EXECUTIVE SUMMARY

1. INTRODUCTION

The Government of Karnataka (GOK) has been encouraging private entrepreneurs in mini hydel schemes. M/s Pioneer Power Corporation Limited (PPCL), a division of M/s Chanakya Cements Limited, Hyderabad, of the M/s Penna Cement Industries Limited (PCIL) group has set up an office in Bangalore with the objective of developing mini hydel schemes in Karnataka.

PPCL envisages to set up a mini hydel project of 24.75MW (3x8.25MW) capacity across the Cauvery river near Shivasamudram Hamlet of Sattegala village, Kollegal Taluk in Chamrajnagar District of Karnataka. The project is called Ranganathaswamy Mini Hydel Project (RMHP).

2. PROPOSED PROJECT

The proposed mini hydel project intends to utilise the surplus water in Cauvery river flowing over an existing anicut and a gross head of around 130m available at the falls downstream, for power generation. The surplus river water will be diverted by constructing a diversion structure of 600 m length across the river, to run 3 turbines of 8.25MW capacity each. After power generation, the water will be released back into the river through a short tailrace canal. The generated power will be evacuated from the powerhouse to the Static Frequency Converter (SFC) switching station of Karnataka Power Transmission Corporation Limited (KPTCL), about 3 km from the proposed project site.

3. ADVANTAGES OF HYDROPOWER

- A renewable source of energy - saves scarce fuel reserves.
- Non-polluting and hence environment-friendly.
- Long life - The first hydro project completed in 1897 at Darjeeling is still in operation.
- Cost of generation, operation and maintenance is lower than the other sources of energy.
- Ability to start and stop quickly and instantaneous load acceptance/rejection makes it suitable to meet peak demand and for enhancing system reliability and stability.
- Has higher efficiency (over 90%) compared to thermal (35%) and gas (around 50%).
- Cost of generation is free from inflationary effects after the initial installation.
- Can provide attendant benefits of irrigation, flood control, drinking water supply, recreation, tourism, etc.
- Being located in remote regions leads to development of interior backward areas (education, medical, road communication, telecommunication, etc.)

4. PROPOSED SITE LOCATION

The proposed RMHP is situated on the right bank of Shiva anicut near Shivasamudram hamlet of Sattegala village, in Kollegal Taluk of Chamrajnagar district in Karnataka State. The Project is about 50km (by road) from Maddur Town. The National Highway (NH209) passes at about 2 km from the project site and is connected to Shivasamudram by a pucca road.

The district headquarters, Chamrajnagar, is about 60km to the south of the project site. Kollegal and Mallavalli towns are approximately 16km from the proposed project site.

The railway station nearest to the project site is Maddur town on South-Central Railway Zone. The Bangalore Airport is the nearest operational airport.

The geographical co-ordinates of the project site are $12^0$16'09"N Latitude and $77^0$10'12"E Longitude.

5. JUSTIFICATION FOR THE PROJECT SITE

A hydel project is a site-specific project for the following reasons:

- There should be sufficient flow of water in the stream to generate power.
- There should be sufficient head difference available for running the turbines.
- The site should be easily accessible.
- Power evacuation facilities should be available within a short distance.

Since the proposed project site near Shivasamudram Hamlet of Sattegala village satisfies the above criteria and allotted by the GOK accordingly, no alternative sites were considered for the project. Moreover, the proposed project site near Shivasamudram Hamlet of Sattegala village has the following advantages.

a. **Easy approach** – The diversion structure of the proposed project is about 2 km from the National Highway (NH209) and can be easily reached by a pucca road connected to the NH. Thus, the project does not need construction of any new approach road to diversion structure and hence no related environmental damages.

b. **Easy & short access** – The power canal is expected to run along the existing road leading to Bharachukki falls. An approach road is required for the powerhouse located in a valley and around 1km (straight distance) from the nearest road. The maximum length of the proposed approach road from the existing road is estimated to be around 1.7 km.

c. **Less human habitation in the vicinity** – The powerhouse is to be set up around 1 km from a Darga. This area has about 40 houses with an approximate population of 100-150. Thus, there will not be any impact due to the project implementation on the population and their activities. Moreover, the powerhouse is located in a valley and the power canal is away from this area.

d. **Less acquisition of land** – The proposed project site is located near the existing VVNL hydroelectric power station of KPTCL and a mini hydel project next to it. Thus, the area is already a recognized location for hydel projects. Further, the existing power transmission facilities of KPTCL can be used for power evacuation from the proposed project. Thus, the project has to evacuate the power for only 3km and does not involve much acquisition of land and construction of power transmission facilities avoiding associated negative environmental impacts.

e. **Easy availability of construction material** – The basic construction material, in particular boulders, will be available from the project excavated material itself, thereby reducing the procurement cost and the environmental impact due to their transportation.

f. **No/minimal impact on fauna** – The project site is surrounded by Cauvery River. Hence, it will not have any impact on the fauna located in the present study area.

g. **No/less waste generation –** It is proposed to utilize most of the excavated material for the construction of the components of the project.

