CHAPTER - 1

EXECUTIVE SUMMARY

1.1 INTRODUCTION

1.1.1 Need for enhancement of capacity

The demand for energy during peak time is increasing within Tata Power Company's (TPC) licensed area in Mumbai. Besides TPC also has to meet the requirements of its expanding consumer base in Mumbai to whom they directly supply power in residential areas in the suburbs of Mumbai. To meet the ever growing power demand, there is an urgent need to enhance TPC's generation capacities - both thermal and hydro since the power scenario in Maharashtra has deteriorated.

TPC has been buying power from other sources so as to mitigate the shortfalls. However in future it may be difficult for TPC to wheel in power from such other surplus sources since the Maharashtra State Electricity Distribution Company MSEDC transmission network is already congested. Thus it is imperative that TPC augments its own generating capacity so as to satisfy the energy needs of its consumer base.

1.1.2 Need for Enhancement of Hydro capacity

1.1.2.1 General requirement

At present, in Maharashtra, TPC has 1330 MW of thermal capacity and 447 MW of hydro. Thus the thermal : hydro ratio is 75 : 25. If TPC's proposals to substantially increase its thermal capacity also materializes, thermal : hydro ratio will be 82 : 18 which is not considered as an optimal ratio. Experts from Ministry of Power have estimated that the ideal energy mix for optimal utilisation of the installed capacity in India is 60% for thermal stations and 40% for hydro power stations. The same logic can be extended to TPC system also. Even if it is not possible to bridge the huge gap fully by the proposed hydro capacity addition, it is proposed to bring the thermal : hydro ratio at least to the existing level of 75 : 25. For this, it is necessary to augment the existing 447 MW hydro capacity. Bhira being one of the three hydro power facilities of TPC in Maharashtra, it is necessary to augment its generating capacity.

The power sector in India is in for lot of reforms in the near future. It is expected that Availability Based Tariff (ABT) will come into force. This means that there will be different tariffs for electricity depending on the time of the day when the power is being consumed.

It would not be economically viable to buy short fall power from other sources at high rates and supply it to TPC consumers. Augmentation of hydro capacity will help to mitigate the peak power shortfall from TPC's own sources and increase plant load factor (PLF) of thermal power plants during off-peak hours.

1.1.2.2 Specific requirement at Bhira

Mulshi Lake supplies water to the Bhira power station. In the past there are instances of overflow of this lake in spite of base loading of the Bhira Generating Station. During 2005 this lake has again overflowed causing floods in parts of Pune district.

After studying the past generation pattern, it is observed that non-monsoon utilization is significantly lower than the theoretical requirement. This is due to the fact that as the live capacity is only 70% of 75% dependable inflows, it does not allow to have the required flexibility so as to utilize the water optimally. This translates into higher water utilisation (resulting in higher generation) during monsoon than what is actually required. There are many instances (past and present) when Bhira station [consisting of Bhira Old Power House (BOPH) and Bhira Pumped Storage Unit (BPSU)] was forced to generate either full day or nearly full day.

It is a known fact that hydro power stations are best suited for peaking operation and thermal power stations for base load operation. With the Mulshi Lake partitioning and capacity augmentation schemes, there will be no necessity to utilise the water to the extent as is being done at present during monsoon. Thus there will be no necessity to base load the Bhira power station.

In spite of base loading, there were instances of spills. With the proposed augmentation along with Lake partitioning scheme, probability of spills in the lakes will be significantly less and these other wise spills can be utilised for power generation.

In order to avoid spilling of Mulshi Lake and subsequent flooding of surrounding areas as well as base loading the station during monsoon, it is necessary to increase storage capacity of the lake itself or transfer water at a higher rate (than that being done/possible at present) from the Mulshi Lake. It is feasible to enhance the live capacity only up to certain extent (688 MCM) which will satisfy the requirement partly. Hence the other alternative of augmenting the generating capacity has also to be studied in parallel.

Hence, in addition to the Lake partitioning scheme, it is planned to increase the generating capacity of the existing hydro power station at Bhira.

TPC assigned TCE the task of preparation of Feasibility Report (FR) to enhance the generating capacity at Bhira and Environmental Impact Assessment (EIA) study in view of the proposed project.

