I & II species in the study area as per Wild Life Act 1971. The study area (10 km radius from the project site) is not having any National Park, Wild Life Sanctuary or Biosphere Reserve etc.

10.5.6 SOCIO ECONOMIC ENVIRONMENT

The population of the study area(for 10 km radius of project site) as per 2011 census records is 229559.Scheduled Caste fraction of the study area (10 km) is 26.92% and Scheduled Tribe 0.04%.Percentage of literacy is 65.30% and that of workers those actually engaged in occupation is 54%.

The total Corporate Social Responsibility (CSR) is of 4.51 crores for three years.

10.6 ENVIRONMENTAL MONITORING PROGRAMME

Environmental Monitoring Programme will be conducted for various environmental components as per conditions stipulated. Biyearly reports will be submitted on regular basis, to MoEF on 1st of June and 1st of December. Details of the Environmental Monitoring schedule, which will be undertaken for various environmental components, are detailed below:

S. No.	DESCRIPTION	FREQUENCY OF MONITORING
1.	Meteorological Data	Daily
2.	Ambient Air Quality	Quarterly
3.	Water Quality	Quarterly
4.	Noise Level Monitoring	Quarterly

10.7 ADDITIONAL STUDIES, RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN

The Additional studies conducted as per the Terms of References issued in 14th meeting of the Reconstituted Committee of the Expert Appraisal Committee for Environmental Appraisal of Mining projects constituted under EIA Notification 2006 on 22-11-13 to carry out the Replenishment study, Details of transportation of mined out materials, Proper specific Conservation plan for Schedule-I and II species, Impact

of mining on plankton, Details of mining activity, Details of gradient of river bed, Details of excavation schedule.

The Public Hearing/Consultation was conducted on 18th July 2014at Sriramasamuthiram panchayat office campus, Sriramasamuthiram village of Thottiyam tehsil in Trichy district in the presence of the District Revenue Officer/Additional District Magistrate, Trichy, District Environmental Engineer, Tamil Nadu Pollution Control Board along with the Executive Engineer, PWD, R.C.Division, Trichy, press fraternity and the public. Totally about 191 numbers of people were present for public hearing of which about 9 person spoke about the project. Majority of public present appreciated the need and necessity of the project.

The various risks associated during operational stage of the project and the disaster management plan to minimize the risks or to combat the associated risks is also discussed.

10.8 PROJECT BENEFITS

- Roads and other infrastructure in the area will be developed. The village roads in the either side of river bank connecting the NH-67 and SH-25 to quarry site will be improved.
- Out of collecting the cost of sand Rs. 800/- per 2 units, Rs. 170.00 (nearby 20% of net revenue of project) will be remitted to the local panchayat administration to improve the socio-economic development of the village. It is nearly twenty percent of total cost of the project will be given by the State Govt. to concern village panchayat as a corporate Social Responsibility while operating the sand quarry.The fund will be used to develop the social infrastructures like constructing the community hall, improving the road, providing drinking water facilities, improving drainage facilities, improving minor irrigation systems, improving the health system in village panchayat, improving the education infrastructure facilities, developing the green belts in available poromboke land and other facilities to the village panchayat. It is necessary to say that the State Government is voluntarily fixed this amount to ensure the CSR to local people while operating the sand quarry.
- The proposed project will generate employment opportunity, which will have beneficial impact.The PWD have provided direct employment for 18 persons and about thousands of persons will get employment through various constructions activity indirectly.The employment of local people shall upgrade the prosperity of the region.These in turn will improve the socioeconomic conditions of the area.

10.9 ENVIRONMENTAL MANAGEMENT PLAN

The EMP is prepared for formulation, implementation and monitoring of all local developmental and environmental protection measures during the mining. Environmental Management measures are suggested to mitigate the possible negative impacts that may be caused to the various attributes of environment due to the proposed mining operations at Mayanur village of U/S and D/S of newly constructed barrage across Cauvery. Since the area of mining operation is confined to a limited extent of 196.25 Ha, there will be no appreciable change or adverse effect on the rainfall, temperature, humidity and wind direction / velocity, at any point of time. This project is not expected to hear any change on the meteorological aspects.

10.9.1 AIR ENVIRONMENT

PAVED SURFACES

Paved surfaces have less dust generation potential. Dust pick-up by wind depends on the wind speed and is usually significant at wind speeds above 5meters per second. However slight speed of vehicle can cause higher dust generation. Dust emissions from paved surfaces can be minimized by adopting following measures:

- Prevent spillages of materials on the paved surfaces during materials transportation.
- Speed controls on vehicle movements.
- Wind reduction control by plantation.

UNPAVED SURFACES

Dust emissions from unpaved surfaces are caused than from paved surfaces are usually much greater. Dust emissions can be controlled by using the following methods:-

- Water sprinkling on unpaved areas during dry wind periods, using a water tanker/ fixed sprinklers.
- Speed controls on vehicle movements to limit speeds.
- Wind reduction control by plantation. Wet suppression of unpaved areas can achieve dust emission
- Reductions of about 70 per cent or more.

VEHICLE

Vehicles travelling over paved or unpaved surfaces tend to crush surface particles and other debris. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents due to turbulent shear between the wheels and the surface.

Dust particles are also sucked into the turbulent wave created behind the moving vehicles. The loads carried by trucks are also potential source of dust, either through wind entrainment or spillages. Mud and dust carry out from unpaved surfaces is another potential problem. Dust emissions due to vehicles can be minimized by:

- Avoid spillage from the loaded trucks.
- Optimize travel distances through appropriate site layout and design.
- Speed controls on vehicles have an approximately linear effect on dust emissions. In other words, a speed reduction from 30 km/hr to 15 km/hr. will achieve about 50 per cent reduction in dust emissions.
- Allowing, the road worthy, vehicles (i.e. certified by Regional transport officer) to minimize the vehicular emission of particulates SO_2, NO_X and Hydrocarbons.

10.9.2 MANAGEMENT MEASURES FOR WATER QUALITY

As mentioned earlier the water that is encountered in the project is rainwater as well as flood water during monsoon station. The following measuresare advocated.

- The overall drainage plan should be done in such a manner that the exiting lean stream will not get affected by providing necessary number of pipelines using sand and bio gradable materials to approach the sand shoals.
- Quarrying shall not be carried out during rainy days or days of flood and it shall be ensured that the quarrying operation shall not disturb the flow of river at any point of quarrying.
- Natural Gradient of the river bed shall be maintained for the free flow of water.

10.9.3 MANAGEMENT MEASURES FOR NOISE QUALITY

Noise levels increase due to mining activities such as excavation loading and transportation of sand.

The following measures are advocated.

- Regular preventive maintenance of excavators and road worthy, Regional transport officer certified Public carrier trucks are permitted to enter the quarry site.
- Provision of the silencers to modulate the noise generated by the machines shall be made wherever required.
- Provision of ear muffs/ear plugs to HEMM operators. This is a statutory requirement from DGMS under MMR-1961.
- Planting of trees with thick foliage along roads to act an acoustic barrier.

10.9.4 LAND RESTORATION

The main intention of land reclamation is to restore the pristine ecological condition in the region that is prevailing because of mining. In this project of mining, the excess sand shoals deposited above the sill in upstream and downstream of newly constructed barrage to restore the river hydrology to pass the flood safely. Here, the removal of sand shoals itself is reclamation, since the lease area is river bad.

10.9.5 GREENBELT AND AFFORESTATION

The optimum size of greenbelt is usually determined on the basis of expected pollution loads from the mine, wind direction, mine surroundings, availability of land and the economics of green belt development and maintenance .The development of the green belt is mainly for buffering the air borne dust and for attenuation of noise levels. By planting a combination of trees which can grow fast and with denser foliage the desired effect of trapping the airborne dust, noise reduction and increasing the aesthetic appeal will be largely achieved. Here, the lease area is in the riverbed. There is a thick vegetation cover in either side of river bank. The budget is allocated under the Environmental Protection measures to develop the green belt wherever the Government poromboke land available. The green belt shall be developed in consultation with the local forest authorities regarding the selection of site specific species, seeding management, plantation techniques and their up keep by deseeding, manuring and regular watering.

10.9.6 OCCUPATIONAL HEALTH AND HYGIENE

The care has been taken to maintain continuous water supply in water spraying system to suppress the dust in approach roads at quarry site and village roads. The workers engaged in quarry site have been provided with personal protective equipments like helmets, hand gloves, masks, safety shoes, goggles, ear plugs etc. Besides that, the rest shed will be provided at site for workers with first aid kits. It is proposed to engage only 18 numbers of skilled and unskilled persons including Assistant Engineer, PWD for entire quarry operation. The authorities have to provide the required facilities at the Public Health Center at Sriramasamudram to conduct medical examination for pre-entry level workmen and staff and provide for periodic examination of target groups as per the requirement stipulated by the Directorate General of Mines Safely, Dhanbad who is the monitoring agency for occupational health of miners.

Noise levels shall be measured in and around mining areas and ensured that the noise levels are within the permissible limits .Adequate measures shall be taken to keep noise levels below 85 db (A)wherever the noise level exceeds 85 db (A), workers shall be provided with earmuffs and ear plugs etc. The mining area and its surroundings shall be kept clean to ensure overall health and safety problems. The medical examinations as mentioned above shall be conducted in respect of persons engaged in the operations of HEMM, tippers, and other machines involved in the

opencast mine. The above examinations include persons engaged in the above operations. The periodically of the above examinations shall be as stipulated by DGMS.

The occupational health services shall aim at

- Identification of assessment of risk from health hazards at workplace
- Surveillance of the factors in working environment and work practices which may affect workers health.
- Surveillance of workers health in relation to work.
- Education of workers on sanitation, cleanliness, hygiene and healthcare.
- Collaborating in providing information, training and retraining of first aiders.
- Preparing quarterly status reports on occupational health and industrial hygiene, noting information on medical examinations, noticeable disease, status of first aid, results of status of air borne dust surveys, noise, temperature, and sanitation in work places.

The project authorities have provided personal protection equipment such as respirators and ear muffs to guard the work persons from dust and noise. These equipments are of approved make duly certified by DGMS, Dhanbad.

10.9.7 BUDGET FOR IMPLEMENTATION OF ENVIRONMENTAL MANAGEMENT PLAN

The cost for environmental protection measures proposed is 52.75 lakhs and its recurring cost for environmental protection measures is 13.20 lakhs

Total Capital and Recurring Cost

(For environmental pollution control measures)

Sl. No.		Capital cost (in Rs. Lakhs)		Annual recurring cost (in Rs. Lakhs)	
		Existing	Proposed	Existing	Proposed
1.	Pollution Control	--	20.00	--	8.00
2.	Pollution Monitoring	--	2.00	--	1.00
3.	Occupational Health	--	5.00	--	1.00
4.	Green Belt	--	10.00	--	2.00
5.	Eco-Toilet	--	0.65	--	0.20
6.	Water Spraying	--	3.00	--	1.00
7.	Conservation Plan for Schedule I & Schedule II species	--	12.10	--	--
	TOTAL		**52.75 Lakhs**		**13.20 Lakhs**

10.10 CONCLUSION

The project is opencast, semi mechanized, shallow mining sand shoals above the river bed without drilling and blasting. It is safe to say that the project is not likely to cause any significant impact on the ecology of the area, as adequate preventive measures will be adopted to contain the various pollutants within permissible limits. The project is to improve the functional efficiency of the newly constructed barrage and to recharge the sandy bed by storing the excess flood water in order to improve the grand water potential. It also helps to maintain the sustainability of drinking water schemes to tap the subsurface water during dry season. The removal of sand shoals above the river bed will reclaim the river bed to carry the maximum flood during monsoon season.

The 156 years old Public Works Department always believes on sustainable principles after taking into consideration of all environmental impact. The project is for ultimate benefit to common public.

NATIONAL INSTITUTE OF TECHNOLOGY

राष्ट्रीय प्रौद्योगिकी संस्थान, तिरुच्चिराप्पल्ली - 620 015, तमिलनाडु

(Institution of national importance by an act of parliament,
Ministry of Human Resource Development, Govt. of India.)

Tiruchirappalli - 620 015, Tamilnadu, India.

Phone : + 91 431 2503150 (Office), + 91 431 2503161 (Direct), Fax : +91 431 2500133

Mobile : +91 9444211585, E-mail : stramesh@nitt.edu, Website : www.nitt.edu

Dr. S.T. RAMESH, M.E., Ph.D.
Associate Professor / Civil Engineering

27.03.2014

To

The Executive Engineer
Public works department / WRD,
River conservatory division
Trichy– 620 001.

Sir,

Please find enclosed herewith the baseline air quality data collected in all the locations (Core and Buffer) for the proposal of Quarrying of sand shoals across Cauvery River over an extent of 196.25 Ha in Sriramasamuthiram and Silaipillyarputhur villages in Thottium Taluk of Trichy district for the period of 3 months. (December 2013 – February 2014). Due to shortage in number of instruments in NIT, Trichy, part of the study was executed by Department of Environmental Science, PSG College of Arts and science, Coimbatore – 641 014.

(Dr. S. T. Ramesh)

Dr. S.T. Ramesh, Ph.D.
Associate Professor
Department of Civil Engineering
National Institute of Technology
Tiruchirappalli - 620 015.

Encl:
AIRQUALITY DATA

TRICHY

AMBIENT AIR QUALITY ASSESSMENT FOR THE 1ST WEEK OF DECEMBER-2013
FROM (2/12/2013) - (7/12/2013) inclusive of 1st and 2nd Batch Sampling

Date	Location	PM 10	PM 2.5	NO2	Sox	Batch
2/12/2013	TCA-1	73	0	BDL	BDL	1st
2/12/2013	TCA-2	71	28	BDL	BDL	1st
2/12/2013	TBA-1	91	88	BDL	1.2	1st
3/12/2013	TBA-2	79	61	2.2	BDL	1st
3/12/2013	TBA-3	92	1	2.1	1	1st
3/12/2013	TBA-4	148	2.8	2.6	2.2	1st
4/12/2013	TBA-5	76	11	1	BDL	1st
4/12/2013	TBA-6	71	77	1.6	BDL	1st
5/12/2013	TCA-1	62	32	BDL	BDL	2nd
5/12/2013	TCA-2	60	105	BDL	BDL	2nd
5/12/2013	TBA-1	84	89	BDL	1.6	2nd
6/12/2013	TBA-2	76	1.2	2.3	BDL	2nd
6/12/2013	TBA-3	93	1.2	1.2	1	2nd
6/12/2013	TBA-4	145	2	3.2	2.5	2nd
7/12/2013	TBA-5	74	14	BDL	BDL	2nd
7/12/2013	TBA-6	66	91	BDL	BDL	2nd

AMBIENT AIR QUALITY ASSESSMENT FOR THE 2nd WEEK OF DECEMBER-2013
FROM (9/12/2013) - (14/12/2013) inclusive of 1st and 2nd Batch Sampling

Date	Location	PM 10	PM 2.5	NO2	Sox	Batch
9/12/2013	TCA-1	82	0	BDL	BDL	1st
9/12/2013	TCA-2	77	40	BDL	BDL	1st
9/12/2013	TBA-1	93	99	2.3	1.2	1st
10/12/2013	TBA-2	77	97	1.2	BDL	1st
10/12/2013	TBA-3	98	1.6	2	1.1	1st
10/12/2013	TBA-4	151	1.2	3.2	1	1st
11/12/2013	TBA-5	80	12	BDL	BDL	1st
11/12/2013	TBA-6	65	83	1.2	BDL	1st
12/12/2013	TCA-1	56	0	BDL	BDL	2nd
12/12/2013	TCA-2	54	38	BDL	BDL	2nd
12/12/2013	TBA-1	82	101	1	BDL	2nd
13/12/2013	TBA-2	83	46	2.5	BDL	2nd
13/12/2013	TBA-3	89	1.8	2.2	1	2nd
13/12/2013	TBA-4	144	1.5	2.6	1.2	2nd
14/12/2013	TBA-5	71	9	1	BDL	2nd
14/12/2013	TBA-6	60	85	BDL	BDL	2nd

DATA COLLECTED BY
NIT-T & PSG-CAS

AMBIENT AIR QUALITY ASSESSMENT FOR THE 3rd WEEK OF DECEMBER-2013 FROM (16/12/2013) - (21/12/2013) inclusive of 1st and 2nd Batch Sampling

Date	Location	PM 10	PM 2.5	NO2	Sox	Batch
16/12/2013	TCA-1	69	0	BDL	BDL	1st
16/12/2013	TCA-2	65	40	BDL	BDL	1st
16/12/2013	TBA-1	90	104	1.7	1	1st
17/12/2013	TBA-2	74	97	1.8	BDL	1st
17/12/2013	TBA-3	87	2.5	2.4	BDL	1st
17/12/2013	TBA-4	148	2.5	2.2	1	1st
18/12/2013	TBA-5	72	16	1.9	BDL	1st
18/12/2013	TBA-6	68	83	1	BDL	1st
19/12/2013	TCA-1	77	0	BDL	BDL	2nd
19/12/2013	TCA-2	76	39	BDL	BDL	2nd
19/12/2013	TBA-1	92	111	1.2	1.5	2nd
20/12/2013	TBA-2	80	101	1.5	BDL	2nd
20/12/2013	TBA-3	94	3	2.6	1.5	2nd
20/12/2013	TBA-4	151	1.8	2.4	BDL	2nd
21/12/2013	TBA-5	76	13	2	BDL	2nd
21/12/2013	TBA-6	71	88	1.5	BDL	2nd

AMBIENT AIR QUALITY ASSESSMENT FOR THE 4th WEEK OF DECEMBER-2013 FROM (23/12/2013) - (29/12/2013) inclusive of 1st and 2nd Batch Sampling

Date	Location	PM 10	PM 2.5	NO2	Sox	Batch
23/12/2013	TCA-1	82	0	BDL	BDL	1st
23/12/2013	TCA-2	79	40	BDL	BDL	1st
23/12/2013	TBA-1	88	116	1.8	BDL	1st
24/12/2013	TBA-2	82	91	1	BDL	1st
24/12/2013	TBA-3	97	1.4	2.5	2	1st
24/12/2013	TBA-4	147	3	3	2.5	1st
26/12/2013	TBA-5	79	11	1.5	BDL	1st
26/12/2013	TBA-6	75	90	BDL	BDL	1st
27/12/2013	TCA-1	61	0	BDL	BDL	2nd
27/12/2013	TCA-2	59	34	BDL	BDL	2nd
27/12/2013	TBA-1	85	99	2	1.5	2nd
28/12/2013	TBA-2	78	104	2.8	BDL	2nd
28/12/2013	TBA-3	92	1.5	2	1.9	2nd
28/12/2013	TBA-4	145	1.2	2.5	1	2nd
29/12/2013	TBA-5	74	14	BDL	BDL	2nd
29/12/2013	TBA-6	71	86	1.5	BDL	2nd

AMBIENT AIR QUALITY ASSESSMENT FOR THE 1st WEEK OF January-2014 FROM (31/1/2014) - (5/1/2014) inclusive of 1st and 2nd Batch Sampling

Date	Location	PM 10	PM 2.5	NO2	Sox	Batch
31/1/2014	TCA-1	63	0	BDL	BDL	1st
31/1/2014	TCA-2	61	37	BDL	BDL	1st
31/1/2014	TBA-1	87	126	1.2	1	1st
1/1/2014	TBA-2	77	95	2	BDL	1st
1/1/2014	TBA-3	87	2.8	2.2	BDL	1st
1/1/2014	TBA-4	146	1.2	3.2	1.2	1st
2/1/2014	TBA-5	69	9	2	BDL	1st
2/1/2014	TBA-6	64	98	1	BDL	1st
3/1/2014	TCA-1	72	0	BDL	BDL	2nd
3/1/2014	TCA-2	70	38	BDL	BDL	2nd
3/1/2014	TBA-1	95	129	2	BDL	2nd
4/1/2014	TBA-2	85	92	2.1	BDL	2nd
4/1/2014	TBA-3	91	2	2.8	1	2nd
4/1/2014	TBA-4	154	1	2.1	2	2nd
5/1/2014	TBA-5	73	13	1.2	BDL	2nd
5/1/2014	TBA-6	73	93	BDL	BDL	2nd

AMBIENT AIR QUALITY ASSESSMENT FOR THE 2nd WEEK OF January-2014 FROM (7/1/2014) - (12/1/2014) inclusive of 1st and 2nd Batch Sampling