In view of the above, the proposed project site near Shivasamudram hamlet of Sattegal village is considered appropriate for construction of the mini hydel project.

6. DETAILS OF THE HYDEL SCHEME

The proposed project is a mini hydroelectric power generation facility, which will use the surplus water in Cauvery River over the existing anicut for generation of electricity. The flow data at Dhanagere gauged by the Irrigation Department of GOK indicates that the flow varied from a minimum of about 10 m^3/sec to a max of 4500m^3/sec over 1985-86 to 1995-96.

It is proposed to construct a **Diversion Structure** of 600 m length on the immediate downstream of anicut to divert only the surplus water flowing over the anicut. The requisite power draft will be diverted to a **Power Canal** through an **Intake Canal**. The power canal water is transmitted to a penstock, through a **Penstock Intake**. The **Penstock** trifurcates to divert the water flows to the powerhouse for power generation. The **Powerhouse** will accommodate three **Turbine Generator (TG)** units, of 8.25MW capacity each. It is proposed to locate the powerhouse on the right bank of the river. After generation of power, water will be released back into the river through a short **Tailrace Canal**. The excess water flow over and above the power draft requirement of TG unit will spill over the diversion structure into the river.

Total installed capacity of the proposed RMHP is **24.75MW (3x8.25MW)**. The average annual energy for the total installed capacity of 24.75MW is estimated at **110Mu,** whereas the net energy available after accounting for 1.0% for station auxiliary consumption and non-availability exigencies of grid at 2.0% is estimated to be **106.7Mu**.

The generated power will be evacuated from the powerhouse to SFC switching station 110kV system by a double circuit, 3km long 66kV-transmission line.

7. INFRASTRUCTURE REQUIREMENT

The proposed RMHP will require the following infrastructure for construction and operation and maintenance of the hydropower station.

7.1 Land

Total land requirement estimated for the proposed project is as given below.

Structure	**Area (acres)**
Diversion structure	2.0
Power canal, penstock, colony and dump yard	53.0
Powerhouse and switch yard	1.0
Tail pond and tail race canal	1.0
Approach roads	4.5
Total	**61.5**

7.2 Water

Water will be used at the facility for construction, power generation and domestic purposes. However, the power generation process does not consume any water. Water requirement during construction phase has been estimated at about 10000 litres per day for construction and domestic purposes. Water for construction purpose will be drawn

from the river course using portable pumps. Potable water for the RMHP staff will be obtained from borewell during the operation phase.

7.3 Power

It is proposed to derive the construction power supply and temporary lighting arrangement from a 250kVA emergency DG set proposed for the plant. This DG set will later be used as plant emergency DG set. In addition, temporary lighting arrangement will be derived from the 415V KPTCL line, which is normally available near the proposed plant during the period of construction.

7.4 Access and Service Roads

There is no approach road at present to reach the powerhouse from the existing road. Hence, it is proposed to provide a 1.7km long approach road connecting the existing road to the project site. This will be a hill type road proposed to connect the powerhouse with the existing road.

A service road is proposed adjacent to the power canal, forebay and penstock intake. The length of the service road will be about 3.7km.

7.5 Manpower

Manpower requirement for the proposed project during its construction stage will be approximately 90, whereas about 15 personnel will be employed during the operation phase of the facility. The plant will operate in three shifts.

7.6 Culvert and Bridge

A culvert will be provided for the alternative of RCC duct in a valley crossing. In addition, provision will be made for four cart bridges at different locations of the power canal.

7.7 Site Office and Quarters

Residential accommodation for PPCL staff during construction and subsequently during operation is necessary. Permanent offices of PPCL operation staff will be located within the powerhouse building and, if found necessary, some additional buildings such as store sheds/yards could be constructed near Shivasamudram hamlet of Sattegala village. Actual allocation of space for site offices and quarters would be finalised after the process of land acquisition is complete.

8. ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

PPCL has entrusted the Centre for Symbiosis of Technology, Environment & Management (STEM) to carry out a Rapid Environmental Impact Assessment (REIA) study of their proposed mini hydel project near Shivasamudram hamlet of Sattegala village. The objective of the REIA study is to identify, predict and assess the likely environmental impact of the proposed RMHP during its construction and operational stages. The REIA study also aims at developing an appropriate Environment Management Plan (EMP) for mitigating adverse environmental impact of the proposed project, if any.

8.1 Baseline Environmental Status

The study area for assessing the potential environmental impacts of the proposed RMHP, is considered to be the area falling within 10 km radius circle with respect to the proposed project site (diversion structure) as centre. Since the project site is located on the boundary of the Mandya and Chamrajnagar districts, the study area is spread over

the two districts. It comprises villages in the Kollegal taluk of Chamrajnagar district and Mallavalli taluk of the Mandya district.

8.2 Air Environment

Micrometeorological data of last five years (1999 to 2003) monitored at the Mandya Observatory of the India Meteorological Department (IMD) has been used as baseline data for this study and the ambient air quality monitoring carried out in the study area during March 2004. Based on the meteorological data, the predominant wind direction is seen from two directions,

- Between west and south-west from April to October,
- Between east and north-east during winter i.e. November to March.

The monthly mean relative humidity recorded at 0830 hrs was in the range of 75% to 90%, whereas that at 1730 hrs was in the range of 32% to 81%. Similarly, the monthly mean temperature recorded varied from a minimum of 14.6°C to a maximum of 36.2°C. The average rainfall is 803mm. On the whole the climate of the study area is agreeable.

In order to assess the baseline status of ambient air quality in the study area, ambient air quality monitoring was carried out at the two locations. The results indicate that concentrations of the ambient air quality parameters at all the monitoring locations in the study area are within the applicable NAAQS for rural areas.

8.3 Noise Level

To establish the baseline noise scenario, noise level monitoring was carried out at the same locations as ambient air quality monitoring. Comparison of the noise monitoring results shows that the average noise levels around the proposed project site are within the applicable CPCB standards.

8.4 Water

Cauvery River at the proposed project site, is a major surface water body within the study area. The perennial river divides into two after the Sattegala Bridge into Gaganachukki on the left and Bharachukki on the right hand side. These branches join together again about 7 km downstream near Hasarubore Halla. The Shiva anicut is existing across Ganganachukki branch of the river. Water supply in most of the villages in the study area is mostly through handpump.

In order to establish the baseline status of water quality in the study area, water samples were collected from the surface and ground water sources mentioned below. The water samples were analysed for their potability.

The water quality results show that the borewell water conforms to IS:10500 drinking water quality standards whereas, the river and borewell needs primary treatment and disinfection before its use for potable purposes.

8.5 Land

The study area comprises “unirrigated land” of 51% and only 6% area is being irrigated. The “cultivable waste land” is 5% whereas about 8% of the area falls under “area not available for cultivation”. About 30% of the land in the study area (10 sqkm radius) is “forest land”. However, there is no forest land involved in the proposed project area.

9. TERRESTRIAL ECOLOGY

9.1 Forest

The study area of 10km radius circle with respect to the proposed project site partially covers the Basavanbetta Reserve Forest, Dhanguru State Forest and Chikkayallur Reserve Forest.

9.2 Flora

The vegetation in general is regarded as dry deciduous and scrub type with the exception of the valleys and a majority of species inhabiting these areas exhibit xeromorphy. List of the flora commonly found in the study area is given in the relevant chapter of this report.

9.3 Fauna

The study area covers Basavanabetta Reserve Forest and Dhanguru State Forest of the Mallavalli range and the Chikkayalur Reserve Forest of the Kollegal range, with various types of animals, birds and reptiles. List of the fauna commonly found in the study area is given in the relevant chapter of this report.

9.4 Aquatic Ecology

There is no significant fishing activity taking place at the project site. However, fishing activities occur upstream and downstream of the project site. List of the fish species commonly found in Cauvery River in the study area is given in the relevant chapter.

10. SOCIO-ECONOMIC FACTORS

The study area (i.e. area within 10 km radius circle of the proposed RMHP site) falls in the Mallavalli and Kollegal taluks of Mandya and Chamrajnagar districts respectively. Population of the villages/town falling within the study area based on the 1991 census. However, the present socio-economic status of the study area has also been assessed on the basis of the field observations and interviews during the site visits.