Date	Location	PM 10	PM 2.5	NO2	Sox	Batch
7/1/2014	TCA-1	75	0	BDL	BDL	1st
7/1/2014	TCA-2	73	37	BDL	BDL	1st
7/1/2014	TBA-1	94	133	2.2	1.1	1st
8/1/2014	TBA-2	84	97	2.2	BDL	1st
8/1/2014	TBA-3	93	1.2	2.8	1.2	1st
8/1/2014	TBA-4	152	1.8	3	2.2	1st
9/1/2014	TBA-5	75	11	1	BDL	1st
9/1/2014	TBA-6	76	92	1.1	BDL	1st
10/1/2014	TCA-1	62	0	BDL	BDL	2nd
10/1/2014	TCA-2	59	40	BDL	BDL	2nd
10/1/2014	TBA-1	83	138	1.8	1	2nd
11/1/2014	TBA-2	73	90	1.2	BDL	2nd
11/1/2014	TBA-3	85	1.5	2.7	2	2nd
11/1/2014	TBA-4	149	1.6	2.2	1.8	2nd
12/1/2014	TBA-5	77	16	BDL	BDL	2nd
12/1/2014	TBA-6	62	94	1	BDL	2nd

AMBIENT AIR QUALITY ASSESSMENT FOR THE 3rd WEEK OF January-2014 FROM (13/1/2014) - (19/1/2014) inclusive of 1st and 2nd Batch Sampling

Date	Location	PM 10	PM 2.5	NO2	Sox	Batch
13/1/2014	TCA-1	65	0	BDL	BDL	1st
13/1/2014	TCA-2	63	43	BDL	BDL	1st
13/1/2014	TBA-1	87	149	1.8	BDL	1st
15/1/2014	TBA-2	77	99	1.4	BDL	1st
15/1/2014	TBA-3	83	2.5	2	1	1st
15/1/2014	TBA-4	146	3	2.4	1.8	1st
16/1/2014	TBA-5	65	21	1.8	BDL	1st
16/1/2014	TBA-6	66	87	BDL	BDL	1st
17/1/2014	TCA-1	69	0	BDL	BDL	2nd
17/1/2014	TCA-2	66	38	BDL	BDL	2nd
17/1/2014	TBA-1	90	136	2.5	1.5	2nd
18/1/2014	TBA-2	76	111	1.6	BDL	2nd
18/1/2014	TBA-3	86	1.8	2.3	1	2nd
18/1/2014	TBA-4	145	2.5	2.6	2.5	2nd
19/1/2014	TBA-5	73	18	1	BDL	2nd
19/1/2014	TBA-6	69	89	1.5	BDL	2nd

AMBIENT AIR QUALITY ASSESSMENT FOR THE 4th WEEK OF January-2014 FROM (20/1/2014) - (27/1/2014) inclusive of 1st and 2nd Batch Sampling

Date	Location	PM 10	PM 2.5	NO2	Sox	Batch
20/1/2014	TCA-1	71	0	BDL	BDL	1st
20/1/2014	TCA-2	69	42	BDL	BDL	1st
20/1/2014	TBA-1	93	141	1.5	2	1st
21/1/2014	TBA-2	83	119	2.5	BDL	1st
21/1/2014	TBA-3	90	3	2.2	1	1st
21/1/2014	TBA-4	152	1.5	2.5	1.5	1st
22/1/2014	TBA-5	72	15	BDL	BDL	1st
22/1/2014	TBA-6	72	92	2	BDL	1st
24/1/2014	TCA-1	58	0	BDL	BDL	2nd
24/1/2014	TCA-2	56	35	BDL	BDL	2nd
24/1/2014	TBA-1	86	139	1	1.9	2nd
25/1/2014	TBA-2	86	110	1	BDL	2nd
25/1/2014	TBA-3	88	1.2	2	1.8	2nd
25/1/2014	TBA-4	153	1.4	3	1	2nd
27/1/2014	TBA-5	68	17	1	BDL	2nd
27/1/2014	TBA-6	63	97	1.9	BDL	2nd

AMBIENT AIR QUALITY ASSESSMENT FOR THE 1st WEEK OF FEBURARY-2014 FROM (1/2/2014) - (6/2/2014) inclusive of 1st and 2nd Batch Sampling

Date	Location	PM 10	PM 2.5	NO2	Sox	Batch
1/2/2014	TCA-1	64	0	BDL	BDL	1st
1/2/2014	TCA-2	60	32	BDL	BDL	1st
1/2/2014	TBA-1	87	131	2.2	BDL	1st
2/2/2014	TBA-2	77	116	2.8	BDL	1st
2/2/2014	TBA-3	91	1.5	1.6	1.2	1st
2/2/2014	TBA-4	146	3	2.8	BDL	1st
3/2/2014	TBA-5	73	18	BDL	BDL	1st
3/2/2014	TBA-6	59	94	BDL	BDL	1st
4/2/2014	TCA-1	67	0	BDL	BDL	2nd
4/2/2014	TCA-2	65	40	BDL	BDL	2nd
4/2/2014	TBA-1	89	143	2.1	1	2nd
5/2/2014	TBA-2	79	111	1.8	BDL	2nd
5/2/2014	TBA-3	87	3	2.1	1.6	2nd
5/2/2014	TBA-4	148	1.5	2.2	1	2nd
6/2/2014	TBA-5	69	15	1.2	BDL	2nd
6/2/2014	TBA-6	67	87	1	BDL	2nd

AMBIENT AIR QUALITY ASSESSMENT FOR THE 2nd WEEK OF FEBURARY-2014 FROM (9/2/2014) - (14/2/2014) inclusive of 1st and 2nd Batch Sampling

Date	Location	PM 10	PM 2.5	NO2	Sox	Batch
9/2/2014	TCA-1	77	0	BDL	BDL	1st
9/2/2014	TCA-2	75	46	BDL	BDL	1st
9/2/2014	TBA-1	92	138	1	1.2	1st
10/2/2014	TBA-2	82	104	1.2	BDL	1st
10/2/2014	TBA-3	94	1.2	2.2	1.4	1st
10/2/2014	TBA-4	151	2.8	2.7	2.3	1st
11/2/2014	TBA-5	76	17	1.6	BDL	1st
11/2/2014	TBA-6	69	91	1.2	BDL	1st
12/2/2014	TCA-1	83	0	BDL	BDL	2nd
12/2/2014	TCA-2	78	40	BDL	BDL	2nd
12/2/2014	TBA-1	91	147	1.2	2	2nd
13/2/2014	TBA-2	81	85	1.7	BDL	2nd
13/2/2014	TBA-3	96	2.8	2.6	BDL	2nd
13/2/2014	TBA-4	149	1.2	2.8	1	2nd
14/2/2014	TBA-5	78	16	1.2	BDL	2nd
14/2/2014	TBA-6	70	94	2	BDL	2nd

AMBIENT AIR QUALITY ASSESSMENT FOR THE 3rd WEEK OF FEBURARY-2014 FROM (16/2/2014) - (21/2/2014) inclusive of 1st and 2nd Batch Sampling

Date	Location	PM 10	PM 2.5	NO2	Sox	Batch
16/2/2014	TCA-1	61	0	BDL	BDL	1st
16/2/2014	TCA-2	59	48	BDL	BDL	1st
16/2/2014	TBA-1	87	150	1	1	1st
17/2/2014	TBA-2	77	96	1	BDL	1st
17/2/2014	TBA-3	92	3	2.4	1	1st
17/2/2014	TBA-4	146	1.8	3	1.7	1st
18/2/2014	TBA-5	79	21	1	BDL	1st
18/2/2014	TBA-6	65	92	1	BDL	1st
19/2/2014	TCA-1	60	0	BDL	BDL	2nd
19/2/2014	TCA-2	58	31	BDL	BDL	2nd
19/2/2014	TBA-1	83	149	BDL	BDL	2nd
20/2/2014	TBA-2	73	102	2.3	BDL	2nd
20/2/2014	TBA-3	98	1.8	1.2	2	2nd
20/2/2014	TBA-4	142	3	3.3	1.2	2nd
21/2/2014	TBA-5	82	10	BDL	BDL	2nd
21/2/2014	TBA-6	63	96	BDL	BDL	2nd

AMBIENT AIR QUALITY ASSESSMENT FOR THE 4TH WEEK OF FEBURARY-2014 FROM (16/2/2014) - (21/2/2014) inclusive of 1st and 2nd Batch Sampling

Date	Location	PM 10	PM 2.5	NO2	Sox	Batch
23/2/2014	TCA-1	67	0	BDL	BDL	1st
23/2/2014	TCA-2	51	43	BDL	BDL	1st
23/2/2014	TBA-1	88	149	2.5	1	1st
24/2/2014	TBA-2	72	94	1	BDL	1st
24/2/2014	TBA-3	91	32	2	BDL	1st
24/2/2014	TBA-4	141	1.5	2	1.8	1st
25/2/2014	TBA-5	75	8	1.5	BDL	1st
25/2/2014	TBA-6	66	95	1	BDL	1st
26/2/2014	TCA-1	55	0	BDL	BDL	2nd
26/2/2014	TCA-2	51	37	BDL	BDL	2nd
26/2/2014	TBA-1	89	151	1	1.8	2nd
27/2/2014	TBA-2	75	112	BDL	BDL	2nd
27/2/2014	TBA-3	95	1.5	2.5	1.5	2nd
27/2/2014	TBA-4	143	3.2	1	2	2nd
28/2/2014	TBA-5	77	10	1.5	BDL	2nd
28/2/2014	TBA-6	68	91	1.8	BDL	2nd

Dr. S.T. Ramesh, Ph.D.
Associate Professor
Department of Civil Engineering
National Institute of Technology
Tiruchirappalli - 620 015.

Dr. V.K. Melkani , I.F.S.,
Principal Chief Conservator of Forests and Chief Wildlife Warden

O/o Principal Chief Conservator of Forests (Head of Forest Force)
Panagal Maaligai, Saidapet,
Chennai-600 015.

D.O. Letter No. WL5/30163/2014 dated 10-02-2015

Sub: Tamil Nadu State – TNPWD – WRD – Kattalai Barrage across Cauvery River – Restore the efficiency of Barrage – Quarrying the sand shoals in U/S and D/S – Over an area of 196.25 Hectares in Cauvery River – Trichy District –Conservation Plan – Approved – Regarding.

Ref: 1) Director, Government of India, Ministry of Environment and Forests & Climate Change, Impact Assessment Division, New Delhi letter F. No. J-11015/64/2013.IA-II (M) dated 17-09-2014.

2) Executive Engineer, PWD / WRD, River Conservancy Division, Trichy letter No. 804/M/F118/2014/D3 dated 23-09-2014.

3) Principal Chief Conservator of Forests and Chief Wildlife Warden letter No. WL5/30163/2014 dated 15-12-2014.

4) Conservator of Forests, Trichy Circle letter No. 11027/2014/D dated 22-01-2015.

* * * *

In pursuance of the Government of India, Ministry of Environment, Forests and Climate Change, New Delhi letter first cited the Conservation Plan along with Budget and implementation schedule (fauna) for the proposed project of quarrying of River sand in U/S and D/S at Katalai Bed Regulator in River Cauvery over an extent of 196.25 Hectares in SF. No. 293 of Sriramasamuthiram Village and in SF No. 288 of Silaipillayaputtur Village in Trichy District, prepared by Environment Impact Assessment Project Consultant, (EIA) Prof A. Alagappa Moses, Associate Professor and Head, Principal Investigator and Chief Consultant, Post Graduate and Research Department of Environmental Sciences, Bishop Heber College (Autonomous), Trichy and submitted by Executive Engineer, PWD / WRO, R.C. Division, Trichy is approved subject to following conditions:-

1) Design and location of the nest shall be got approved from the Conservator of Forests, Trichy Circle before placing.

2) Funds for People's Biodiversity Register may be provided to Tamil Nadu Biodiversity Board and People's Biodiversity Register may be prepared in consultation with Tamil Nadu Biodiversity Board as therein Rule No. 22 (8), (9) and (10) of the Biological Diversity Rule, 2004.

3) Project authority shall ensure no deviation from the Conservation Plan.

4) Compliance report shall be submitted by the Project authority to the Conservator of Forests, Trichy Circle within one year from the approval of the project.

Yours faithfully,

Encl: Conservation Plan – 2 Nos

Principal Chief Conservator of Forests
and Chief Wildlife Warden

To

Thiru. B. Kalaiselvan, B.E.,
The Executive Engineer, PWD/WRD,
River Conservancy Division,
Trichy – 620 001.

Copy to the Conservator of Forests, Trichy Circle, Trichy for necessary action.

Copy to the Divisional Forest Officer, Trichy Division, Trichy for necessary action.

Copy to Member Secretary, Tamil Nadu Biodiversity Board, Office of Principal Chief Conservator of Forests and Chief Project Director, JFM Building, Velachery, Chennai for information.

CONSERVATION PLAN ALONG WITH BUDGET AND IMPLEMENTATION SCHEDULE

FOR FAUNA

For

THE PROPOSED PROJECT OF QUARRYING OF RIVER SAND IN U/S AND D/S OF KATTALAI BED REGULATOR IN RIVER CAUVERY OVER AN EXTENT OF 196.25 HA. IN TRICHY DISTRICT OF TAMIL NADU

Project Proponent

The Public Works Department

Water Resources Organization

River Conservancy Division

Cauvery Basin, Trichy

EIA Project Consultant

Prof. A. Alagappa Moses

Associate Professor and Head

Principal Investigator and Chief Consultant

POST GRADUATE AND RESEARCH DEPARTMENT OF ENVIRONMENTAL SCIENCES

Bishop Heber College (Autonomous)

(Nationally Reaccredited at the A$^+$ Level by NAAC)

(Recognized as "College with Potential for Excellence" by UGC)

Tiruchirappalli, Tamilnadu – 620 017

DEPARTMENT OF ENVIRONMENTAL SCIENCES
BISHOP HEBER COLLEGE (An Autonomous Institution affiliated to Bharathidasan University)
(Nationally Reaccredited at the A+ Level by NAAC)
(Recognized by UGC as "College with Potential for Excellence")
Tiruchirapalli - 620 017. Tamilnadu

Prof. A. Alagappa Moses
Associate Professor and Head / Co-ordinator, UBHPEA, INDIA

CERTIFICATE

This is to certify that the **Conservation Plan Along with Budget and Implementation Schedule for Fauna for "The Proposed Project of Quarrying of River Sand in U/S and D/S of Kattalai Bed Regulator in Cauvery River over an extent of 196.25 HA"** in Tiruchirappalli District of Tamil Nadu has been proposed by the Post Graduate and Research Department of Environmental Sciences, Bishop Heber College (Autonomous), Tiruchirappalli – 620 017, Tamil Nadu.

Principal Investigator & Consultant

Prof. A. Alagappa Moses
Empanelled Functional Area Expert
Ecology and Biodiversity
(Accredited by NABET for **Category A** Projects - vide AC MOM III, 2010 New Delhi and MOM 98, November 5, 2014)

Email: aalagappamoses@gmail.com
Mobile: +919842490051

1.PROJECT OUT LINE

The Public Works Department has applied for quarrying the sand shoals over an extent of 196.25 Ha in SF No. 293 of Sriramasamuthiram Village and in SF No. 288 of Silaipillayaputtur Village in Trichy District of Tamil Nadu. The land belongs to Public Works Department which is classified as Government River Poramboke land. The precise area communication for this area was issued vide Letter R.C.No.291/ Kanimam/2013 dated 18-06-2013 by the State Government.

As per EIA Notification dated 14th September 2006 as amended on 01-12-2009, this proposed sand quarry project fall in category 'A' and therefore this project requires Environmental Clearance from Ministry of Environment and Forests.

The Public Works Department prepares the Environmental Impact Assessment (EIA) report as per TOR issued vide Lr.No. J-11015/343/2013-IA.II(M),GOI, Ministry of Environment and Forests, IA Division, in its 14th meeting of the Reconstituted Expert Appraisal Committee for Environmental Appraisal of Mining projects constituted under EIA notification 2006 dated 22.11.2013., to carry out the Rapid Environmental Impact Assessment (REIA) studies spanning one season Viz December 2013 to February 2014 , so as to delineate Environmental Management Plans (EMP) to mitigate any adverse impacts due to mining activity caused by the quarrying operation to remove the sand shoals in upstream and downstream of Kattalai old bed regulator in Karur District with the project cost of 6.66 Crores.

It is proposed to mine the sand shoals of quantity 15,01,247 m^3 for three years. The method of mining is semi mechanized using earth work excavators, shallow mining on shoals, and directly loading into consumer vehicles.

2. Brief description about the project and site for which conservation plan is develop

The Proposed project is mining of sand on riverbed. The extent of the project is 196.25 Ha spreads in Sriramasamuthram and Silaipillayarpithur villages in Thottiyam taluk of Tiruchirappalli district. Since, the project area is more than 50 Ha, it is classified under category 'A' as per schedule of EIA Notification , 2006 for which prior Environmental Clearances needs to be obtained from MoEF.

Type of project:

This project is to desilt the shoals which have accumulated over a long period of time, these accumulated shoals has not been removed due to cost

constrained. This accumulated shoals has decreased the functional efficiency of the barrage. It is a project based sand quarry proposal where, the Public Works Department in the State is a single agency to operate the sand quarry.

The Expert Appraisal Committee has recommended to conduct a systematic base line study with reference to Flora and Fauna within the Core and Buffer zone of the project area to an extent of 10 Km, radius. Realising the significance of the scientific study and its values, the PWD has taken up the task as a moral/social responsibility to avert the adverse impact on the environment due to the sand quarrying operations and then to manage the factors to avoid the ill effects on the environment.

The proposed Environmental Management Plan (EMP) would certainly ensure the protection and conservation of the animals that belong to schedule I & II that have been recorded in the study area of 10 Km. radius. The beneficiaries of the EMP are the general public, the Forest Department and the Public Works Department.

3.Status of the schedule I animal and fauna

Status of Fauna

The Kattalai Bed Regulator in River Cauvery, Mayanur and its surroundings supports diverse faunal elements falling under a wide array of status and schedule as prescribed by The Wildlife (Protection) Act (1972). The schedule I animals recorded in the study area of 10KM radius is as follows:

Table – 1 List of Fauna falling under Schedule I & II of The Wildlife (Protection) Act, 1972

Sl. No.	Common Name	Scientific Name	Status	WPA Schedule
		BIRDS		
1	Peafowl	Pavo cristatus	Common, Resident Breeding	Schedule I
2	Osprey	Pandion haliaetus	Rare	Schedule I
		REPTILES		
3	Monitor Lizard	Varanus bengalensis	Common	Schedule I
		MAMMALS		
4	Bonnet Macaque	Macaca radiate	Lower risk	Schedule I
5	Jackal	Canis aureus	Lower risk	Schedule I
6	Grey mongoose	Herpestes edwardsii	Lower risk	Schedule I

These species require enhancement of habitat features such as platforms / abandoned poles / trees / dead tree trunks for perching, roosting and nesting. Many of the species recorded are also water dependent.

These species would also require both protection of water bodies and preventing the sources and causes of pollution. This may involve developing a conservation plan for safeguarding both species and their habitat in and around the quarry area. Thus it is imperative to prepare a conservation strategy incorporating measures for conservation of fauna.

4. Status of the habitat

The forest type of the project area is the Southern Tropical Dry Mixed Deciduos forest 5A/C3 (Tamilnadu Forest Department, Forest working plan – 2010 - 2020)

5. Objectives of the Proposal

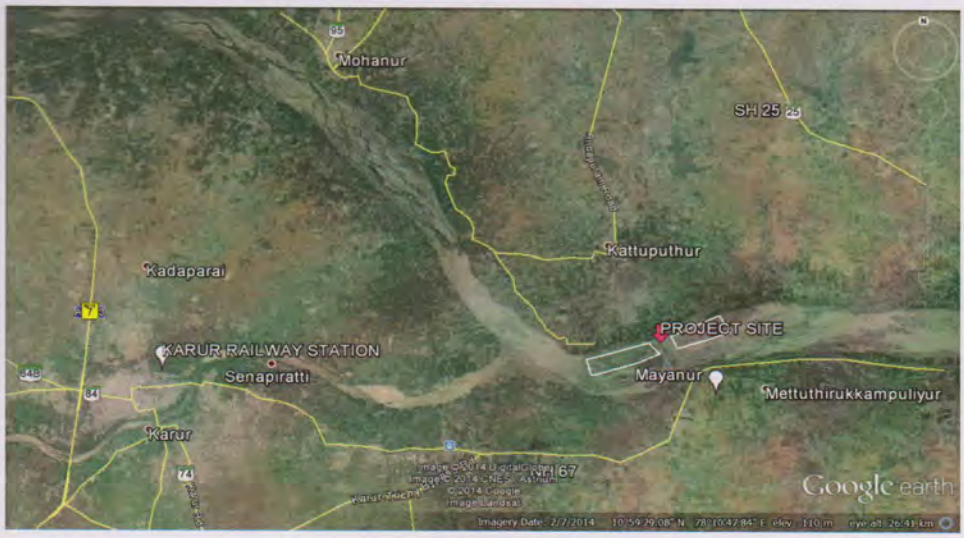
a. Conservation of wild animals which are listed in the schedules under Wildlife Protection Act, 1972.

b. Creating awareness among the stakeholders of the villages to protect wild animals which are listed in the schedules under Wildlife Protection Act, 1972 and conservation of the habitat

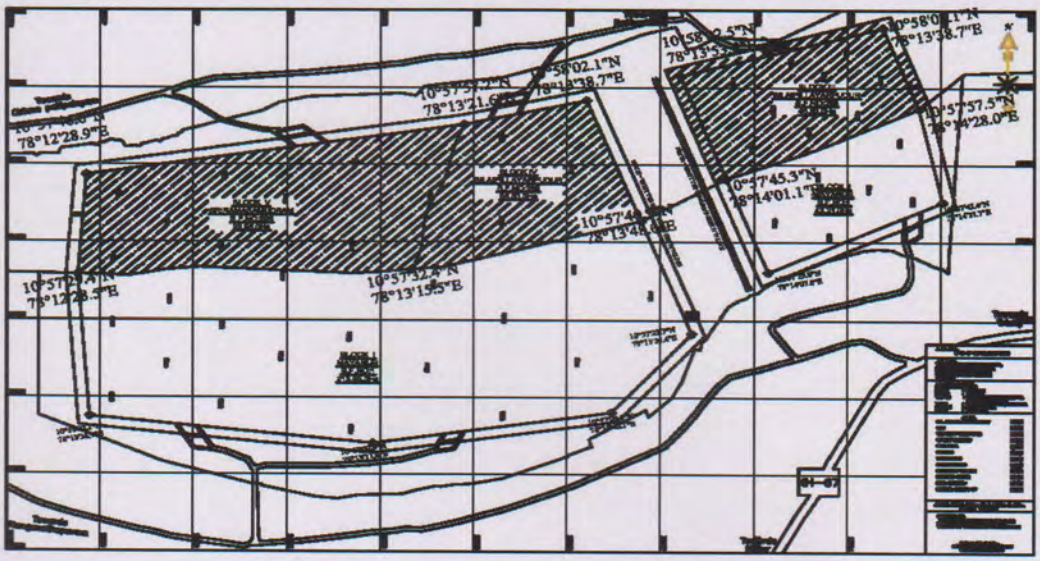
6. Maps clearly demarcating the mining sites core and buffer zone with co-ordinates with GPS co-ordinates

The mining lease area falls in Sriramasamuthiram and Silaipillayaputtur villages of Thottiyam taluk in Trichy district of Tamil Nadu state. The location is in the upstream and downstream of Kattalai bed regulator in Cauvery river at mile 85/0 from Mettur reservoir project. The project (core) area lies in the coordinates of

	Latitude	**Longitude**
NW	- 10°57'46.0"N	78°12'28.9" E
NE	- 10°58'02.1"N	78°13'38.7" E
SW	- 10°57'29.4"N	78°12'28.5" E
SE	- 10°57'57.5"N	78°14'28.0"E



Google Map showing location of the project



Plan showing GPS co-ordinates of the project site

7. Core Zone:

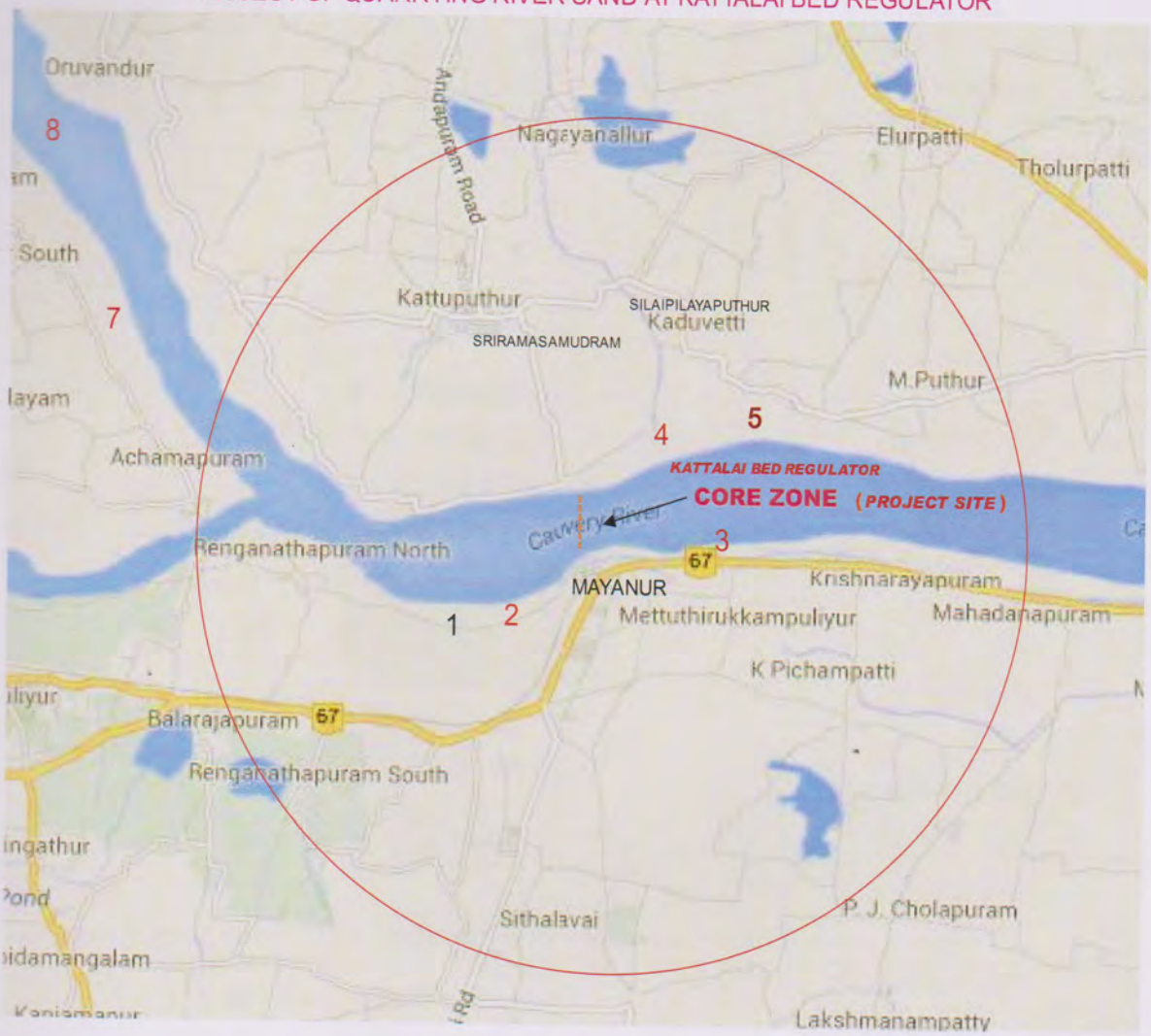
Core zone is the project site which is located in Sriramasamuthiram and Silaipillayaputtur villages of Thottiyam taluk in Trichy district of Tamil Nadu state. The location is in the upstream and downstream of Kattalai bed regulator in Cauvery river. The terrain of the area is plain and sandy. The entire area is characterized by Scrubby elements. The project site is river poramboke land maintained by Public Works Department.

Buffer Zone:

Buffer zone is the zone, 10KM radius measured from the boundaries of the project boundary in every direction. The buffer zone area falls in Thottiyam Tehsil in Trichy District and Krishnarayapuram Tehsil in Karur District.

STUDY AREA MAP OF OF 10KM RADIUS

PROJECT OF QUARRYING RIVER SAND AT KATTALAI BED REGULATOR



LEGEND

1: KATTALAI RF

2: MAYANUR RF

3: SITHALAVAI RF

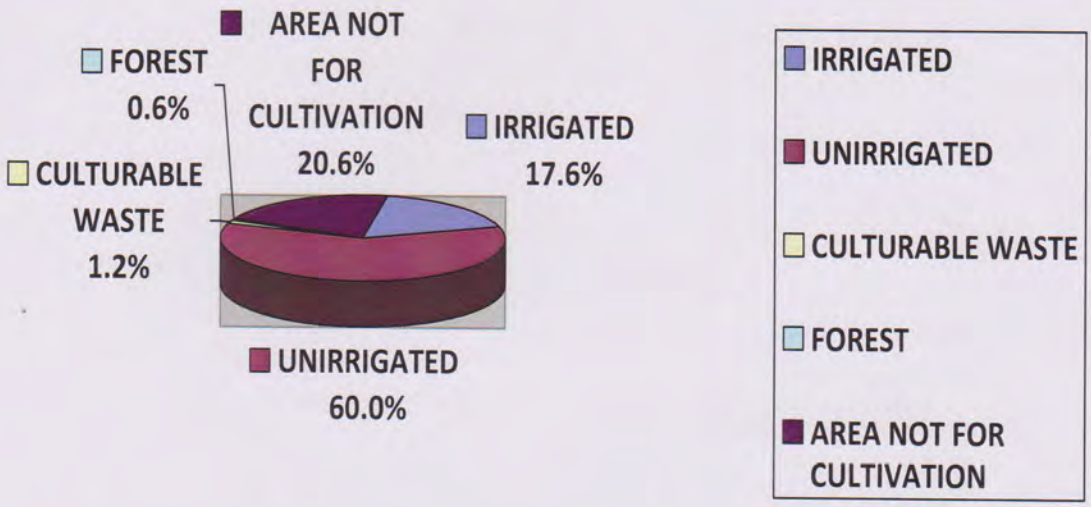
4: SILAIPILAYAPUTHUR

5: NATHAM RF

There were 26 villages, two town panchayat (Krishnarayapuram and P.J. Cholapuram) in Karur District and one town Panchayat (Kattuputhur) in Trichy District.

Land Use Area

Sl. No	NAME	IRRIGATED	UNIRRIGATED	CULTURABLE WASTE	FOREST	AREA NOT FOR CULTIVATION	TOTAL AREA IN HA
1	Thottiyam	3720.958	11498.593	232.695	73.900	4172.608	19698.755
2	Krishnarayapuram	1798.295	7345.030	139.095	122.16	2296.665	11701.245
Total		5519.253	18843.623	371.79	196.06	6469.273	31400



The study area covered in buffer zone is classified as follows:

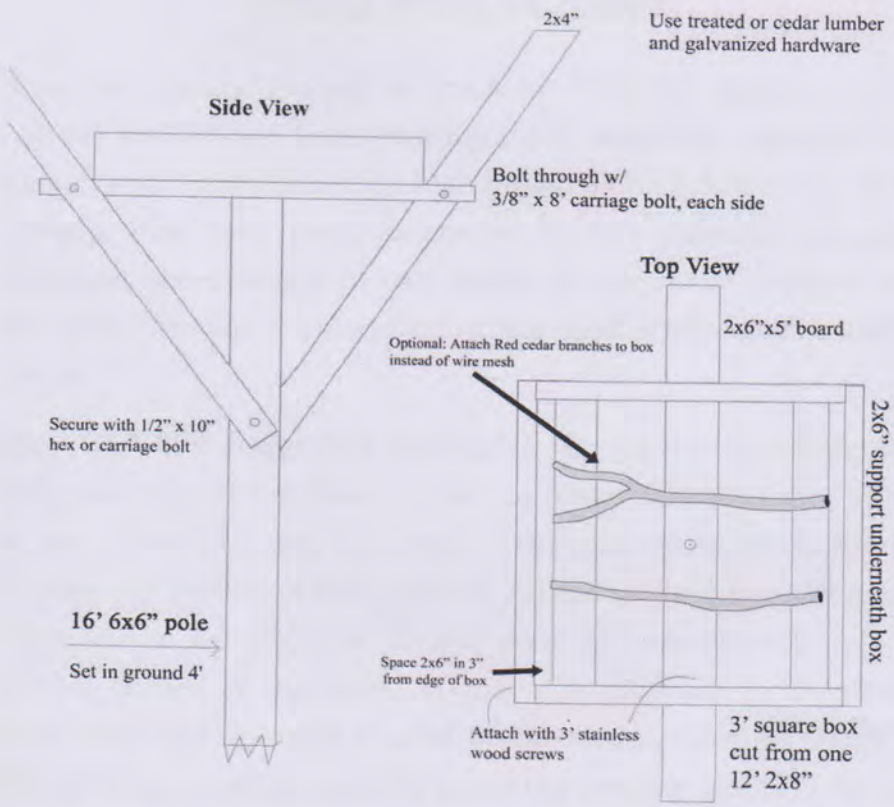
Sl. No.	Buffer Zone	Aquatic/ Terrestrial
1	Sriramasamudram	Terrestrial
2	Mayanur	RF
3	Mettuthirukkampuliyur	Terrestrial
4	Silapilliyarpudur	RF
5	Unniyur	Terrestrial
6	Nagayanallur	Terrestrial
7	Kattuputhur	Terrestrial
8	Thottiyapatty	Terrestrial
9	Sithalavai	Terrestrial
10	Veerarackiyam	Aquatic
11	Natham	RF
12	Kattalai	RF
13	Sithalavai	RF
14	Thirumukkoodalur	Aquatic

The villagers and the school children will be motivated to involve in preparing the People's Biodiversity Register (PBR) which will be of a great resource to the Biodiversity Authority. The PBR methodology manual developed by Dr. Madhav Gadgil (2005) will be used for this task as well as for Ecosystem goods and services, Landscape and biodiversity and Ecosystem monitoring. The whole exercise of PBR would be good awareness education to the people. For this, Funds may be provided to Forest Department.

b) Construction of Nest arrangement for Osprey and Peafowl

Construction of Nest arrangements will be done in Public Works Department river poramboke land in study area. The works will be executed by this department under the guidance of the Department of Environmental Science, Bishop Heber College, Trichy. The Osprey nest and Pea Fowl nest will be well protected by providing trenches and appropriate fencing around the nesting structures.

1. Osprey Nest Construction and Placement



Breeding populations of Ospreys are widespread in water sheds. Nesting activity is associated with aquatic habitats such as rivers, lakes and reservoirs.

Breeding populations of Ospreys are widespread in water sheds. Nesting activity is associated with aquatic habitats such as rivers, lakes and reservoirs. Open topped live or dead trees are preferred natural nest sites throughout the range (Zarn, 1974). Ospreys select a nest site that provides maximum visibility of the surrounding terrain (Odegan, 1977). Nests are frequently located over water or at the water edges (Van Daele, 1980).

2.Pea Fowl Nesting Box Construction

Nesting Boxes for Peafowl

Peahens nest on the ground in the wild. They will scrape out a shallow depression in the ground and line it with grass or whatever vegetation available. The nest is concealed under brush, in high grass, along a fence row, and etc. the nest box designs that have been suggested in this management plan is an outcome of several observations in the habits of free range peafowl on various habitats. The peahens use a second story hay and straw maw many times to hide their nests.

The first nest box design is a triangular shaped nesting platform made of wood. Rough sawn 1 inch x 6 inch lumber to make this platform. The sides of the platform are 32 inches long. The front of the platform is 46 inches long. The boards that form the bottom of the platform extend beyond the side boards by 6 inches on each side of the platform. This is done so that the entire platform can be secured in a corner of the shelter. Once the platform is constructed and secured in a corner, hay or straw is used to line the platform to create the nest. Peahens will not carry nesting material up to the nesting platform on their own. Placing a porcelain goose egg to act as a fake, nest egg to encourage the hens to use the nest.

(Hopkins' Alternative Livestock Website : www.hopkinslivestock.com).

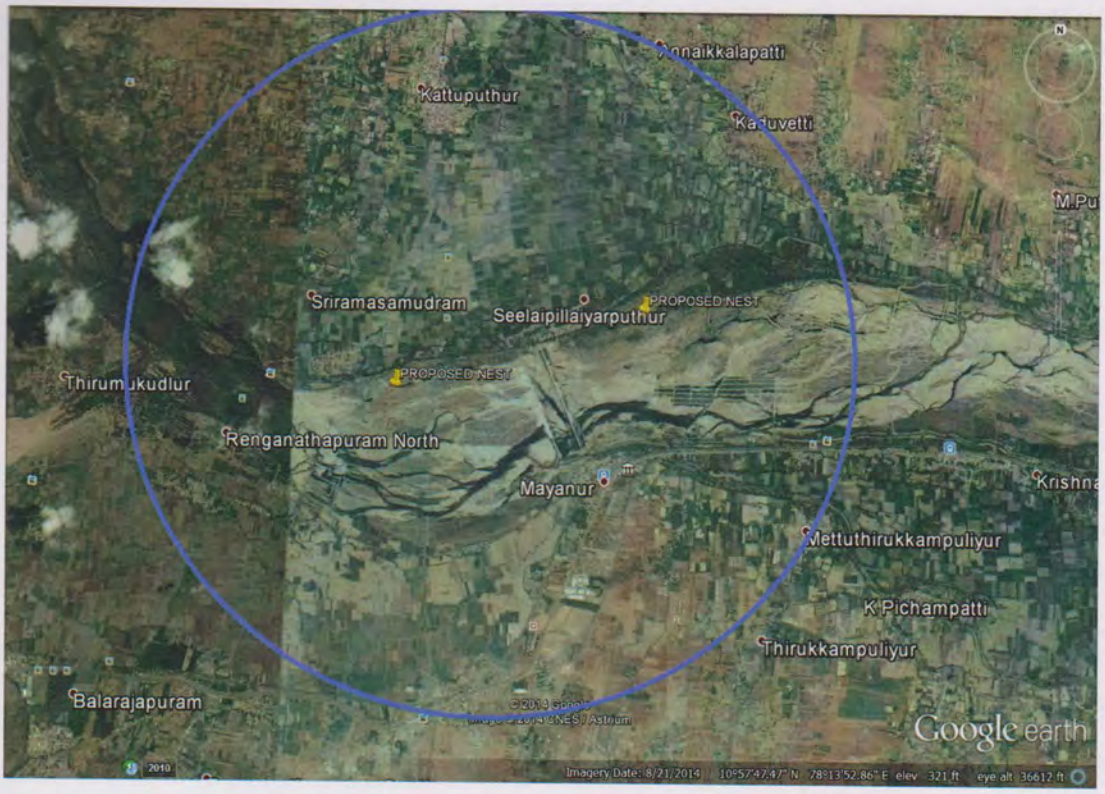


Fig-7 PROPOSED NEST ARRANGEMENTS IN STUDY AREA

9. Strategies

9.1. Conservation of wildlife fauna

Erection of eco-friendly nesting structures for the Osprey and Pea Fowl

9.2. Awareness programme for Conservation of wildlife fauna

Awareness Programmes for the Conservation of Jackal, Monitor Lizard and Mongoose

i. Preparation of Hand bills, posters etc.
ii. Rally
iii. Street Play
iv. Meetings
v. Film shows

Programmes will be organized in villages falling under the core and buffer zone of KBR by the Forest Department. For this awareness programme, funds may be provided to the Forest Department by the Public Works Department.

Sl.No	Strategies for conservation				Budget in Rupees
	Proposal	Description	Implementing Agency	Funding Agency	
1.	**Conservation of wildlife Fauna**				
	a) Osprey nest	Providing Nest arrangements in two places of PWD river poramboke land @125000/each including cost of trenches, fencing arrangements, maintenance and other amenities etc.,	PWD	PWD	250000
	b) Pea Fowl nest	Providing Nest arrangements in two places of PWD river poramboke land @ 50000/each including cost of trenches, fencing arrangements, maintenance and other amenities etc.,	PWD	PWD	100000
2.	**Awareness Programme**				
	a) Peoples Bio-diversity Register	PBR is the great resource which will be developed by involving school children. The PBR methodology manual developed by Dr.Madhar Gadgil (2005) will be used.	Forest Department (Funds may be provided to the Forest Department and work will be executed by the Department of Environmental Sciences, Bishop Heber College, Trichy (Consent letter enclosed)	PWD	500000
	b) Awareness programme to forest fringe villages for conservation of Jackal, Monitor Lizard and Mangoose.	10 villages 4 programmes once in three months @ Rs. 30000/-	Forest Department	PWD	360000
		Total			**1210000**

BISHOP HEBER COLLEGE (AUTONOMOUS) ★ DEPT. OF ENVIRONMENTAL SCIENCES ★ TRICHY-17

A. ALAGAPPA MOSES
Associate Professor & Head
PG & Research Department of Environmental Sciences
Bishop Heber College (Autonomous)
Tiruchirappalli - 620 017.

11. Implementation

Funding sources: PWD

Implementing Agency: Forest Department, Public Works Department and the Department of Environmental Sciences, Bishop Heber College, Tiruchirappalli.