Total population of the study area is 47975, of which 27876 are males and 23099 are females. The scheduled caste and scheduled tribe population of the study area is 12400 (i.e.25.8%), of which 6442 are males and 5958 are females. Average population density in the study area is approximately 173 persons/km^2, which shows sparse habitation in the area. The study area also covers a Belakavadi town, which has a population of 7282 with a SC population of 1435. The population density is 12775 persons/km^2.

The overall literacy rate in the villages of the study area is 35.0%, whereas male and female literacy rates are 43.3% and 26.1% respectively. Literacy is relatively very low among females. Primary and middle schools are generally available in the villages in the study area whereas, high schools are available only in two villages. The literacy in Belakavadi town is 54.3%. Schools upto Senior Secondary level are available here. Also a vocational training school is present in the town. Facilities for higher education are available at the taluk and district headquarters of Mallavalli, Kollegal, Mandya, and Chamrajnagar.

Overall employment in the villages of the study area is 35.6% whereas the male and female employment rates are 56.4% and 13.2%, respectively. However, the employment situation in the town (39.5%) is slightly better than that in the villages in the study area.

Drinking water supply exists in all the villages in the study area either through tap, hand pump, well water or tank water with handpump being the most common. Similarly, all the villages in the

study area are provided with electricity. The Belakavadi town has all facilities of the villages and more such as cinema hall, public libraries, reading rooms, banks, societies, etc.

The common mode of transportation in the study area is through State and private transport buses. The national highway (NH-209) passes from north-west through the middle and then towards the south of the study area. Most of the villages in the study area are connected by kutcha / pucca roads. The state transport (KSRTC) buses are available on internal routes, and in addition to the private services available. Shivasamudram hamlet of Sattegala village is connected to NH-209 by a pucca road. Maddur is the nearest major broad gauge railway station at about 50km from the project site.

11. BENEFITS OF THE PROJECT

The benefits and major objectives expected to be achieved by the proposed RMHP are presented in the following text.

11.1 Increased Power Availability

The proposed power project is designed to generate 24.75MW of electric power, which will help improve the power availability partially in the region.

11.2 Lower Cost for Power Generation

The proposed project is a mini hydel project with simple design of turbines, generators and civil works. Therefore, the project takes lesser time for its construction and commissioning, reducing the related costs substantially. Moreover, since a hydel scheme is based on water, which is available freely, and does not require any fossil fuels, expenditure towards, fuel procurement & transportation are saved. As a result, the cost of generation of power is lesser compared to thermal power.

11.3 Minimal Environmental Impacts

Hydropower is a free gift of nature – clean, economical, perennial and inexhaustible i.e. renewable. The small hydel projects are considered to have minimal impact on the surrounding environment due to negligible area of submergence, no gaseous emissions, or solid waste generation such as fly ash. Moreover, SHPs are simple to operate and easy to maintain.

11.4 Socio-economic Benefits

The proposed RMHP is expected to provide direct employment to about 15 persons during the operational phase. Also, during the construction phase, approximately 90 construction workers will be employed for a period of about 14 months, providing a direct employment potential to the local villagers. Moreover, indirect employment (secondary support job opportunities) will be generated by the power project, which has the potential to be developed also into a picnic spot.

Table 1: Expected Beneficial Impacts of the Project

a. Increased availability of electric power in the region.
b. Employment to about 90 persons during construction and 15 persons during operation phase as direct services, while there will also be indirect employment for supporting services.
c. The economy of the area improves due to permanent infusion of money through salaries to the employees as well as income to the indirectly employed people.
d. The local economy will also improve, if the project site is developed as a picnic spot.

	Development of the project site as a picnic spot will further improve aesthetics of the site.
e.	Greenbelt development around the project site will improve the flora in the area and also aesthetics of the area.
f.	The power generated will be made available over a larger region. The positive impacts of the project will, therefore, not be restricted to the local population alone.
g.	Transport, Communication and other community facilities will improve. There will be considerable socio-economic development in the surrounding villages.
h.	Will help in development of the interior backward areas.
i.	The project can be suitably modified in future to provide attendant benefits of irrigation, flood control, drinking water supply, recreation, tourism, etc.

12. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATIVE MEASURES

The likely impacts of the proposed RMHP, during its operation phase, on the surrounding environment are summarised in **Tables 2** and **3** respectively.