12. Monitoring

- Public Works Department
- Forest Department
- Department of Environmental Sciences, Bishop Heber College, Tiruchirappalli.

A. ALAGAPPA MOSES
Associate Professor & Head
PG & Research Department of
Environmental Sciences
Bishop Heber College (Autonomous)
Tiruchirappalli - 620 017.

7.1.15
Executive Engineer, PWD, WRO
R.C. Division, Trichy -1.

(Countersigned)
Bde

COUNTERSIGNED
Conservator of Forests,
Tiruchirappalli Circle
Tiruchirappalli

22/1/15

DISTRICT FOREST OFFICER
TIRUCHIRAPPALLI 1.

/Counter signed/
APPROVED subject to condition issued in Ref. No. WL-5/30163/2014 dt 10.2.15

12/2
10/2/15
Principal Chief Conservator of Forests
and
Chief Wildlife Warden
Chennai-600 015.

DEPT. OF ENVIRONMENTAL SCIENCES
BISHOP HEBER COLLEGE (AUTONOMOUS), TRICHY-17.

DEPARTMENT OF ENVIRONMENTAL SCIENCES
BISHOP HEBER COLLEGE (An Autonomous Institution affiliated to Bharathidasan University)
(Nationally Reaccredited at the A+ Level by NAAC)
(Recognized by UGC as "College with Potential for Excellence")
Tiruchirapalli - 620 017. Tamilnadu

Prof. A. Alagappa Moses
Associate Professor and Head / Co-ordinator, UBHPEA, INDIA

LETTER OF CONSENT

We do express our consent to do the **People's Biodiversity Register (PBR)** in the project area of 10Km radius towards Conservation of Biodiversity as given in the Conservation Plan for the "Project of Quarrying the sand in Upstream and Downstream of Kattalai Bed Regulator in River Cauvery over an extent of 196.25 Ha. in Tiruchirappalli District".

Principal Investigator &
Chief Consultant
A. ALAGAPPA MOSES
Associate Professor & Head
PG & Research Department of
Environmental Sciences
Bishop Heber College (Autonomous)
Tiruchirappalli - 620 017.

DEPT. OF ENVIRONMENTAL SCIENCES * BISHOP HEBER COLLEGE (AUTONOMOUS) * TRICHY-17.

UNITED BOARD FOR CHRISTIAN HIGHER EDUCATION IN ASIA Since 1922
Phone: 0431 – 2770136/2770158/2770058/2772345 Fax: 0431 – 2770293
Mobile: +919842490051 Email: aalagappamoses@gmail.com
Web: www.bhc.edu.in / www.cuea.in / www.heberenvironment.com
UNITED BOARD HEBER PARTNERSHIP FOR ENVIRONMENTAL ACTION (UBHPEA)
A joint Environmental initiative of United Board for Christian Higher Education in Asia, Hong Kong and Bishop Heber College, India

DEPARTMENT OF ENVIRONMENTAL SCIENCES
BISHOP HEBER COLLEGE (An Autonomous Institution affiliated to Bharathidasan University)
(Nationally Reaccredited at the A+ Level by NAAC)
(Recognized by UGC as "College with Potential for Excellence")
Tiruchirapalli - 620 017. Tamilnadu

Prof. A. Alagappa Moses
Associate Professor and Head / Co-ordinator, UBHPEA, INDIA

CERTIFICATE

This is to certify that the **Rapid Environmental Impact Assessment of Flora and Fauna** study for **"The Proposed Project of Quarrying of River Sand in U/S and D/S of Kattalai Bed Regulator in Cauvery River over an extent of 196.25 ha. in Tiruchirappalli District of Tamilnadu"** was carried out by the Post Graduate and Research Department of Environmental Sciences, Bishop Heber College (Autonomous), Tiruchirappalli – 620 017, Tamil Nadu during the month of December 2013 - February 2014

Principal Investigator & Consultant

A. ALAGAPPA MOSES
Associate Professor & Head
PG & Research Department of Environmental Sciences
Bishop Heber College,(Autonomous)
Tiruchirappalli - 620 017.

Prof. A. Alagappa Moses
Empanelled Functional Area Expert
Ecology and Biodiversity
(Accredited by NABET for Category A Projects - vide AC MOM III, 2010 New Delhi and MOM 98, November 5, 2014)

Email: aalagappamoses@gmail.com
Mobile: +919842490051

1.0 Introduction

The demands of an ever – increasing human population have jolted us into the realization that our environment is precious, finite, and deteriorating. This realization came upon us at the very time great numbers of people were experiencing tremendous benefits from our technologies, which have often resulted in significant losses to the natural environment. The environment is composed of non-living and living factors forming a network of inter-relationships that are easily disturbed by people. Within the larger challenge of sustainable development lies the even greater challenge of the requirement of environmentally sound equitable economic growth.

Conservation, protection and preservation of the environment have been the cornerstone of the Indian ethos, culture and traditions. It has been enshrined in our constitution also, which is one of the first in the world to recognize the importance of environmental conservation. As the constitution provides the framework for creating a welfare State, it is incumbent on the authorities that the finite natural resources of the country be optimally utilized without adversely affecting the health of the people or the environment.

2.0 The Project

The Public Works Department is initiating to open new sand quarries in River Cauvery and Coleroon. This department is operating the sand quarries in a systematic and scientific manner. It is our moral/social responsibility to avert the adverse impact on the environment due to the sand quarrying operations. Hence, it is essential to monitor the environment impact due to these sand quarries. As a prelude Public Works Department is intending to collect the base line data with reference to Flora and Fauna in Kattalai Bed Regulator - Sand Quarry, Karur and then to manage the factors to avoid the ill effects on the environment.

2.1 Objectives:

1. To carry out a systematic baseline survey of Flora and Fauna around 10 km radius of the study area.
2. To list the plants and animals present in the study area as per the classifications of MOEF,
3. To identify the impacts of the proposed expansion activities on the plants and animals,
4. To evaluate the impacts of the proposed action, and to propose Environmental Management Plan.

2.2 Scope of the work

1) The study is required to be carried out as part of EIA study as per the guidelines of the Ministry of Environment and Forests, Govt. of India and State Level Environmental Impact Assessment Authority:
2) The study should be based on the systematic field survey and secondary data (One season).
3) The study should cover the following:

2.2.1 FLORA

i) Area should be divided as core zone and buffer zone
ii) Listing of all species (scientific and local names) found in the study area - 10 km. Radius.
iii) Listing of species as per the following classifications:
(1) Agricultural crops
(2) Commercial crops
(3) Plantation
(4) Natural vegetation
(5) Grass lands
(6) Endangered species
(7) Endemic species
(8) Others
iv) Based on the above findings Impacts of the proposed expansion.
v) Environmental Management plans to improve existing status of flora in the area.

2.2.2 FAUNA

a) Core and Buffer zone divisions
b) Listing of all species in the study area of 10 km radius around the study area
c) Schedule for each species as per the Wild Life (Protection) Act, 1972 and as amended subsequently should also be furnished.
d) Zoological and local name of the species should be furnished
e) Listing of species should be classified as:
i) Endangered species
ii) Endemic species
iii) Migratory species
iv) Details of aquatic fauna
b) Presence of endangered and endemic species should be supplemented by density.

Based on the above findings, impacts of proposed expansion should also be assessed.

3.0 BIOLOGICAL ENVIRONMENT ASSESSMENT - FLORA & FAUNA

A habitat or an area comprises of different kinds of plants and animals within its boundary. The distribution of flora and fauna in the given area represents the Biological portion of the environment that includes, what is present in the study area, its value, its response to impacts, description of community uniqueness, the dominant species, and an evaluation of rare or endangered species.

The above studies were carried out using the standard methods proposed by John G. Rau and David C. Wooten 1980.

3.1 ECOLOGY

The detailed ecological assessment of the study area has been carried out with the following objectives:

- Identification of flora and fauna and their biodiversity within the study area
- Preparation of checklist of species which also include endangered, endemic and protected (both floral and faunal categories)
- Evaluation of impact of proposed project on flora and fauna of the area.

3.2 Study Area: Kattalai Bed Regulator - Sand Quarry, Karur Sand Quarry

The Flora and Fauna assessment has been carried out in the Kattalai Bed Regulator - Sand Quarry, Karur Sand Quarry situated in Thottiyam taluk.

The study area has been divided into core zone and buffer zone. The details of the field monitoring stations are given in Table 1

The flora and fauna studies were carried out in 10 study sites representing the entire study area of 10 km radius around the proposed site.

Table 1 Details of Monitoring Stations – Flora and Fauna

S. No.	Core Zone	Aquatic/ Terrestrial
1	KBR- Sand Quarry site	Aquatic
2	Sriramasamudram	Terrestrial
3	Mayanur	RF
4	Mettuthirukkampuliyur	Terrestrial
5	Silapilliyarpudur	RF

S. No.	Buffer Zone	Aquatic/ Terrestrial
7	Unniyur	Terrestrial
8	Nagayanallur	Terrestrial
9	Kattuputhur	Terrestrial
10	Thottiyapatty	Terrestrial
11	Sithalavai	Terrestrial
12	Veerarackiyam	Aquatic
13	Natham	RF
14	Kattalai	RF
15	Thirumukkoodalur	Aquatic

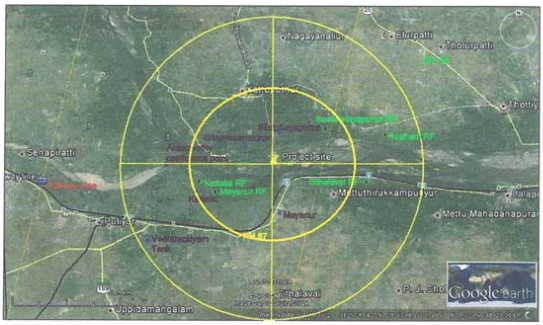


Figure 1 Kattalai Bed Regulator – Sand Quarry - Study Area showing RF & Tank

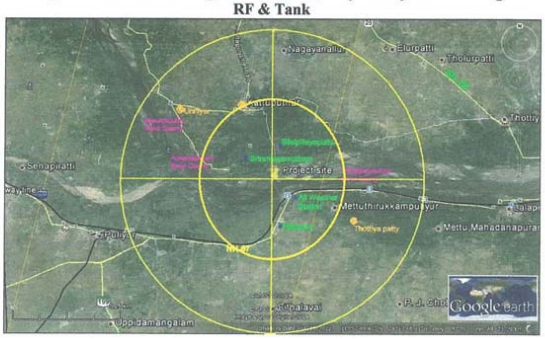


Figure 2 Kattalai Bed Regulator – Sand Quarry - Study Area showing Terrestrial and Aquatic Habitats

4.0 Methodology

4.1 Flora

The Study of flora involved intensive sample survey of vegetation in the project site and other locations applying standard methods (e.g., Greig-Smith 1983, Caustan 1988). To examine the trees and shrubs, quadrats of 25 x 25 m and for herbs

2 x 2 m were laid. In each of the larger quadrats (i) Species (ii) their number, and (iii) Girth at Breast Height (GBH, were measured. (Chaturvedi and Khanna, 1982).

Abundance, relative abundance, density and relative density of each species and species diversity and evenness for each of the Zones were calculated using the numerical data (Ludwig and Reynolds 1988, Lande 1996, Smith and Wilson 1996).

The standard statistical analysis, the normal frequency diagram and distribution of plants in the study area were analyzed using the procedures of Raunkiaer, 1934. The analysis carried out as per Raunkiaer's law of frequency classes provides the information on the Heterogeneity and Homogeneity of plants and its pattern of distribution in the study area.

The species of vegetation found in each station were identified and listed according to their families, both in dicotyledons and monocotyledons of the plant kingdom. The plant species were classified as per the classifications of "Bentham and Hooker" and identified by using Gambles book on "Flora of Madras Presidency" and Mathew's book on "Flora of the Tamil Nadu Carnatic".

4.2 Fauna

Both direct and indirect observation methods were used to survey the fauna. Visual encounter (search) method was employed to record vertebrate species. Additionally survey of relevant literature was also done to consolidate the list of vertebrate fauna distributed in the area (Smith 1933-43, Ali and Ripley 1983, Daniel 1983, Prater 1993, Murthy and Chandrasekhar1988).

Since birds may be considered as indicators for monitoring and understanding human impacts on ecological systems (Lawton, 1996) attempt was made to gather quantitative data on the group by.

Point Count (South Wood): Point count is the most commonly used survey technique in determining the composition and abundance. The survey is done on 360° arch around a fixed survey station and a radius of 20 metres was covered.

Roadside counts(South Wood): The team travelled within and between the sites on a slow phase in which all the fauna sighted were recorded and identified.

Indirect evidence: Pug marks, track marks were also recorded and later identified. (South Wood, 1978).

Information from local people: Information was also collected from the local people and were recorded in the list.

Based on the Wildlife Protection Act, 1972 (WPA 1972, Anonyomous. 1991, Upadhyay 1995, Chaturvedi and Chaturvedi 1996) species were short-listed as Schedule II or I and considered herein as endangered species. Species listed in Ghosh (1994) are considered as Indian Red List species.

4.3 Plankton

The studies on the aquatic biological environment were carried out in selected sites.

The analysis of Phyto and Zoo-plankton was carried out as per the procedures of APHA 1987. The concentrated samples were analyzed by Sedge wick rafter cell for plankton density and diversity, Shannon Weaver Index calculations were applied to find out the diversity of Plankton groups and the status of water body (Welch, 1964; Prema Michael, 1972).

5.0 Description about the Study sites

5.1 Core Zone

The study was carried out in the core zone including the proposed quarry site. The terrain of the area is plain and sandy. The entire area is characterized by Scrubby elements and the type of forest is Tropical Scrub forest with riparian vegetation. It is chiefly characterized by *Acacias* and *Prosopis* community representing the Umbrella thorn forest.

5.2 Buffer Zone

The terrain of the area is plain with mixed scrub vegetation. The entire area is characterized by Scrubby elements and the type of forest is Tropical Scrub forest. It is chiefly characterized by *Acacias* and *Prosopis* community representing the Umbrella thorn forest.

6.0 ASSESSMENT OF FLORA IN THE STUDY AREA

6.1 PLANT COMMUNITIES

The Vegetation present within a defined area is termed as a plant community. This is determined by the nature of the dominant species it contains. By the term dominant species or dominance it is understood that species of plants having same life and growth, forms predominating in an area.

The distribution of vegetation at different sites, its density, dominance, frequency, Importance Value Index (IVI), economic importance, and medicinal uses were studied and the results are given in the following sections. Based on the study carried out in core and buffer zones 134 plant species were recorded in the study area

Table – 2 Flora in Mayanur Study Area - Core and Buffer Zone

S. No.	Plant Name	Family	Habit	Common name
1	*Abutilon crispum*	Malvaceae	Herb	Hairy Indian Mallow
2	*Abutilon indicum*	Malvaceae	Herb	Indian Mallow
3	*Acacia auriculiformis*	Mimosaceae	Tree	Earleaf Acacia
4	*Acacia nilotica*	Mimosaceae	Tree	Babool
5	*Acalypha indica*	Euphorbiaceae	Herb	Indian Copperleaf
6	*Achyranthes aspera*	Amaranthaceae	Herb	Prickly Chaff Flower
7	*Aerva lanata*	Amaranthaceae	Herb	Mountain Knot Grass
8	*Ailanthus excelsa*	Simaroubaceae	Tree	Match box
9	*Albizia lebbeck*	Mimosaceae	Tree	Siris Tree
10	*Altrernanthera sessilis*	Amaranthaceae	Herb	Sessile Joy weed
11	*Ammania baccifera*	Lythraceae	Shrub	Blistering Ammannia
12	*Argemon maxicana*	Papavaraceae	Herb	Mexican Prickly Poppy
13	*Aristida adscensionis*	Poaceae	Herb/Grass	Six-weeks three-awn
14	*Aristida funiculate*	Poaceae	Herb/Grass	Aristida
15	*Arundo donax*	Poaceae	Herb/Grass	Giant Cane
16	*Azadirachta indica*	Meliaceae	Tree	Neem
17	*Bambusa arundinacea*	Poaceae	Tree grass	Indian Thorny Bamboo
18	*Boerhavia diffusa*	Nyctaginacea	Herb	Hog weed
19	*Bombax malabarica*	Malvaceae	Tree	Cotton tree
20	*Borassus flabellifer*	Palmaceae	Tree	Palmyra Palm
21	*Brassica juncea*	Coniferaceae	Herb	Mustard
22	*Calotropis gigantea*	Apocyanaceae	Shrub	Crown Flower
23	*Calotropis procera*	Apocyanaceae	Shrub	Rubber Bush
24	*Cardiospermum halicacabum*	Sapindaceae	Climber	Balloon Vine
25	*Casuarina equisetifolia*	Casuarinaceae	Tree	Whistling Pine
26	*Chloris barbata*	Poaceae	Herb/Grass	Slimspike windmill grass
27	*Chrysopogon aciculatus*	Poaceae	Herb/Grass	Golden Beardgrass
28	*Cissampelos pareira*	Menispermaceae	Climber	Velvet Leaf
29	*Cissus quadrangularis*	Vitaceae	Vine	Veldt Grape or Devil's Backbone
30	*Citrullus colocynthis*	Cucurbitaceae	Creeper	Kumutty/ bitter cucumber
31	*Clitoria ternaceae*	Fabaceae		
32	*Coccinea indica*	Cucurbitaceae	Climber	Ivy gourd, little gourd
33	*Cocos nucifera*	Palmaceae	Tree	Coconut
34	*Crotolaria juncea*	Fabaceae	Herb	
35	*Crotolaria retusa*	Fabaceae	Herb	Rattleweed
36	*Croton bonplandianum*	Euphorbiaceae	Herb	Ban Tulsi
37	*Cucumis maderaspatanus*	Cucurbitaceae	Climber	Madras Pea Pumpkin
38	*Cucurbita maxima*	Cucurbitaceae	Creeper	Pumpkin
39	*Cyanodon dactylon*	Poaceae	Herb/Grass	Bermuda Grass
40	*Cyclea burmanni*	Menispermaceae	Climber	Shining Moon-Seed
41	*Cyclea peltata*	Menispermaceae	Climber	Raj Patha
42	*Cyperus alternifolius*	Cyperaceae	Herb	Umbrella Palm/papyrus
43	*Cyperus pangorei*	Cyperaceae	Sedge Grass	Papyrus Sedge

43	*Cyperus pangorei*	Cyperaceae	Sedge Grass	Papyrus Sedge
44	*Cyphostemma auriculatum*	Vitaceae	Climber	Eared Cyphostemma
45	*Delonix elata*	Caesalpiniaceae	Tree	White Gulmohar
46	*Datura metal*	Solanaceae	Herb	Downy thorn apple
47	*Derris scandens*	Fabaceae	Climber	Jewel Vine
48	*Eclipta alba*	Asteraceae	Herb	False daisy
49	*Diplocyclos palmatus*	Cucurbitaceae	Climber	Lollipop Climber
50	*Eichhornia crassipes*	Pontederiaceae	Herb	Water Hyacinth
51	*Erythrina indica*	Fabaceae	Tree	Indian Coral Tree
52	*Eucalyptus globules*	Myrtaceae	Tree	Blue Gum
53	*Eucalyptus terreticornis*	Myrtaceae	Tree	Forest Red Gum
54	*Euphorbia antiquorum*	Euphorbiaceae	Shrub	Triangular Spurge
55	*Euphorbia hirta*	Euphorbiaceae	Herb	Asthma Weed
56	*Ficus benghalensis*	Moraceae	Tree	Banyan Tree
57	*Ficus carica*	Moraceae	Tree	Weeping Fig
58	*Gliricidia sepium*	Fabaceae	Tree	Tree Of Iron
59	*Ficus religiosa*	Moraceae	Tree	Peepal
60	*Gossypium hirsutum*	Malvaceae	Shrub	Upland cotton or Mexican cotton
61	*Hibiscus vitifolius*	Malvaceae	Herb	Grape Leaved Mallow
62	*Ipomoea carnea*	Convolvulaceae	Herb	Bush Morning Glory
63	*Ipomoea staphylina*	Convolvulaceae	Climber	Onan kodi
64	*Jatropha curcas*	*Euphorbiaceae*	*Herb*	
65	*Jatropha glandulifera*	*Euphorbiaceae*	*Herb*	Glandular Jatropha
66	*Justicia simplex*	Acanthaceae	Herb	water-willow and shrimp plant
67	*Lantana camara*	Verbenaceae	Herb	Spanish Flag or West Indian Lantana
68	*Lawsonia inermis*	Lythraceae	Shrub	Henna
69	*Leonotis nepetifolia*	Lamiaceae	Herb	Lion ear
70	*Leucas aspera*	Lamiaceae	Herb	Common Leucas/Thumbai
71	*Lippia nodiflora*	Verbenaceae	Herb	Frog fruit
72	*Leucaena leucocephala*	Mimosaceae	Tree	Suba
73	*Luffa aegyptiaca*	Cucurbitaceae	Climber	Sponge gourd
74	*Mangifera indica*	Anacardiaceae	Tree	Mango
75	*Melothria maderaspatana*	Cucurbitaceae	Climber	Madras pea pumpkin
76	*Mollugo alsinoides*	Aizoaceae	Herb	Slender Carpetweed
77	*Momordica charantia*	Cucurbitaceae	Climber	Bitter guard
78	*Morinda tinctoria*	Rubiaceae	Shrub	Indian Mulberry
79	*Moringa oleifera*	Moringaceae	Tree	Drumstick
80	*Mucuna monosperma*	Fabaceae	Climber	Negro Bean
81	*Murraya koenijii*	Rutaceae	Shrub	Curry leave
82	*Musa paradisiacal*	Musaceae	Tree	Banana
83	*Nerium oleander*	Apocyanaceae	Shrub	Oleander
84	*Ocimum canum*	Lamiaceae	Herb	Hoary Basil
85	*Ocimum sanctum*	Lamiaceae	Herb	Holy Basil
86	*Oryza sativum*	Poaceae	Herb	Paddy

87	*Oxystelma esculentum*	Asclepiadaceae	Climber	Rosy Milkweed Vine
88	*Parthenium hysterophorus*	Asteraceae	Herb	Carrot Grass
89	*Passiflora foetida*	Passifloraceae	Climber	Love in a Mist
90	*Pedalium murex*	Pedaliaceae	Herb	Large Caltrops
91	*Phoenix dactylifera*	Arecaceae	Tree	Date palm
92	*Phoenix pusilla*	Arecaceae	Tree	Ceylon Date Palm
93	*Phoenix sylvestris*	Arecaceae	Tree	Wild Date Palm
94	*Phyllanthus amaras*	Euphorbiaceae	Herb	stonebreaker or seed-under-leaf
95	*Phyllanthus reticulates*	Euphorbiaceae	Herb	Black-Honey Shrub
96	*Pithecelobium dulce*	Mimosaceae	Tree	Madras Thorn
97	*Polyalthia longifolia*	Annonaceae	Tree	Ashoka
98	*Pongamia glabra*	Fabaceae	Tree	Pongam Tree
99	*Prosopis juliflora*	Mimosaceae	Tree	Algaroba
100	*Psidium guazava*	Myrtacee	Tree	Guava
101	*Punica granatum*	Punicaceae	Shrub	Pomegranate
102	*Ricinus communis*	Euphorbiaceae	Shrub	Castor
103	*Saccharum officinarum*	Poaceae	Herb	Sugar cane
104	*Saccharum spontaneum*	Poaceae	Herb/Grass	Kans Grass
105	*Sesamum indicum*	Pedaliaceae	Herb	Black sesame
106	*Semecarpus anacardium*	Anacardiaceae	Tree	Indian marking nut tree
107	*Sida acuta*	Malvaceae	Herb	Common Wire weed
108	*Sida cordifolia*	Malvaceae	Herb	Heart-Leaf Sida
109	*Solanum melongina*	Solanaceae	Herb	Brinjal
110	*Solanum nigrum*	Solanaceae	Herb	Black Nightshade
111	*Solanum xanthocarpum*	Solanaceae	Herb	Thorny Nightshade
112	*Sorghum bicolor*	Poaceae	Herb	Sorghum/jower
113	*Stephania japonica*	Menispermaceae	Climber	Tape Vine
114	*Syzigium cumini*	Myrtaceae	Tree	Jamun
115	*Tamarindus indicus*	Fabaceae	Tree	Tamarind
116	*Tectona grandis*	Verbenaceae	Tree	Teak
117	*Terminalia arjuna*	Combretaceae	Tree	Arjun Tree
118	*Terminalia catappa*	Combretaceae	Tree	Indian Almond
119	*Thephrosia purpurea*	Fabaceae	Herb	Wild Indigo
120	*Thespesia populnea*	Malvaceae	Tree	Indian Tulip Tree
121	Thevetia neriifolia	Apocynaceae	Shrub	Yellow oleander
122	*Tinospora cordifolia*	Menispermaceae	Climber	Guduchi
123	*Tribulus terrestris*	Zygophyllaceae	Creeper	Puncture Vine
124	*Tridax procumbens*	Asteraceae	Herb	Tridax Daisy
125	*Typha angustifolia*	Cyperaceae	Herb	Lesser Indian Reed Mace
126	*Ventilago maderaspatana*	Rhamnaceae	Tree	Red Creeper
127	*Vernonia cinerea*	Asteraceae	Herb	Little Ironweed
128	*Vinca rosea*	Apocynaceae	Herb	Vinca
129	*Vitex negundo*	Verbenaceae	Shrub	Chaste Tree
130	*Wrightia tinctoria*	Apocynaceae	Tree	Dyers's oleander
131	*Zea mays*	Poaceae	Herb	Maize

132	*Ziziphus jujuba*	Rhamnaceae	Tree	Ber/ Indian plum
133	*Ziziphus mauritiana*	Rhamnaceae	Tree	Red date or Indian date
134	*Ziziphus oenoplea*	Rhamnaceae	Shrub	Jackal Jujube

6.2 Distribution of Vegetation in Core and Buffer Zone

The plant species were classified into Agricultural crops, commercial crops, plantation, natural vegetation, Endangered and endemic plants and medicinal plants. It was found that *Borassus flabellifer, Brassica juncea, Cocos nucifera, Gossypium hirsutum, Mangifera indica, Momordica charantia, Moringa oleifera, Phoenix dactylifera, Musa paradisiacal, Oryza sativum, Pithecelobium dulce, Psidium guazava, Punica granatum, Saccharum offcinarum, Sesamum indicum, Solanum melongina, Solanum nigrum, Sorghum bicolor, Tamarindus indicus,*and *Zea mays* were the cultivated plants in the core zone. None of these zones possess endangered and endemic plants. The details of natural vegetation and medicinal plants are given in Table - 3

Table -3 Distribution of Vegetation in the Core and Buffer Zone

Agricultural Crops	*Borassus flabellifer, Brassica juncea, Cocos nucifera, Gossypium hirsutum, Mangifera indica, Momordica charantia, Moringa oleifera, Phoenix dactylifera, Pithecelobium dulce, Psidium guazava, Punica granatum, Saccharum offcinarum, Sesamum indicum, Solanum melongina, Solanum nigrum, Sorghum bicolor, Tamarindus indicus, Zea mays.*
Commercial Crops	*Bambusa arundinacea, Cyperus alternifolius, Cyperus pangorei, Tectona grandis*
Plantation	*Casuarina equisetifolia, Eucalyptus globules, Eucalyptus terreticornis, Mangifera indica, Tamarindus indicus, Tectona grandis.*
Natural Vegetation	*Abutilon crispum, Abutilon indicum, Acacia auriculiformis, Acacia nilotica, Acalypha indica, Achyranthes aspera, Aerva lanata, Ailanthus excels, Albizia lebbeck, Altrernanthera sessilis, Ammania baccifera, Argemon maxicana, Aristida adscensionis, Aristida funiculata, Arundo donax, Azadirachta indica, Bambusa arundinacea, Boerhavia diffusa, Bombax malabarica, Borassus flabellifer, Calotropis gigantean, Calotropis procera, Cardiospermum halicacabum, Chloris barbata, Chrysopogon aciculatus, Cissampelos pareira, Cissus quadrangularis, Citrullus colocynthis, Clitoria ternaceae, Coccinea indica, Crotolaria juncea, Crotolaria retusa, Croton bonplandianum, Cucumis maderaspatanus, Cucurbita maxima, Cyanodon dactylon, Cyclea burmanni, Cyclea peltata, Cyperus alternifolius, Cyperus pangorei, Cyphostemma auriculatum, Delonix elata, Datura metal, Derris scandens, Eclipta alba, Diplocyclos palmatus, Eichhornia crassipes, Erythrina indica, Euphorbia antiquorum, Euphorbia hirta, Ficus benghalensis, Ficus carica, Gliricidia sepium, Ficus religiosa, Hibiscus vitifolius, Ipomoea carnea, Ipomoea staphylina, Jatropha curcas, Jatropha glandulifera, Justicia simplex, Lantana camara, Lawsonia inermis, Leonotis nepetifolia, Leucas aspera, Lippia nodiflora, Luffa aegyptiaca, Melothria*

	maderaspatana, Mollugo alsinoides, Morinda tinctoria, Mucuna monosperma, Nerium oleander, Ocimum canum, Ocimum sanctum, Oxystelma esculentum, Parthenium hysterophorus, Passiflora foetida, Pedalium murex, Phoenix dactylifera, Phoenix pusilla, Phoenix sylvestris, Phyllanthus amaras, Phyllanthus reticulates, Pithecelobium dulce, Polyalthia longifolia, Pongamia glabra, Prosopis juliflora, Ricinus communis, Saccharum spontaneum, Semecarpus anacardium, Sida acuta, Sida cordifolia, Solanum nigrum, Solanum xanthocarpum, Stephania japonica, Syzigium cumini, Tamarindus indicus, Terminalia arjuna, Terminalia catappa, Thephrosia purpurea, Thespesia populnea, Thevetia neriifolia, Tinospora cordifolia, Tribulus terrestris, Tridax procumbens, Typha angustifolia, Ventilago maderaspatana, Vernonia cinerea, Vinca rosea, Vitex negundo, Wrightia tinctoria, Ziziphus jujube, Ziziphus mauritiana, Ziziphus oenoplea.
Endangered Species	Nil
Endemic Species	Nil
Medicinal Plants	*Abutilon crispum, Abutilon indicum, Acacia nilotica, Acalypha indica, Achyranthes aspera, Aerva lanata, Altrernanthera sessilis, Ammania baccifera, Argemon maxicana, Azadirachta indica, Calotropis gigantea, Calotropis procera, Cardiospermum halicacabum, Cissampelos pareira, Cissus quadrangularis, Citrullus colocynthis, Coccinea indica, Crotolaria retusa, Croton bonplandianum, Cucumis maderaspatamus, Cyanodon dactylon, Cyclea burmanni, Cyclea peltata, Cyphostemma auriculatum, Datura metal, Derris scandens, Diplocyclos palmatus, Eucalyptus globules, Eucalyptus terreticornis, Euphorbia antiquorum, Euphorbia hirta, Ficus religiosa, Hibiscus vitifolius, Jatropha glandulifera, Justicia simplex, Lantana camara, Leucas aspera, Momordica charantia, Moringa oleifera, Mucuna monosperma, Nerium oleander, Ocimum canum, Oxystelma esculentum, Phoenix dactylifera, Phyllanthus amaras, Phyllanthus reticulates, Pongamia glabra, Psidium guazava, Punica granatum, Ricinus communis, Sesamum indicum, Sida acuta, Sida cordifolia, Solanum nigrum, Solanum xanthocarpum, Terminalia arjuna, Terminalia catappa, Thephrosia purpurea, Thespesia populnea, Tinospora cordifolia, Tribulus terrestris, Tridax procumbens, Vitex negundo.*

It was observed that the Flora, which includes herbs, shrubs and trees, were sparsely distributed in Core Zone.

Around the core zone the natural vegetation showed moderate growth. The core zone has herbaceous and shrubby vegetation which are scarcely distributed.

Among natural vegetation the common herbs such as *Croton*, common grasses like *Aristida adscensionis, Aristida funiculate, Arundo donax*, and *Cynodon dactylon*, were in the study areas. Less population of herbs were found in the core zone when compared to the buffer zone. Regarding shrubs, *Jatropha, Cassia*, and *Calotropis* were thriving well in drought hit areas.

6.3 Stratification

Stratification, or layering, is the occurrence of plants at different levels in a stand. The number of strata above the ground varies according to the kind of community. The study sites are characterized by scrub and climbers with low thorny trees and predominant xerophytic vegetation. The stratification in the study area is as follows:

Table – 4 Stratification

Stratum 1	Grasses	*Aristida adscensionis, Aristida funiculate, Arundo donax, Cynodon dactylon,Sacharum spontaneum, Typha angustifolia*
Stratum 2	Herbs	*Crotons parviflora, Tephrosia purpurea*
Stratum 3	Climbers	*Cissampelos pareira, Cissus quadrangularis, Citrullus colocynthis, Coccinea indica, Cyclea burmanni, Cyclea peltata, Derris scandens, Diplocyclos palmatus.*
Stratum 4	Shrubs	*Calotropis gigantea, Punica granatum, Ricinus communis*
Stratum 5	Trees	*Pongamia pinnata, Ficus sp,*

The above five strata were found in the entire field monitoring stations with equal representation. This shows the life – forms of the area and its amplitude. This also reflects the light intensity, temperature, and organic content of the soil and other factors of the area.

6.4 Periodicity (Phenology)

Periodicity refers to the regular seasonal occurrence of various processes such as photosynthesis, growth, pollination, flowering and ripening of fruits and seeds; and the manifestations of the processes, such as formation of leaves, elongation of shoots, appearance of flowers and dissemination of seeds. This results from the inherent genetic characteristics of each species, under the influence of a particular combination of the environmental conditions.

Periodicity means particularly the recurrence at certain times of these processes and their manifestations, while phenology refers more to the appearance of the manifestations at certain seasons of the year, rather than to their cyclic nature.

The characteristic species of the scrub forests and other dominant Herbs are in flowering and the trees at the onset of blooming are well adapted to the seasonal changes in the physical environment.

Periodicity and Phenology is perfectly maintained in the study area among the various species recorded during the survey.

6.5 Vitality (Vigor)

Vitality relates to the condition of plant and its capacity to complete the life cycle, while vigor refers more specifically to the state of health or development within a certain stage.

The studies carried out at different sites reveals that the plant species found in the area are well-developed plants, which regularly complete their life cycle.

6.6 Life Form

The life form in a broad sense is meant the characteristic vegetative appearance such as the size, shape, branching etc. The life form observed in the study area reveals that there are several communities ranging from open grassland, succulent perennials (*Euphorbia* sps), Climbers (*Cissampelos pareira, Cissus quadrangularis, Citrullus colocynthis, Coccinea indica,*) and small annual plants (*Abutilon crispum, Abutilon indicum, Acalypha indica, Achyranthes aspera, Aerva lanata, Altrernanthera sessilis*). The kinds of life forms, the number of individuals of each kind and their spacing gives a good structure to the community.

6.7 Habitat Forms

The habitat forms of the study area can be broadly classified into three classes in the order of their dominance.

(a) **Xerophytes**: *Euphorbia tirucalli, E. antiquorum*

(b) **Mesophytes**: *Pongamia pinnata, Thespisia populnea, Ficus sps*

(c) **Hydrophytes**: Eichhornia crassipes, *Typha angustifolia.*

The xerophytes group is classified on the basis of its ability to endure drought, plants belonging to the xerophytic group were not seen in the buffer zone. Mesophytes include sun and shade plants and Hydrophytes include submerged floating and amphibious plants.

7.0 Quanititative Characteristics

The quantitative characteristics are the one, which can be readily measured. It includes density of the plants, basal area dominance and frequency.

7.1 Relative Density and Dominance

The relative density and dominance values of different species found in the study are shows that the dominant plants of various sites have a high percentage value of density and dominance. These values are incorporated in calculating the Importance value Index.

7.2 Importance Value Index (IVI)

The Importance Value Index (IVI) is an expression used to summarize the plant data; it is desirable to use as many values as possible. The density of one species gives an idea of the number of plants in a stand; the dominance gives an idea of relative degree to which a species predominate a community by its numbers, size or biomass.

Species that exerts the greatest control or influence in the community are called 'dominants'. Plant dispersion over an area or within a community is another parameter; frequency is the measure of species in a series of plots.

Frequency expresses the proportion of equal size sample plots in which at least one plant of that species occur relative to the number of plots taken.

Thus the IVI of species is the combination of relative density, relative dominance and relative frequency values of a species added together to obtain a single expression. Importance value Index (IVI).

The Importance value allows quantitative comparison of each species in a stand with the other species in the stand, or allows comparison of the species in one stand with species in other stands.

Table – 5 Importance Value Index - Core Zone

S. No.	Plant Name	Frequency Class	Relative Abundance	Relative Dominance	Relative Frequency	Relative Density	IVI
1	*Abutilon crispum*	B	5.502	2.512	25	2.685	35.70
2	*Abutilon indicum*	B	3.429	2.053	25	0.987	31.45
3	*Acacia auriculiformis*	A	2.962	4.236	14	2.256	23.45
4	*Acacia nilotica*	B	3.976	4.058	25	1.788	34.82
5	*Acalypha indica*	B	5.622	2.165	40	4.678	52.47
6	*Achyranthes aspera*	B	4.738	1.989	40	3.136	49.86
7	*Aerva lanata*	A	2.496	1.718	14	2.558	20.77
8	*Altrernanthera sessilis*	B	4.761	2.028	38	3.015	47.80
9	*Ammania baccifera*	B	5.063	1.91	26	3.429	36.40
10	*Argemon maxicana*	B	3.103	3.172	34	3.284	43.56
11	*Aristida adscensionis*	B	5.685	3.339	40	2.043	51.07
12	*Aristida funiculata*	B	3.788	1.865	28	1.886	35.54
13	*Arundo donax*	C	5.917	3.381	55	1.811	66.11
14	*Azadirachta indica*	A	2.737	1.937	18	3.271	25.95
15	*Boerhavia diffusa*	C	4.086	2.846	58	3.515	68.45
16	*Borassus flabellifer*	A	2.107	2.062	20	1.956	26.13
17	*Calotropis gigantea*	B	4.039	2.092	33	2.944	42.08
18	*Cardiospermum halicacabum*	A	2.046	6.116	20	2.095	30.26
19	*Chloris barbata*	A	2.198	1.727	18	2.054	23.98

20	*Cissampelos pareira*	B	4.179	1.869	23	2.317	31.37
21	*Cissus quadrangularis*	C	6.587	7.176	60	2.961	76.72
22	*Citrullus colocynthis*	C	4.307	1.851	45	2.051	53.21
23	*Chrysopogon aciculatus*	A	2.063	2.522	14	1.943	20.53
24	*Clitoria ternaceae*	A	2.698	3.207	16	1.771	23.68
25	*Coccinea indica*	C	6.426	7.007	50	1.453	64.89
26	*Cocos nucifera*	B	4.782	4.332	35	1.93	46.04
27	*Crotolaria juncea*	B	5.842	3.296	40	2.176	51.31
28	*Crotolaria retusa*	B	5.843	2.263	23	4.962	36.07
29	*Croton bonplandianum*	C	3.481	3.295	56	2.593	65.37
30	*Cucumis maderaspatanus*	B	2.729	2.741	25	4.221	34.69
31	*Cyanodon dactylon*	A	1.589	1.848	13	3.706	20.14
32	*Cyclea burmanni*	B	3.428	1.877	30	2.237	37.54
33	*Cyclea peltata*	A	2.497	1.895	13	2.647	20.04
34	*Cyperus alternifolius*	A	2.166	3.169	15	1.922	22.26
35	*Datura metal*	B	4.478	1.909	37	2.177	45.56
36	*Derris scandens*	A	2.325	1.981	17	3.255	24.56
37	*Eclipta alba*	A	2.289	2.166	13	3.157	20.61
38	*Diplocyclos palmatus*	B	3.096	4.182	40	2.307	49.59
39	*Eichhornia crassipes*	B	5.132	2.254	36	5.819	49.21
40	*Eucalyptus terreticornis*	A	2.466	2.007	14	1.878	20.35
41	*Euphorbia antiquorum*	A	2.142	1.988	18	1.496	23.63
42	*Euphorbia hirta*	A	1.597	3.434	16	0.862	21.89
43	*Ficus benghalensis*	A	2.426	3.323	10	1.416	17.17
44	*Ficus carica*	C	5.537	4.327	57	1.35	68.21
45	*Ipomoea carnea*	C	4.142	3.534	48	2.589	58.27
46	*Ipomoea staphylina*	C	3.706	2.675	60	1.856	68.24
47	*Jatropha curcas*	D	9.242	1.194	70	2.922	83.36
48	*Jatropha glandulifera*	A	2.525	1.805	16	1.582	21.91
49	*Justicia simplex*	B	2.266	2.287	25	3.333	32.89
50	*Leonotis nepetifolia*	E	6.512	3.473	85	4.578	99.56
51	*Leucas aspera*	A	1.771	0.795	15	4.253	21.82
52	*Lippia nodiflora*	C	3.596	0.812	50	6.304	60.71
53	*Luffa aegyptiaca*	B	3.641	0.852	30	4.002	38.51
54	*Pedalium murex*	C	5.155	1.002	49	4.111	59.27
55	*Phoenix sylvestris*	B	2.147	1.701	38	4.703	46.55
56	*Phyllanthus reticulates*	C	6.819	1.523	60	1.298	69.64
57	*Saccharum spontaneum*	C	7.991	1.915	57	2.967	69.87
58	*Sida acuta*	A	2.688	1.016	20	1.781	25.49
59	*Thephrosia purpurea*	C	6.953	0.783	54	2.993	64.73