Table 2: Construction Phase: Potential Impacts and Mitigative Measures

S No.	Environmental Components	Potential Impacts	Source of Impacts	Mitigative Measures		Remarks
1.	Air quality	Increased SPM concentration in ambient air.	Construction equipment, vehicular traffic, excavation, concreting, *etc*.	Vehicular check; water spraying for dust suppression;	🔴	Minor negative but temporary
2.	Noise	Increased noise levels	Construction equipment, various construction activities	Equipment selection & maintenance; usage of ear plugs/muffs by the construction workers	🔴	Minor negative impact but temporary
3.	Water	Demand of water supply in addition to extraction from borewells. Local increase in suspended solids	Construction equipment, concrete mixing & curing, cleaning, workers' domestic needs dust suppression etc. Erosion due to excavation activities	Equipment selection, steam curing, high pressure hose for cleaning. Plantation around site before construction.	🔴	Minor negative impact on surface water
					🟡	No impact on ground water
4.	Land	Construction wastes, unstable slopes, soil erosion	Construction waste (excavated material)	Appropriate waste disposal measures; slope stabilization and greenbelt development.	🟡	No impact on land use.
					🔴	Minor negative on soil quality
5.	Aesthetics	Land clearance, construction waste. Disturbance to the visitors in the area.	Construction activities and waste	Appropriate waste disposal and greenbelt development. Alternative passages.	🔴	Minor negative.
6.	Terrestrial Ecology	Impact on top soil & existing ecosystem in the vicinity of the site.	Construction activities in a 5km stretch	Low noise generating equipment, soil binding vegetation, greenbelt development. Providing passages.	🔴	Minor negative and temporary.
7.	Aquatic Ecology	Change in flow, increase in suspended solids and TDS	Construction activity of diversion canal, power house and tailrace canal	Providing rocky boulders/structures near the powerhouse to restore the original habitat to the extent possible.	🔴	Short term Minor negative impact

S No.	Environmental Components	Potential Impacts	Source of Impacts	Mitigative Measures		Remarks
8.	Socio-economic factors					
(i)	Population	No impact	Construction jobs	Employing local people, Providing proper facilities and community services for the workers		No impact
(ii)	Education	No impact	-	Employing local people		No impact
(iii)	Employment	Increase in direct & indirect employment opportunities	Construction jobs to the local manual laborers and professionals	Employing local people to the extent possible.		Moderate positive
(iv)	Infrastructure facilities & Community services	Disturbance of existing infrastructure & community facilities	Construction activities	Alternative arrangements		No impact

Table 3: Operation Phase: Potential Impacts and Mitigative Measures

S No.	Environmental Components	Potential Impacts	Source of Impacts	Mitigative Measures		Remarks
1.	Air quality	None	Occasional vehicular movement	Green belt development, usage of good quality fuels.		No impact.
2.	Noise	Increased noise levels but below the prescribed standard.	Operation of noise generating equipment like turbines, pumps & compressors	Equipment will be provided with noise reduction measures such as acoustic barriers, vibration pads etc. Maintenance routine for the equipment. Green belt development.		No impact.
3.	Water	None	None	Minimize water usage by water conservation, reuse of treated sewage for greenbelt irrigation. No discharge of untreated wastewater into the river. Mandatory flows shall be maintained.		No impact
4.	Land	None	Project activities	Development of a systematically managed green belt to maintain ecology of the area. Appropriate disposal of solid waste, garbage.		No impact on landuse
						No impact on soil quality
5.	Aesthetics	Better environment	Development of project site as additional picnic spot	Development of greenery and site as picnic spot		Minor positive impact
6.	Terrestrial Ecology	Minor loss of trees, obstruction to animals to access the river.	Project activities	Greenbelt development. Providing suitable access to river for animals.		No impact
7.	Aquatic ecology	Change in flow, passage for fishes.	Diversion of flow	Mesh of appropriate size will be provided at the inlet points of the intake canal to prevent entry of fish along with water into the turbines.		No impact – Water will overflow over the Diversion structure. Also, water will be released back into the river within a dist. (5000 m). Moreover, no fishing activities reported at the site.

S No.	Environmental Components	Potential Impacts	Source of Impacts	Mitigative Measures		Remarks
8.	Socio-economic factors					
(i)	Population	*Small increase in population*.	Direct / indirect job opportunities, secondary services	Employment of local people to the extent possible		No impact
(ii)	Education	None	None	Employment of local people to the extent possible		No impact
(iii)	Employment	Better employment opportunities	Operation phase direct & indirect project and social requirements, Development of the site as picnic spot	Employment of local people to the extent possible		Moderate positive
(iv)	Infrastructure facilities & Community services	Improvement in infrastructure facilities & community services	Operation phase project and social requirements	-		Minor positive
9.	Population displacement and rehabilitation	None	No displacement of population	-		No impact