Table – 6 Importance Value Index – Buffer Zone

S. No.	Plant Name	Frequency Class	Relative Abundance	Relative Dominance	Relative Frequency	Relative Density	IVI
1	*Abutilon crispum*	A	1.676	0.635	15	2.234	19.55
2	*Abutilon indicum*	A	1.946	1.241	10	1.546	14.73
3	*Acacia auriculiformis*	A	1.702	1.723	9	1.934	14.36
4	*Acacia nilotica*	A	1.946	0.309	14	1.935	18.19
5	*Acalypha indica*	A	1.207	0.231	13	1.372	15.81
6	*Achyranthes aspera*	A	1.035	0.248	16	1.916	19.2
7	*Aerva lanata*	A	1.077	0.288	16	0.423	17.79
8	*Ailanthus excelsa*	A	1.592	0.438	13	1.692	16.72
9	*Albizia lebbeck*	A	1.583	1.137	11	1.224	14.94
10	*Altrernanthera sessilis*	A	1.625	0.459	10	4.146	16.23
11	*Ammania baccifera*	A	1.427	1.351	14	2.572	19.35
12	*Argemon maxicana*	A	1.124	0.462	16	1.994	19.58
13	*Aristida adscensionis*	B	3.389	0.219	30	0.446	34.05
14	*Aristida funiculata*	A	1.691	0.953	12	0.993	15.64
15	*Arundo donax*	A	1.946	0.231	13	2.546	17.72
16	*Azadirachta indica*	B	3.846	0.341	23	1.479	28.67
17	*Bambusa arundinacea*	A	1.771	1.407	20	1.264	24.44
18	*Boerhavia diffusa*	A	2.308	1.574	14	1.247	19.13
19	*Bombax malabarica*	B	3.924	1.278	40	2.707	47.91
20	*Borassus flabellifer*	A	1.416	1.33	9	0.951	12.7
21	*Brassica juncea*	C	4.545	1.616	52	1.387	59.55
22	*Calotropis gigantea*	B	3.727	1.262	24	2.383	31.37
23	*Calotropis procera*	C	4.371	2.136	48	2.531	57.04
24	*Cardiospermum halicacabum*	B	3.712	0.297	30	3.456	37.47
25	*Casuarina equisetifolia*	A	1.736	0.327	10	0.736	12.8
26	*Chloris barbata*	A	1.779	4.351	11	2.397	19.53
27	*Chrysopogon aciculatus*	A	1.856	1.962	17	1.487	22.31
28	*Cissampelos pareira*	A	1.846	0.326	13	1.379	16.55
29	*Cissus quadrangularis*	A	0.604	0.411	14	1.207	16.22
30	*Citrullus colocynthis*	A	0.623	0.344	12	0.889	13.86
31	*Clitoria ternaceae*	A	1.556	0.756	10	1.366	13.68
32	*Coccinea indica*	A	0.473	1.442	13	1.612	16.53
33	*Cocos nucifera*	A	1.691	0.242	7	4.398	13.33
34	*Crotolaria juncea*	B	3.369	4.992	38	2.029	48.39
35	*Crotolaria retusa*	A	1.048	1.531	20	4.657	27.24
36	*Croton bonplandianum*	A	1.408	0.498	14	3.142	19.05
37	*Cucumis maderaspatanus*	A	1.475	0.489	16	1.673	19.64
38	*Cucurbita maxima*	A	1.468	0.977	12	2.083	16.53
39	*Cyanodon dactylon*	A	1.109	1.347	11	1.358	14.81
40	*Cyclea burmanni*	A	1.357	1.318	12	1.61	16.29
41	*Cyclea peltata*	A	1.217	0.326	15	1.691	18.23
42	*Cyperus alternifolius*	B	3.036	1.339	34	2.593	40.97
43	*Cyperus pangorei*	A	1.741	0.327	16	0.735	18.8

44	*Cyphostemma auriculatum*	A	1.123	0.286	13	2.255	16.66
45	*Delonix elata*	A	0.636	0.216	14	1.314	16.17
46	*Datura metal*	B	3.103	0.397	24	0.932	28.43
47	*Derris scandens*	A	0.502	0.417	16	0.298	17.22
48	*Eclipta alba*	A	1.812	1.442	12	0.856	16.11
49	*Diplocyclos palmatus*	A	2.706	1.479	18	0.786	22.97
50	*Eichhornia crassipes*	C	4.253	0.3	57	2.025	63.58
51	*Erythrina indica*	A	1.094	0.242	14	1.292	16.63
52	*Eucalyptus globules*	A	1.253	0.223	13	2.358	16.83
53	*Eucalyptus terreticornis*	A	1.572	1.669	17	1.018	21.26
54	*Euphorbia antiquorum*	A	1.253	0.475	15	2.769	19.5
55	*Euphorbia hirta*	B	3.796	0.346	23	3.011	30.15
56	*Ficus benghalensis*	B	3.537	0.738	40	3.636	47.91
57	*Ficus carica*	B	4.207	0.344	36	2.741	43.29
58	*Ficus religiosa*	C	5.039	0.348	46	3.438	54.83
59	*Gliricidia sepium*	C	6.871	0.351	53	3.547	63.77
60	*Gossypium hirsutum*	A	1.827	1.761	15	4.139	22.73
61	*Hibiscus vitifolius*	A	0.797	0.344	14	0.724	15.87
62	*Ipomoea carnea*	B	3.658	0.687	20	2.435	26.78
63	*Ipomoea staphylina*	A	1.553	0.543	15	0.217	17.31
64	*Jatropha curcas*	A	1.362	0.317	12	0.429	14.11
65	*Jatropha glandulifera*	A	1.562	1.935	11	1.499	16
66	*Justicia simplex*	B	3.628	0.318	26	2.802	32.75
67	*Lantana camara*	A	1.362	0.392	12	1.024	14.78
68	*Lawsonia inermis*	B	2.496	0.3	47	2.509	52.31
69	*Leonotis nepetifolia*	B	3.716	0.316	40	3.631	47.66
70	*Leucas aspera*	A	1.347	0.346	12	1.046	14.74
71	*Lippia nodiflora*	A	1.123	0.309	11	1.142	13.57
72	*Leucaena leucocephala*	A	1.153	0.229	14	1.498	16.88
73	*Luffa aegyptiaca*	A	1.485	0.644	13	1.231	16.36
74	*Mangifera indica*	A	1.097	0.764	14	1.258	17.12
75	*Melothria maderaspatana*	A	1.699	0.347	20	1.582	23.63
76	*Mollugo alsinoides*	A	1.181	0.645	15	2.136	18.96
77	*Momordica charantia*	A	0.868	1.429	17	4.562	23.86
78	*Morinda tinctoria*	A	1.724	1.317	14	2.712	19.75
79	*Moringa oleifera*	A	0.478	1.868	16	1.234	19.58
80	*Mucuna monosperma*	A	1.452	1.244	13	0.332	16.03
81	*Murraya koenijii*	A	1.362	1.352	14	3.735	20.45
82	*Musa paradisiaca*	B	3.839	0.276	36	1.563	41.68
83	*Nerium oleander*	A	1.184	1.159	16	0.702	19.05
84	*Ocimum canum*	B	3.716	1.365	35	2.135	42.22
85	*Ocimum sanctum*	A	1.797	0.346	15	1.046	18.19
86	*Oryza sativum*	A	1.536	1.201	20	2.011	24.75
87	*Oxystelma esculentum*	A	1.357	0.318	17	1.636	20.31
88	*Parthenium hysterophorus*	B	5.207	0.344	27	1.756	34.31
89	*Passiflora foetida*	A	1.332	0.348	13	3.446	18.13

90	*Pedalium murex*	C	6.828	1.346	50	3.549	61.72
91	*Phoenix dactylifera*	C	5.629	1.344	46	4.139	57.11
92	*Phoenix pusilla*	B	2.707	1.641	37	2.724	44.07
93	*Phoenix sylvestris*	B	6.422	2.347	25	0.43	34.2
94	*Phyllanthus amaras*	A	1.694	1.636	13	2.247	18.58
95	*Phyllanthus reticulatus*	E	7.581	0.317	74	4.535	86.43
96	*Pithecelobium dulce*	A	1.632	1.937	14	1.499	19.07
97	*Polyalthia longifolia*	A	1.662	0.318	13	1.802	16.78
98	*Pongamia glabra*	A	1.362	0.436	16	1.024	18.82
99	*Prosopis juliflora*	B	3.341	0.384	18	1.509	23.23
100	*Psidium guazava*	C	5.716	0.316	48	3.631	57.66
101	*Punica granatum*	A	1.347	0.346	17	1.046	19.74
102	*Ricinus communis*	A	1.125	0.309	12	3.142	16.58
103	*Saccharum officinarum*	D	1.153	0.229	70	0.932	72.31
104	*Saccharum spontaneum*	A	1.455	0.644	18	1.238	21.34
105	*Sesamum indicum*	A	1.097	0.731	10	1.258	13.09
106	*Semecarpus anacardium*	B	4.699	0.347	22	3.586	30.63
107	*Sida acuta*	C	5.181	1.66	50	2.136	58.98
108	*Sida cordifolia*	A	1.839	1.829	10	1.868	15.54
109	*Solanum melongina*	B	3.723	1.317	13	2.712	20.75
110	*Solanum nigrum*	B	3.478	1.868	26	2.234	33.58
111	*Solanum xanthocarpum*	A	1.444	0.244	17	0.342	19.03
112	*Sorghum bicolor*	B	3.362	0.352	28	2.735	34.45
113	*Stephania japonica*	B	3.839	0.276	25	2.499	31.61
114	*Syzigium cumini*	A	1.219	1.833	11	0.732	14.78
115	*Tamarindus indicus*	A	1.716	1.365	18	1.133	22.21
116	*Tectona grandis*	A	1.797	1.346	12	1.046	16.19
117	*Terminalia arjuna*	C	4.536	2.169	48	5.011	59.72
118	*Terminalia catappa*	B	2.207	3.344	24	2.636	32.19
119	*Thephrosia purpurea*	B	2.682	1.348	30	5.387	39.42
120	*Thespesia populnea*	C	4.871	0.371	55	3.439	63.68
121	*Thevetia neriifolia*	C	4.826	2.327	45	1.466	53.62
122	*Tinospora cordifolia*	A	1.637	0.344	20	2.139	24.12
123	*Tribulus terrestris*	B	3.742	3.882	25	2.714	35.34
124	*Tridax procumbens*	A	0.422	0.347	14	0.435	15.2
125	*Typha angustifolia*	A	1.974	0.489	16	1.247	19.71
126	*Ventilago maderaspatana*	B	2.362	0.317	40	3.007	45.69
127	*Vernonia cinerea*	A	1.622	1.935	12	1.858	17.42
128	*Vinca rosea*	A	1.707	0.318	15	1.802	18.83
129	*Vitex negundo*	C	2.362	0.572	53	3.024	58.96
130	*Wrightia tinctoria*	A	1.341	1.325	14	2.509	19.18
131	*Zea mays*	A	1.716	1.316	13	0.631	16.66
132	*Ziziphus mauritiana*	A	1.347	0.346	11	1.046	13.74
133	*Ziziphus jujuba*	C	4.586	2.309	45	2.142	54.04
134	*Ziziphus oenoplea*	A	1.963	0.348	9	0.932	12.24

8.0 STATUS OF FLORA AS PER RAUNKIAER'S FREQUENCY CLASSES

Raunkiaer classified the occurrence of species in an area into five classes of frequency Class – A (1 to 20%), Class – B (21 to 40%) Class – C (41 to 60%) Class – D (61 to 80%) and Class – E (81 to 100). The normal distribution of the frequency percentages derived from such classification is expressed and has been named Raunkiaer's "Law of Frequency". The numbers of species falling in the above five categories are given in the following tables.

The ecological status of vegetation was calculated using the Raunkiaer's normal frequency diagrams and the results are given in Table – 7 and depicted in Fig. 2 for core and buffer zone.

8.1 Ecological Status of Vegetation

The heterogeneity of species in the core and buffer zone and the distribution of five different classes in the study area fulfill the Raunkiaer's "Law of Frequency".

Table – 7 Ecological Status of Vegetation as per Raunkiaer's Law

Dominant Species
Core Zone
Abutilon crispum, Abutilon indicum, Acacia auriculiformis, Acacia nilotica, Acalypha indica, Achyranthes aspera, Aerva lanata, Altrernanthera sessilis, Ammania baccifera, Argemon maxicana, Aristida adscensionis, Aristida funiculate, Arundo donax, Azadirachta indica, Borassus flabellifer, Calotropis gigantea, Chloris barbata, Cissampelos pareira, Cissus quadrangularis, Citrullus colocynthis, Cyanodon dactylon, Chrysopogon aciculatus, Coccinea indica, Cyanodon dactylon, Cyclea burmanni, Cyclea peltata, Cyperus alternifolius, Eucalyptus globules, Eucalyptus terreticornis, Euphorbia antiquorum, Euphorbia hirta, Ficus benghalensis, Ficus carica
Buffer Zone
Abutilon crispum, Abutilon indicum, Acacia auriculiformis, Acacia nilotica, Acalypha indica, Achyranthes aspera, Aerva lanata, Altrernanthera sessilis, Ammania baccifera, Aristida adscensionis, Aristida funiculata, Arundo donax, Azadirachta indica, Bambusa arundinacea, Calotropis gigantea, Cardiospermum halicacabum, Chloris barbata, Chrysopogon aciculatus, Cissampelos pareira, Cissus quadrangularis, Citrullus colocynthis, Coccinea indica, Crotolaria retusa, Croton bonplandiamum, Cyanodon dactylon, Cyclea peltata, Cyperus alternifolius, Datura metal, Eichhornia crassipes, Euphorbia antiquorum, Euphorbia hirta, Ipomoea carnea, Ipomoea staphylina, Jatropha glandulifera, Justicia simplex, Lantana camara, Leucas aspera, Parthenium hysterophorus, Phyllanthus amaras, Phyllanthus reticulates, Pongamia glabra, Prosopis juliflora, Saccharum spontaneum, Sida acuta, Sida cordifolia, Thephrosia purpurea, Thespesia populnea, Tinospora cordifolia, Tribulus terrestris, Tridax procumbens, Typha angsutifolia, Vernonia cinerea, Vitex negundo.

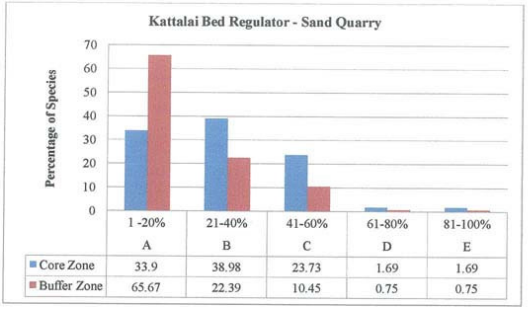


Figure 2 Raunkiaer's Law of Frequency

The conclusions were made as per the Raunkiaer's law on the basis of the following.

(a) Whether the distribution of plants fulfils the Raunkiaer's law of frequency diagram, if it does not fulfill then it indicates that the distribution of plant community is affected by human impact.

(b) A comment on the impact – whether the distribution is Homogeneous or Heterogeneous.

The result shows that, the distribution is Heterogeneous, in Core and Buffer zones thus fulfilling the Raunkiaer's law. The Heterogeneity and the species diversity observed among the plant community in the Core and Buffer zones reveals that, the characteristic species of scrub forests are distributed evenly throughout the study area. They were recorded in all the stands used for this investigation showing the highest frequency; there is a wide distribution of plant species observed in various stands. Though, there were dominancy observed for few cultivated species, the distribution of vegetation throughout the study area is heterogeneous in nature. The Heterogeneous status indicates that there is no human impact in the core and buffer zones.

8.2 Habitat Pattern

The environmental conditions with one kind of habitat exhibit variation from spot to spot. The ecological amplitude of one or more of the species under consideration delimits the extent of a habitat. The habitat pattern is associated with the environmental conditions; this has been very well manifested in the study area.

Though the topography is plain with some undulations here and there the presence of scrub elements and deciduous species clearly shows the habitat pattern in this area.

8.3 Changes

The Changes from the initial establishment of vegetation on an area to the terminal climax community are continuous. However, a given group of species will reach a peak of dominance at a certain stage of the sequence. Then as the dominance of this group decreases, the dominance of another group of species will develop to a maximum. This kind of change in dominant species have been observed in the study area, among different transects. The dominance of *Crotons*, *Prosopis juliflora*, *Acacia nilotica* and *Cissus quadrangularis* are noticed in many sites, but some of these plants were absent in some sites showing the occurrence of a change leading to the dominance of other aquatic species like, *Eichhornia crassipes, Ipomea carnea* and *Typha angustifolia* and other grasses. This group is then characteristic as an indicator of its respective stage of the directional change sequence.

The Change from one stage to the subsequent stage may be especially prominent where there is a change of life form of the dominant species. There is usually an increase in productivity per unit area, in organic mass per unit area because of the presence of the larger life forms, in complexity and diversity of species and life forms, and in the relative stability and homogeneity of the populations. The soil and other aspects of the habitat will also undergo progressive development.

8.4 Climax

The Climax community is the one in which no further directional change takes place under the prevailing environmental conditions. This is the terminus of habitat and vegetation development.

The climax community of the study area is Grasses, Aquatic herbs, Climbers and other thorny shrubs. The climax community is in the steady state with respect to productivity structure and population, with the dynamic balance of its populations dependent upon its respective site. The community has a maximum diversity, relative stability and homogeneity of the species populations within and between the stands of a given climax type. The given climax type is characterized in appearance within and between stands.

9.0 Discussions on Vegetation Analysis

The interpretations based on the above analysis and the floristic composition reveals that, the vegetation encountered in the study area is termed as the original

characteristic of Thorn forests / Scrub forests intermingled with aquatic herbs and social forestry maintained by the State Forest Department. The core zone comprises of small herbs, sedges and grasses with sparse distribution of trees that are well adapted to the sandy and fallow lands.

The type of forest / vegetation found in the study area is Open scrub along with the representative elements of the aquatic and dry scrub forest types. Physiognomically it occurs in the shape of scrub woodland or thicket; the latter may be dense or discontinuous.

Floristically it is distinguished by some characteristic and preferential species (Braun-Blanquet, 1932), exclusively or mostly confined to this vegetation type, in relation to the types described by champion (1936) and champion and Seth (1968).

9.1 Status of the Plants

There is no endangered, threatened, or rare species of plants recorded in the study area.

10. 0 ASSESSMENT OF FAUNA IN KATTALAI BED REGULATOR - SAND QUARRY, KARUR

The animal life of an area is dependent upon the vegetation and there are countless relationships between the species composing an animal community. Fauna assessment involves more problems than flora assessment by virtue of the greater variety of animal types, their mobility and behaviour. Faunal assessment provides a basis for determining relative abundance and evaluating commonness or rarity of each species encountered.

In the study area, the animal survey was conducted in all the sampling sites along with the plants. The study includes surveys of the animal communities such as aquatic organisms, insects, molluscs, reptiles, fishes, amphibians, birds and mammals. The details of fauna found in core and buffer zone as per the MoEF guidelines are given in the Table 9 – 17.

S. No.	Category	Details furnished Yes/No	Details of Table/text
1	Listing of all species in the study area of 10 km radius around the study area	Yes	Table 9 – 17
2	Schedule for each species as per the Wild Life (Protection) Act, 1972 as amended subsequently should also be furnished.	Yes	

3	Zoological and local name of the species should be furnished	Yes	
4	Listing of species should be classified as:	Yes	
	Endangered species	Yes	
	Endemic species	Yes	
	Migratory species	Yes	
	Details of aquatic fauna – Plankton, Molluscans, crabs, shrimps and fishes etc.	Yes	9, 11 & 12

10.1 The Plankton

The term plankton refers to unattached organisms that are dispersed individually or in colonies in water. Phytoplanktons are plant plankton, and zooplanktons are animal plankton. Water samples were collected using standard methods and analyzed for plankton diversity.

10.1.1 Shannon Weaver Index (SWI)

The SWI is a measure of diversity, it may be considered as an overall index of diversity as it concedes a true picture of the information theory. The species diversity

Where,
n = Number of individual species
N = Total number of individual species
Pi = Importance value for each species n/N

of such a community may be computed by employing the SWI of diversity by applying the Index.

$$H = - \Sigma n/N \log n/N$$
Or
$$H = - \Sigma pi \log pi$$

The SWI can be interpreted based on the SWI-H values obtained by computing the values of quantitative plankton analysis. Based on the H-values of SWI, the quality of water can be classified into the following three categories.

Table – 8 SWI – STANDARD TABLE

SWI – H VALUE	QUALITY OF WATER
X > 3	Clear
1 to 3	Moderately polluted
X < 1	Heavily polluted

The list of plankton present in the water body is given in Table – 9 along with its SWI values.

Table – 9 List of Plankton

S. No.	Plankton	Kattalai Bed Regulator	Veerarackiyam	Thirumukkodalur	Unniyur
1	Calamus	✔	✔	✔	✔
2	Cyclops	✔	✔	✔	✔
3	Daphnia	✔	✔	✔	✔
4	Moina	✔	✔	✔	
5	Nauplius	✔			✔
6	Rotifer	✔	✔	✔	✔
7	Notonecta	✔	✔		✔
8	Streptocephalus	✔	✔	✔	✔
9	Conocostrachan	✔	✔	✔	✔
10	Dysticus		✔	✔	✔
11	Dragonfly nymph	✔	✔	✔	✔
12	Chironomous		✔		
	H - Value	3.278	3.548	2.256	3.385
	Status	Clear	Clear	Clear	Clear

The results indicate that the water is clear and free from pollution. The sand quarrying activity will not affect the life plankton as they are well adapted with their locomotive ability to move fast to ensure their survival. The abundance of fishes also indicates that the plankton distribution is uniform across the aquatic habitats.

10.2 Butterflies

Table – 8 List of Butterflies

	Common Name	Scientific Name	Status/Schedule
	SKIPPERS		
1.	Ceylon swift/African straight swift	*Parnarabada*	*Common/Na*
2.	Rice swift	*Borbocinnara*	*Common/ NA*
3.	Bevan's Swift	*Pseudoborbobevani*	*Common/Na*
4.	Indian palm bob	*Suastusgremius*	*Common/Na*
	SWALLOWTAILS:		
5.	Common jay	*Graphiumdoson*	*Common/ NA*
6.	Tailed jay	*Graphiumagamemnon*	*Common/Na*
7.	Common rose	*Atrophaneuraaristolochiae*	*Common/Na*
8.	Crimson rose	*Atrophaneura hector*	*Common/ NA*
	YELLOWS AND WHITES		
9.	Common grass yellow	*Euremahecabe*	*Common/ NA*
10.	Spotless grass yellow	*Euremalaeta*	*Common/Na*
11.	Common emigrant	*Catopsiliapomona*	*Common/Na*
12.	Yellow orange tip	*Ixias pyrene*	*Common/Na*
13.	Crimson tip	*Colotisdanae*	*Common/Na*
14.	Great orange tip	*Hebomoiaglaucippe*	*Common/ NA*
15.	Common albatross	*Appiasalbina*	*Common/Na*
16.	Western striped albatross	*Appiaslibythea*	*Common/Na*

17.	Common gull	*Ceporanerissa*	*Common/ NA*
	Common Name	*Scientific Name*	*Status/Schedule*
18.	Common jezebel	*Delias eucharis*	*Common/Na*
	BLUES		
19.	Forget-me-not	*Catochrysopsstrabo*	*Common/Na*
20.	Pale grass blue	*Pseudozizeeriamaha*	*Common/ NA*
21.	Lesser grass blue	*Zizinaotis*	*Common/Na*
22.	Tiny grass blue	*Zizulahylax*	*Common/Na*
23.	Eastern grass jewel	*Freyeriaputli*	*Common/ NA*
24.	Indian cupid	*Everes lacturnus*	*Common/Na*
25.	Lime blue	*Chiladeslajus*	*Common/ NA*
26.	African babul blue	*Azanusjesous*	*Common/Na*
	BRUSH FOOTED		
27.	Plain tiger	*Danauschrysippus*	*Common/ NA*
28.	Blue tiger	*Tirumalalimniace*	*Common/Na*
29.	Black rajah	*Charaxes solon*	*Common/Na*
30.	Common evening brown	*Melanitisleda*	*Common/ NA*
31.	Common bush brown	*Mycalesisperseus*	*Common/Na*
32.	Tawny coster	*Acraeaviolae*	*Common/Na*
33.	Common leopard	*Phalantaphalantha*	*Common/ NA*
34.	Common castor	*Ariadne merione*	*Common/Na*
35.	Angled castor	*Ariadne ariadne*	*Common/Na*

10.3 Insects

Table – 9 Insects

S.No	Common name	Scientific Name	Status/Schedule
1	House fly	Muscadomestica	Common/ NA
2	Common grasshopper	Gastrimargusmarmoratus	Common/ NA
3	Painted grasshopper	Cleoboracrassa	Common/ NA
4	Red cotton bug	Dysdercuscingulatus	Common/ NA
5	White spotted cockroach	Coridiapetivariana	Common/ NA
6	House cockroach	Periplanataamericana	Common/ NA
7	Honey bee	Apisindica	Common/ NA
8	Small honey bee	Apisflorea	Common/ NA
9	Anopheles mosquito	Anopheles meigen	Common/ NA
10	Water scorpion	Nepacinerea	Common/ NA
11	Praying mantis	Gongylusgongiloides	Common/ NA
12	Water strider	Gerrisgracilicornis	Common/ NA

10.4 Molluscans / Crabs / Shrimps

Table – 10 List of Molluscans / Crabs / Shrimps

S.No	Common name	Scientific name	Status / Schedule
1.	Apple snail	*Pilaglobosa*	Common / NA
2.	*Fresh water mussel*	*Lamellidenscorrianus*	Common / NA
3.	Fresh water mussel	*Parreysiafavidens*	Common / NA
4.	Wheel snail	*Planorvisgyrautus*	Common / NA
5.	Tower snail	*Limnaeaperegra*	Common / NA
6.	Cone snail	*Limnaeatruncatula*	Common / NA
7.	Freshwater crab	*Parathelphusaconvexa*	Common / NA
8.	Shrimp	*Macrobrachiumrosenbergii*	Common / NA

10.5 Amphibians

Table – 12 List of Amphibians

S. No	Common Name	Scientific Name	Status/Schedule
1.	Skittering frog	Ranacyanophlyctis	Common/ NA
2.	Indian Bull frog	Hoplobatrachustigerinus	Common/ NA
3.	Painted kaloula	Kaloulataprobanica	Common/ NA
4.	Common Indian toad	Bufomelanostictus	Common/ NA
5.	Indian Pond frog	Ranahexadactylus	Common/ NA

10.6 Fishes

Table – 11 List of Fishes

S.No	Common name	Scientific name	Status / Schedule
1.	Spotted snake head, green snake head	*Channapunctatus*	Common / NA
2.	Tank-goby	*Glossogobiusgiuris*	Common / NA
S.No	**Common name**	**Scientific name**	**Status / Schedule**
3.	Minor carp	*Labeobata*	Common / NA
4.	Mozambique Tilapia	*Oreochromismossambicus*	Common / NA
5.	Climbing perch	*Anabas testudineus*	Common / NA
6.	Freshwater crab	*Parathelphusaconvexa*	Common / NA
7.	shrimp	*Macrobrachiumrosenbergii*	Common / NA
8.	Catla	*Cyprinuscatla*	Common / NA
9.	Common Carp	*Cyprinuscarpio*	Common / NA
10.	Mud Carp	*Cirrhinusmolitorella*	Common / NA

10.7 Reptiles

Table – 13 List of Reptiles

S. No	Common Name	Scientific Name	Status /Schedule
1.	common skink	*Mabuyacarinata*	**Common / NA**
2.	Indian rat snake	*Ptyasmucosus*	**Common / NA**
3.	Common vine snake	*Ahaetullanasurta*	**Common / NA**
4.	Buff-striped keelback water snake	*Amphiesmastolata*	**Common / NA**

5.	Indian chameleon	*Chamaleozeylanicus*	**Common / NA**
6.	Montior Lizard	*Varanusbengalensis*	**Common / I**
7.	Indian mud turtle	*Lissemyspunctata*	**Common / NA**
8.	Indian pond terrapin	*Melanochelystrijuga*	**Common / NA**

10.8 Birds

Table – 14 List of Birds

S.No	Common Name	Scientific Name	Remarks	Status
	KINGFISHERS			
1.	COMMON KINGFISHER	*Alcedoatthis*		C,R
2.	WHITE-THROATED KINGFISHER	*Halcyon smynensis*		C,R
3.	PIED KINGFISHER	*Cerylerudis*		C,R
4.	**PEAFOWL**	*Pavocristatus*	Schedule I	C,R,Br
	BEE-EATERS			
5.	GREEN BEE-EATER	*Meropsorientalis*		C,R
6.	BLUE-TAILED BEE-EATER	*Meropsphilippinus*		C,M
	CUCKOOS AND COUCALS			
7.	PIED CUCKOO	*Clamatorjacobinus*		C,R,Br
8.	COMMON HAWK CUCKOO	*Hierococcyxvarius*		C,R
9.	ASIAN KOEL	*Eudynamysscolopacea*		C,R,Br
10.	GREEN-BELLIED MALKOHA	*Phaenicophaeustristis*		C,R
11.	GREATER COUCAL **PARAKEETS**	*Centropussinensis*		C,R
12.	ROSE-RINGED PARAKEET	*Psittaculakrameri*		C,R, Br
	SWIFTS			
13.	ASIAN PALM SWIFT	*Cypsiurusbalasiensis*		C,R,Br
14.	HOUSE SWIFT	*Apusaffinis*		C,R
	OWLS			
15.	BARN OWL	*Tyto alba*		C,R
16.	COLLARED SCOPS OWL	*Otusbakkamoena*		O,R
17.	SPOTTED OWL	*Athenebrama*		C,R
	EAGLES			
18.	BLACK KITE	*Milvusmigrans*		C,R,Br
19.	BRAHMINY KITE	*Haliasturindus*		C,R,Br
20.	MARSH HARRIER	*Circus aeruginosus*		C,M
21.	SHIKRA	*Accipiter badius*		C,R,Br
22.	OSPREY	*Pandionhaliaetus*	Schedule I	Rare
	PIGEONS			
23.	ROCK PIGEON	*Columba livia*		C,R
	DOVES			
24.	LAUGHING DOVE	*Streptopeliasenegalensis*		C,R,Br
25.	SPOTTED DOVE	*Streptopeliachinensis*		C,R,Br
26.	RED COLLARED DOVE	*Streptopeliatranquebarica*		C,R,Br

27.	EURASIAN COLLARED DOVE	*Streptopeliadecaocto*		C,R,Br
	CRAKES AND RALLIDS			
28.	PURPLE SWAMPHEN	*Porphyrioporphyrio*		C,R,Br
29.	COMMON MOORHEN	*Gallinulachloropus*		C,R
30.	COMMON COOT	*Fulicaatra*		C,R,Br
	DUCKS			
31.	SPOT BILLED DUCK	*Anasporcilorhyncha*		C,R,Br
32.	GARGANEY	*Anasquerquedula*		C,M
	WADERS			
33.	COMMON REDSHANK	*Tringatotanus*		O,M
34.	COMMON GREEN SHANK	*Tringanebularia*		O,M
35.	GREEN SANDPIPER	*Tringaocropus*		O,M
36.	WOOD SANDPIPER	*Tringaglareola*		C,M
37.	COMMON SANDPIPER	*Actitishypoleucos*		C,M
	WADERS AND JACANAS			
38.	BLACK-WINGED STILT	*Himantopushimantopus*		C,R, Br
	PLOVERS			
39.	LITTLE RINGED PLOVER	*Charadriusdubius*		O,M
	LAPWINGS			
40.	YELLOW-WATTLED LAPWING	*Vanellusmalarbaricus*		C,R,Br
41.	RED-WATTLED LAPWING	*Vanellusindicus*		C,R, Br
	FLAMINGOS,IBISES AND SPOONBILL			
42.	GLOSSY IBIS	*Plegadisfalcinellus*		C,SM
43.	BLACK-HEADED IBIS	*Threskiornismelanocephalus*	NT	C,R,Br
44.	EURASIAN SPOONBILL	*Platalealeucorodia*		C,R,Br
	PELICANS			
45.	SPOT-BILLED PELICAN	*Pelecanusphilippensis*	NT	Re,SM, Br
	STORKS			
46.	PAINTED STORKS	*Mycterialeucocephala*	NT	Re,SM,Br
47.	ASIAN OPENBILL	*Anastomusoscitans*		C,R,Br
48.	WOOLLY-NECKED STORK	*Ciconiaepiscopus*		O,M
	SHRIKES			
49.	RUFOUS TREEPIE	*Dendrocittavagabunda*		C,R
50.	HOUSE CROW	*Corvussplendens*		C,R
51.	LARGE-BILLED CROW	*Corvusmacrorhynchos*		C,R
	ORIOLES AND CUCKOOSHRIKES			
52.	ASHY WOODSWALLOW	*Artamusfuscus*		O,SM
53.	EURASIAN GOLDEN ORIOLE	*Oriolusoriolus*		C,M
54.	BLACK-HEADED CUCKOOSHRIKE	*Coracinamelanoptera*		O,SM
	DRONGOS			
55.	BLACK DRONGO	*Dicrurusmacrocercus*		C,R,Br
56.	ASHY DRONGO	*Dicrurusleucophaeus*		O,M

57.	ASIAN PARADISE-FLYCATCHER	*Terpsiphoneparadisi*		C,M
58.	COMMON IORA	*Aegithinatiphia*		C,R
59.	COMMON WOODSHRIKE	*Tephrodornispondicerianus*		C,R
	MYNAS			
60.	COMMON MYNA	*Acridotherestristis*		C,R,Br

NT-NEAR THREATENED C – Common R – Resident SM – Seasonal Migrant
Br - Breeding O – Occassional Ra – Rare

10.9 Mammals

Table – 15 List of Mammals

Sl. No.	Common Name	Scientific Name	IUCN status / Schedule
1	Bonnet Macaque	*Macacaradiata*	*Lower risk/II*
2	Jackal	*Canisaureus*	*Lower risk/II*
3	Indian palm squirrel	*Pumambuluspalmarum*	*Lower risk/III*
4	Grey mongoose	*Herpestesedwardsii*	*Lower risk/II*
5	Black naped hare	*Lepusnigricollis*	*Lower risk/III*
6	Indian flying fox	*Pteropusgiganteus*	*Lower risk/III*
7	Short nosed fruit bat	*Synopterus sphinx*	*Lower risk/III*
9	Indian gerbils	*Tateraindica*	*Lower risk/III*
10	Large bandicoot – rat	*Bandicotaindica*	*Lower risk/III*
11	House rat	*Rattusrattus*	*Lower risk/III*

Based on the above tables, the following observations were made:

11.0 Inference

11.1 Invertebrates

The insects in the study area are interrelated with each other and other organisms. They are in perfect balance in their existence. Some of them act as pests, while others are useful and beneficial to the environment and human beings.

11.2 Pisces

The lentic and lotic systems represent common fishes which supports the local people during the seasons.

11.3 Amphibians

The toads and frogs were the amphibians recorded in the study area. Many of them were seen along the Lentic water system and other areas.

11.4 Reptiles

The reptiles recorded in the study area include lizards, and snakes. Among the reptiles presence of Mugger Crocodile (*Crocodyluspalustris*) seems to be a concern, though their numbers a very low in the study area. They come under vulnerable category

and need to be protected. These animals tend to live near UPPER & GRAND ANAICUT dam area. The Monitor Lizard(*Varanusbengalensis*) which is found in the banks of the river is also a Near Threatened reptile species.

11.5 Birds

Birds play an important role in understanding the ecological balance and its interrelationships. The occurrence of birds in various locations largely depends on the site characteristics and their presence in different study sites reveals that there is a good relationship between the birds and other organisms and the environment. The maintenance of the eco-balance could be seen in the selected study areas.

The avifauna seems to thrive very well supported by the wetlands, river and the agricultural land. The riverbed seems to be an idle feeding and roosting site for both wintering and resident birds. Presence of few near threatened species of birds is somewhat significant to this area, but all the four species are wide spread and locally common.

11.6 Mammals:

The distribution of mammals is largely dependent upon the environment of the respective areas. The mammals present in the study area include Mongoose, Indian palm Squirrel, etc. These mammals are spread over the study area. Mammal species recorded in the area are common species found all over the state/country. There is no immediate threat to them.

Based on the faunal study, this area seems to support a variety of diverse animal species.

All other faunal species of Pisces, Amphibians Molluscs, insects, butterflies are common species only.

Hence quarrying will not have any direct negative impact on the faunal diversity.

Suggestions: Artificial water lagoons can be maintained during summer months for animals to feed and roost within the riverbed. Water flow can be regulated during lean period to reach the shores in few areas which help animals.

A. ALAGAPPA MOSES
Associate Professor & Head
PG & Research Department of Environmental Sciences
Bishop Heber College (Autonomous)
Tiruchirappalli - 620 017.

12.0 REFERENCES

Ali E.A. (1993) Damage to plants due to industrial pollution and their use as Bioindicators in Egypt. Environm. Pollu. 81:251-255.

Anderson, P.G., (1914) The effect of dust from cement mills on setting of fruit. Plant World, 17: 57-68

Anonymous (1991) Indian Wildlife Protection Act 1972 (as amended up to 1991). Natraj Publishers, Dehra Dun.

Anonymous (1994) The environmental impact assessment notification,1994(as amended on 4.5.94). Ministry of Environment and Forests, Government of India.

Bhone, H. (1963) Schadlizchkeit Von Shavb, aus Zemen twerken fur Watdbestaude Allg. Furestz. 18. 107-111

Bose T K and Chowdhury B (1991) (ed.) Tropical garden plants In colour. Horticulture and Allied Publishers, Calcutta.

Burton A J, K S Pregitizer and N W Macdonald (1993) Foliar nutrients in Sugar Maple Forests along a regional pollution-climate gradient. Soil Science Soc. America J. 57:1619-1628.

Braun Blanquet, 1932, Plant Sociology, McGraw, Hill Book Co., New York.

Caustan D R (1988) An introduction to vegetation analysis. Unwin Hyman, Boston

Champion H.G., (1936), A Preliminary survey of the forests types of India and Burma, Indian For. Rec. 1: pp 1-36, Dehradun.

Champion H.G. and S.K.Setha (1968) A revised survey of the forest types of India, Manager of Publ., Delhi.

Chaturvedi R G and Chaturvedi MM (1996) Law on protection of environment andprevention of pollution (central and states). The Law Book Co., Allahabad.

Corriz,A.S. Llacuna, M.Durfort and J.Nadal (1994) A study of the ciliar tracheal epithelium on passerine birds and small mammals subjected go to air pollution: Ultrastructural study. Arch. Environm. Contam. Toxicol. 27: 137-142.

Christodoulkais N S (1993) Air pollution effects on the guard cells of the injury resistant leaf of *Laurus nobilis* L.Bull. Environ. Copntam. Toxicol. 51:471-478.

Chaturvedi AN and LS Khanna (1982) Forest mensuration. International Book Distributors, Dehradun.

Darley, E.F. (1966) Studies on the effect of Cement-Kiln dust on vegetation. J.Air Pollut. Cont. Ass. 16: 145-150.

Erhardt W, H Gebhardt, K Hopker, A Keitel, T Mayer, K Kremes, L Murmann-Kristen, R Umalauff-Zimmenrmann and R D Zimmermann, (1922) Biological monitoring of air pollution effects in the state of Baden, Wurttemberg, Federal Republic of Germany. In: D H Appl. Sci. p 917 – 928.

Fosberg F R and MH Sachet (1965) Manual for tropical herbaria. Utrecht, Netherlands

Gamble J S (1957) Flora of the presidency of Madra. Vol.1, II and III. Bishan Singh Mahendrapal Singh, Dehradun.

Ghosh AK (ed) (1994) The red data book on Indian animals, Part I: Vertebrata (Mammalia, Aves, Reptilia and Amphibia).

Greig-Smith P (1083) Quantitative plant ecology, Studies in ecology. Vol.9, Blackwell Scientific Pub., Oxford

Gorriz A,S Liacuna, M Durfortr and J Nadal (1994) A study of the ciliar tracheal epithelium on passerine birds and small mammals subjected to air pollution : Ultrastructural study. Arch. Environm. Contam. Toxicol. 27: 137-142

Gupta, P D K Banerjee, K.L. Sharma, P.AQ. Azeez and A.Singh (1988) Cardio-respiratory profile of factory workers of North Delhi. Report submitted to Council of Scientific and Industrial Research, New Delhi, India.

John G. Rau and David C. Wooten (1960), Environmental Impact Assessment, McGraw Hill, New York.

Kannan K. *1991* Fundamentals of Environmental Pollution S.Chand & Co. Ltd., New Delhi.

Kulkarni B.G. and Masurekar V.B. *1985* Toxicity of Aromatic petroleum hydrocarbons to the Clam Meretrix casto Var. Ovum (Hanely) in: Current Pollution Researches in India (Ed.) R.K. Trivedy & P.K. Goel Environmental Publications, Karad 251-254.

Kumaravelu, G (2001) *Watershed Management - A Forestry Approach. Management plan series, Dept. of Forests, Govt. of Tamil Nadu.*

Liu D.H.F., Liptak B.G. and Bouis P.A. *1997* Environmental Engineer's Handbook Lewis Publishers, Boca Raton.

Lande R(1996) Population abundances, geographic ranges and conservation: 1994 Witherby lecture, Bird Study 43:3-19

Ludwig JA and JF Reynolds (1988) Statistical Ecology – a Primer on methods and computing. John Wiley and sons, Ny.p.337.

Meher – Homji, V.M. (1973), A Phytosociological study of the Albizia amara Boiv Community of India, Phytocoenologia 1 (1) :pp 114-24.

Nandini V., Deshmukh, Vinay, D. Deshmukh and Masurekar V.B. 1985 Effect of Petroleum hydrocarbons on the speckled prawn *Metapanaeus monoceros* (Fabricius) in: Current Pollution Researches in India (Ed.) R.K. Trivedy & P.K. Goel Environmental Publications, Karad 239-244.

Jafri, S., Srivastava, K. and Ahmed, K.J. (1979) Environmental Pollution and epidermal structure in *Syzygium cuminii* L. Steel, Indian J. Air Pollut. Contr. 2: 74-77

Joshi O P, D K Wagela and K Pawar (1997) Urban air pollution effects on two species of Cassia. Poll. Res. 16: 1-3.

Oblisami, G., Pathmanabhan, G. and Padmanabhan, C. (1978) Effect of particulate pollutants from Cement kilns on cotton plants, J. Air Pollut. Contr. 1: 91-94

Odum, Eugene P. 1971, Fundamentals of Ecology W.B.Saundres Company.SISI.

Oosting, H.J.1958, The study of plant communities, W.H.Freemanteo., San Francisco.

Parish, S.B. (1910) The effect of Cement dust on citrus trees. Pl. Wld.13: 288-291.

Prema Michael, 1972, Ecological Methods – Practical Manual.

Pandey J and M. Agarwal (1994) Evaluation of air pollution phytotoxicity in a sensonally dry tropical urban environment using three woody perennais. New Phytologist 126: 53-61

Philips, E.A. 1959, Methods of Vegetation Study. Henry Holtt eo. Inc.

Raju B.S.N (1997) Fundamentals of air pollution, Oxford and IBH, New Delhi, pp 149

Raunkiaer, C. 1934. The life forms of plants and statistical plant geography: Being the collected paper of C.Raunkiaer, Calarendon Press, Oxford, England

Stolle K.W. and D.R. Mangis (1992) Identification and use of plant species as ecological indicators of air pollution stress in national park units. In:L D.H. Mckenzie, D.E. Hyatt and V J.

Salim Ali, 1979, The Book of Indian Birds, 11th Edition, BNHS, Oxford University Press.

Santapau H (1955) Botanical Collectorn manual, New Delhi.

Seibke K.F.W Badeck, G.H. Kohlmaier, M. Plochi and C. Wientzek (1990) Modelling pollutant exchange between plant and environment. Uptake and metabolism of sulphur dioxide by different leaf cell compartments. In : Jorgensen S E (ed.) Modelling in ecotoxicology, Developments in environmental modeling 16, Elsevier, pp. 149 –172.

Smith MA (1933-43) Fauna of British India (Vol.1,II and III). Taylor and Francis, New Delhi.

Smith B and JB Wilson (1996) A Consumers guide to evenness indices. Oikos 76: 70-82

Singh J M Agrawal and D Narayan (1994) Effect of power plant emissions of plant community Structure Ecotoxicology 3 : 110-122

Steubing L (1992) Air pollution effects on heathland. In: D H Mckenzie, D E Hyatt and V J Mcdonald (1992) (Ed) Ecological indicators Vol. II. Elsvier Appl. Sci. p,841 – 865.

South Wood, 1978. Ecological Methods, Chapman and Hall. P 1- 150.

Tara Gandhi, (1995) Bird-aided Natural regeneration of Vegetation. Bird Diversity and conservation thrusts for the nineties and beyond. Ornithological Society of India pp 32- 44.

Ted Hanes (1980) Vegetation and Wildlife Impact Analysis, EIA Handbook, McGraw Hill, pp 7-01, Chap,1.

Tuiney, F.W., O.S. Admodt and H.L. Ahlgren, 1937, Preliminary report of a study on methods used in botanical analysis of pasture swards. 3. Amer. SOC. Agron, 29:835-40.

Upadhya CB (1995) Forest laws (central and states). Hind Publishing House, Allahabad.

Welch, 1978 Limnology, McGraw –Hill Pub House, NY

World Bank(1991a) Environmental Assessment Source Book. Vol.I Policies, Procedures, and Cross-sectoral issues. World bank technical paper number 139. The World Bank, Washington, DC

World Bank(1991b) Environmental Assessment Source Book. Vol.III Guidelines for environmental assessment of energy and industry projects. World bank technical paper number 154. The World Bank, Washington, DC.

PLATES
PLATE 1 – Mammals

Bonnet macaque

Black Naped Hare

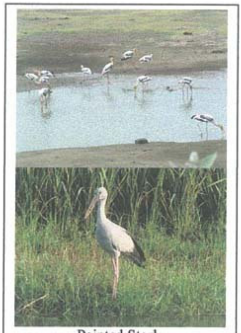
Palm squirrel

Short Nosed Fruit Bat

House Rat

Plate – 2 Birds

Pied Wagtail



Painted Stork

Pea Cock

Plate – 3 Reptiles

Green wine Snake

Mugger Crocodile

Skink

Water Snake

Plate – 4 Amphibians

Mud Turtle

Green Pond Frog

Plate – 5 Pisces

Carp & Cat Fish

Carp & Cat Fish/Fishing

BUTTERFLIES & INSECTS


Yellow Pansy


Sripted Tiger


Common Rose


Common Grasshopper


Tiger Beetle


Stick Insect

Plate – 7 Kattalai Bed Regulator - Sand Quarry, Karur View - Cormorants

A. ALAGAPPA MOSES
Associate Professor & Head
PG & Research Department of
Environmental Sciences
Bishop Heber College (Autonomous)
Tiruchirappalli - 620 017.

Dr.K.S.Palanisamy, I.A.S.,
District Collector and
District Magistrate,
Tiruchirappalli - 620 001.

Office : 0431 - 2415358
Fax : 0431 - 2411929
Res. : 0431 - 2420181
Fax : 0431 - 2420681

Lr.no Collr/ Trichy/ F.PH 1/ PWD/2014/dated 23/02/2015

Dear Sir,

Sub : TamilNadu State – TNPWD(RC Division), Trichy - Projects attracting EIA Notification 2006 dated 14.09.2006 as amended - proposed quarrying river sand (15,01,247 M^3) in upstream and downstream of kattalai bed regulator in Cauvery river over an extent of 196.25 Hectares in SF.NO.293, Sri Ramasamudram and SF.No.288, Silaipillayaputtur Villages,ThottiamTaluk ,Trichy District –reconstituted Expert Appraisal Committee on 26/08/2014 -Agenda item no.2.1 - Public hearing conducted by District Revenue officer/ Additional District Magistrate -clarification on rank- reg

Ref: 1. MoEF Notification : S.O.1533 dated 14/09/2006
2. MoEF (IA Division), Agenda for 14th reconstituted Expert Appraisal committee on 26/11/2013 and 22nd meeting on 26/08/2014
3. MoEF&climate change (IA Division) GOI Lr.no F.No. J11015 /343/2013 .IA II (M), dated 17/09/2014
4. EE, PWD (RC Division), Trichy Lr.no.113m/F118/2015/D3 dated 16/02/2015

With reference to the above, it is informed that public notice was published in newspapers on 17/06/2014 for conducting public hearing for the following project.

"Establishment of quarrying river sand (15,01,247 M^3) in upstream and downstream of kattalai bed regulator in Cauvery river over an extent of 196.25 Hectares in SF.NO.293, Sri Ramasamudram and SF No.288, Silaipillayaputtur Villages,ThottiamTaluk ,Trichy District"

In the Environmental Impact Assessment Notification S.O.No. 1533 of Ministry of Environment and Forest dated 14/09/2006, as amended the Procedure for conducting the public hearing is mentioned in Appendix IV, the para 4.0 mentions the panel for conducting public hearing,

"The District Magistrate or his/her representative not below the rank of an Additional magistrate assisted by a representative of SPCB or UTPCC, shall supervise and preside over the entire public hearing process".

The Section 20 of Criminal Procedure Code 1973(Cr.P.C) provides thus: (Revenue Manual) In every District, the following Officers are appointed as Magistrates by virtue of the officer held by them as noted against each.

	Designation of the officer	Appointed as	Local Jurisdiction
1.	Collector	District Magistrate	Entire District
2.	Joint Collector	Additional District Magistrate	Entire District
3.	District Revenue Officer	Additional District Magistrate	Entire District
4.	Revenue Divisional Officer	Sub Divisional Magistrate	Entire Revenue
5.	Tahsildar	Mandal Executive Magistrate	Entire Mandal

Additional District Magistrate shall have such of the powers of a District Magistrate under this or under any other Law for time being in force

As per the as per TOR issued vide Letter no. J11015 /343/2013 –IA II (M), GOI dated 31/03/2014, Public hearing was conducted for this project on 18/07/2014.

The District Revenue Officer in his capacity as Additional District Magistrate, Trichy District presided over the entire Public hearing meeting held on 18/07/2014 and signed the minutes of the Public hearing submitted to the MoEF (IA Division) GOI.

This is for kind information.

District Collector/District Magistrate
Trichy District, Tamilnadu

23/2/2015
DEETY

To
The Director,
MoEF&climate change (IA Division),
GOI Indira Paryavaran Bhawan,
Aliganj,
Jor Bagh Road,
New Delhi -110003

Copy to
The Executive Engineer, PWD/WRD, RC Division,Court campus, Cantonment, Trichy

STUDIES ON TRANSPORTATION OF MINED OUT MATERIALS AS PER THE IRC AND ITS IMPACT ON ENVIRONMENT.

METHOD OF MINING AND LOADING OF SAND:

The excess sand shoals above the theoretical bed are scooped using excavator and loaded directly in to the public carrier trucks. The travel distance is optimized between the quarry site and NH/SH bypassing the settlements. The entire mining operation is simple, opencast and eco friendly. The road worthy and RTO certified public carrier vehicles are permitted.

TYPE OF TRUCKS USED:

In Government operated sand quarries, the public carrier trucks can be loaded 2 units(200 Cuft) or 3 units(300 Cuft) according to the vehicle size i.e., single axis or multi axis directly in the river bed after paying charges through demand draft to concern Assistant Engineer.The maximum tonnage is 9 tonnes and 14 tonnes respectively. The PCU(Passenger Car Unit) value of the above two axle and three axle trucks are 3.The proposed number of trucks per day is 282 nos.

IMPACT ON EXISTING ROADS:

In left bank side of the proposed quarry site is connected to the Major District road (Selaipillayaputhur – Kattuputhur road) and further connected to State Highways (ie., SH-25,Trichy – Namakkal road) and in right bank side, it directly connects to the National Highway(ie., NH-67, Trichy-Karur road).

The existing PCU values of MDR,SH and NH are 6828,19036,15828 respectively(vide Annexure 7.2). The proposed rise of PCU value due to movement of trucks is 846 0nly.The increased PCU value is evenly distributed to MDR,SH and NH in both the side of project. The study reveals that the level of the service of existing road does not alter due to proposed movement of loaded and unloaded trucks. It also reveals that the width of the existing roads(ie., MDR) and river bank connecting between project site and roads are more than sufficient to carry the proposed traffic of trucks during the operation of quarry.

STUDY OF IMPACT ON ENVIRONMENT DUE TO PROPOSED TRAFFIC:

The National Institute of Technology, Tiruchirapalli conducted the emission test of trucks of similar categories with loaded and unloaded condition of other PWD operated quarries. The test results are depicted in table 7.11.

Table 1.1 Vehicle is Empty

Sl. No.	Type of vehicle	Registration No.	Parameters						
			O_2 ppm	CO_2 ppm	NO ppm	NO_2 ppm	NO_x ppm	SO_2 ppm	C_xH_y ppm
1	1616 x L /Tipper (2 units)	TN 37 BT 0097	20.4	1.3	81	0	81	0	25
2	1616 x L /Tipper (2 units)	TN 30 AL 2579	20.9	0	0	0	0	0	8
3	1616 x L /Tipper (2 units)	TN 40 B 8799	20.8	0.5	0	0	0	1	44
4	1616 x L /Tipper (2 units)	TN 39 AV 2535	20.9	1.5	273	1	274	78	27
5	1616 x L /Tipper (2 units)	TN 34 K 9898	20.8	1.5	233	2	235	0	45
6	25 Tons multi Axle Goods	TN 75 K 1200	20.9	1.1	57	0	57	2	34

	vehicle (Tarus)								
7	25 Tons multi Axle Goods vehicle (Tarus)	TN 31 AD 8627	20.8	0.7	0	0	0	1	21
8	25 Tons multi Axle Goods vehicle (Tarus)	TN 48 U 0352	20.9	1.2	123	0	123	0	5
9	25 Tons multi Axle Goods vehicle (Tarus)	TN 33 BD 8329	20.8	1.2	115	0	115	1	1
10	25 Tons multi Axle Goods vehicle (Tarus)	TN 33 BD 8389	20.7	0.9	62	0	62	2	5

Vehicle is loaded fully

Sl. No.	Type of vehicle	Registration No.	Parameters						
			O_2 ppm	CO_2 ppm	NO ppm	NO_2 ppm	NO_x ppm	SO_2 ppm	C_xH_y ppm
1	1616 x L /Tipper (2 units)	TN 37 BT 0097	20.4	1	159	0	159	0	12
2	1616 x L /Tipper (2 units)	TN 30 AL 2579	20.9	0.8	88	0	88	2	6
3	1616 x L /Tipper (2 units)	TN 40 B 8799	20.8	1	80	0	80	3	23
4	1616 x L /Tipper (2 units)	TN 39 AV 2535	20.9	1.2	166	0	166	0	25
5	1616 x L /Tipper (2 units)	TN 34 K 9898	20.8	1	176	0	176	0	38
6	25 Tons multi Axle Goods vehicle (Tarus)	TN 75 K 1200	20.9	1	117	0	117	1	5
7	25 Tons multi Axle Goods vehicle (Tarus)	TN 31 AD 8627	20.8	0.4	12	0	12	2	36
8	25 Tons multi Axle Goods vehicle (Tarus)	TN 48 U 0352	20.9	0.8	88	0	88	3	46
9	25 Tons multi Axle Goods vehicle (Tarus)	TN 33 BD 8329	20.8	0.6	66	0	66	1	39
10	25 Tons multi Axle Goods vehicle (Tarus)	TN 33 BD 8389	20.7	0.6	38	0	38	2	48

Figure : 7.7 Depicting the testing of loaded and unloaded vehicles

ADDITIONAL PARTICULARS ON MOVEMENT OF TRANSPORT

The proposal for Environmental Clearance was considered by the Expert Appraisal Committee in its 22nd meeting held during August 26-27, 2014. The committee was of the view that the proponent needs to submit the plan to bypass the villages during the transportation of sand, arrangements proposed to avoid accident during movement of trucks and display of sign boards on the transport routes.

TRANSPORT PLANS TO BYPASS THE VILLAGES

The detailed alternate route map is shown in fig.7.8 to bypass the village settlement in either side of river bank. The river bank road is under the control of PWD will be used to bypass the village settlement and directly enter into NH-65 and SH-25 through other district roads.

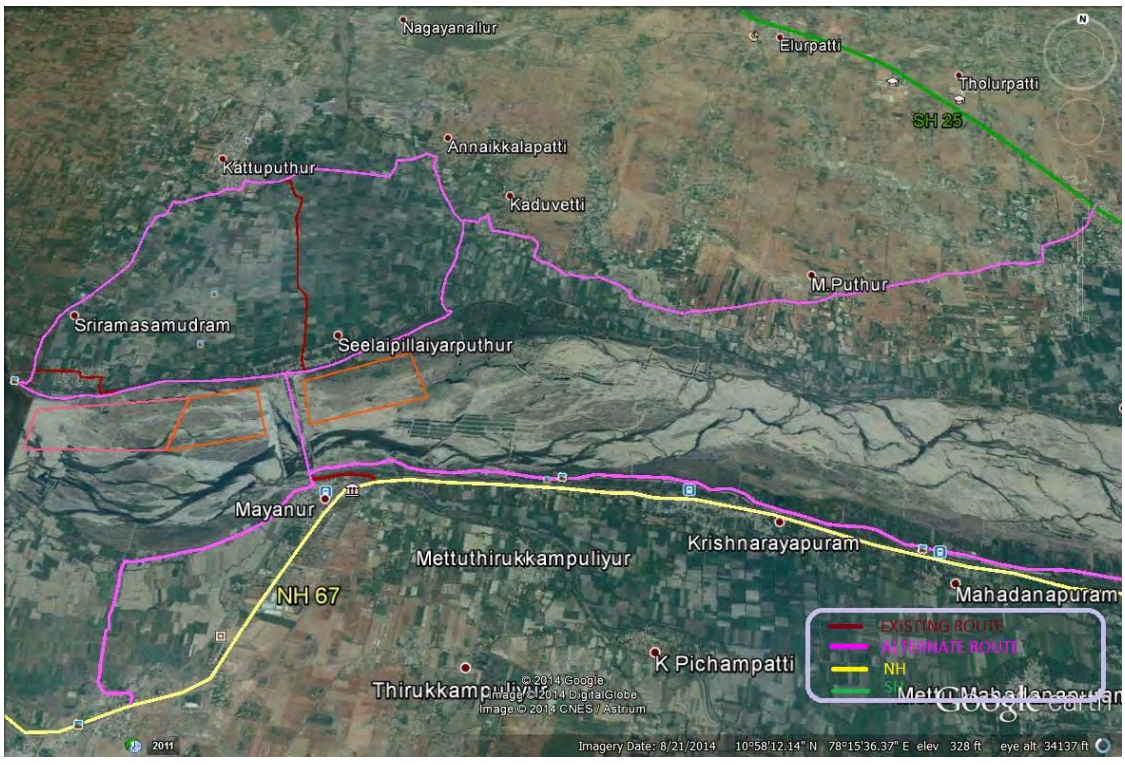


Figure 1.1 Alternative Route Map to bypass the village settlement

ACTION PLAN ON MOVEMENT OF TRUCKS TO AVOID ACCIDENT:

(i) Trucks carrying sand shall be covered using tarpaulin to avoid spilling.

(ii) Water sprinkling in quarry sites and the unpaved sections of the road in a regular interval.

(iii) Ensure that only trained, authorized and licensed drivers operate the vehicles

(iv) Enlist the help of another worker before reversing the vehicle

(v) Switch-off the engine when not in use to save fuel, prevent accidents and unnecessary noise and air pollution.

(vi) Lower the tipping bodies when the machine is unattended, but if it is necessary to leave them in the raised position they should be blocked to prevent their fall by fixing a sturdy support below.

(vii) Carryout periodic servicing to the manufacturer's requirements. All records of maintenance and repairs should be in writing or kept on site.

(viii) Keep the vehicle tidy and the cabin free from clumsy utilities, which might obstruct the controls and create hazards.

(ix) Display of sign boards on the transport routes.

(x) Avoid carrying additional passengers in the cabin or on the body of the dumper, while in field operation other than the connected workers.

(xi) Follow safe driving principles and avoid running the vehicle across the slopes on uneven ground.

(xii) Provide stop blocks when the vehicle is tipping into or running alongside excavations or when it is parked.

(xiii) Avoid overload the vehicle.

(xiv) Carry only well secured loads, which are likely to pollute the air and spill over to pollute the soil and water through proper use of covers and fasteners.

DISPLAY OF SIGNBOARDS ON THE TRANSPORT ROUTE

Signs are one of the most important elements in an effective traffic control plan. It is proposed to develop, install and maintain signs on haul roads. The necessary sign boards are proposed to install in haul roads and roads leads to MDR, SH and NH.