Present scope covers EIA studies only and to:

a. Identify and evaluate the environmental impact due to the construction activities and operation of the proposed plant

b. Delineate the mitigation measures for the impacts

c. Outline the Environmental Management Plan and post project monitoring requirements

1.2 PROPOSED SCHEME

1.2.1 Existing Water Conductor System (WCS)

Bhira power station was commissioned in the year 1927.It is fed by Mulshi lake which has 523 MCM live storage capacity. The present generation capacity of Bhira Hydro Power Station is 300 MW out of which 150 MW is from Bhira Old power house (25X6) and 150 MW Bhira pumped storage unit. Pumped Storage Unit (BPSU) was commissioned in 1997.

Water conductor system (WCS) of Bhira Old Power House (BOPH) consists of an intake, 4.38 km long tunnel followed by surge shaft, short length of tunnel (about 50 m), steel lined galleries (each 50 m long), Valve House No.1 (at Dongerwadi) and penstocks feeding Pelton units.

Water Conductor System (WCS) of pumped storage unit consist of intake Tunnel (No2) followed by surge shaft, valve house, steel lined tunnel, penstock feeding BPSU unit.

1.2.2 Options considered

Mulshi Lake partitioning is an essential part of the proposed augmentation at Bhira. It can be taken up even without the scheme for enhancing the generating capacity.

However, it is to be noted that without Lake partitioning scheme, in a 75% dependable year, requirement for additional generating capacity will be 30 MW & 80 MW considering non-monsoon & monsoon requirements respectively. Since peak shortages are more pronounced in non-monsoon period, augmentation considering non-monsoon requirement is the governing criteria while determining the additional capacity. Thus it can be inferred that while Mulshi Lake partitioning is necessary for the augmentation of the Bhira power station.

As per the studies carried out and elaborated in the Feasibility Report, it is proposed to augment the Bhira station by 75 MW.

Two alternatives were studied to select the capacity of the new power plant.

In the first alternative, installing a new 75 MW unit fed by with 75 MW WCS (downstream of tunnel no.1 surge shaft) is studied.

Second alternative being studied is relegating/retaining the unit no.1 (25 MW) of BOPH as a standby (to be used only in case of emergencies) and install a new unit of 100 MW fed by 100 MW WCS (downstream of tunnel no.1 surge shaft). It is observed that unit no.1 of the BOPH being very old is having a very low efficiency of 79%. Also, head loss in the existing penstock no.1 feeding unit no.1 is about 33.3 m. With the new WCS downstream of the tunnel no.1, head loss in the WCS of 100 MW will be significantly lower which will result in additional generation. In addition, as efficiency of the new unit will be about 91% there will be higher generation vis-à-vis the generation through the existing unit no.1. With the installation of 100 MW unit, it will be possible to avoid the cost towards refurbishment of unit no.1.

These alternatives are studied and discussed in detail in the Feasibility Report.

Considering all the factors, it is proposed to install a new 100 MW unit fed by 100 MW WCS (Alternative II).

1.2.3 Proposed WCS

Proposed system consists of existing tunnel (tunnel no.1), extension of existing valve house (to accommodate new valve), new branch tunnel, new penstock, new power house and tail race.

BASELINE (EXISTING) ENVIRONMENT

Baseline environmental condition for ambient air quality was monitored during post-monsoon season of 2005. The average background concentration in the study area for SPM, RPM, SO_2, NO_X and CO was recorded. The observed ambient air quality values are well within the National Ambient Air Quality Standards (NAAQS).

Tail race water (water released after power generation) and ground water samples were collected during the monitoring period and were analysed for quality based on the parameters of Indian Standards 10500. The measured parameters are in agreement with those of the standard.

Reconnaissance survey of the area was carried out to establish the baseline environmental condition. Relevant secondary data collection and ecological study has been carried out, so that necessary care and management action could be implemented during the construction and operational phase of the project.

Most of the people around the site have an income directly or indirectly from agriculture and other service related work. Some of them are employed with existing unit of TPC

1.4 IMPACTS DUE TO PROPOSED SCHEME

1.4.1 Construction phase

Construction activities are likely to last for a period of about 3 years. There will be minor but temporary impact due to construction activities. Most of the impacts are reversible in nature.

Impacts are due to

- Blasting
- Noise
- Air pollution
- Water pollution
- Disposal of excavated material
- Domestic waste
- Change in socio-economic scenario

Suitable measures are proposed to manage/mitigate these impacts. Equipments and vehicles used during construction phase will be properly maintained to reduce the impacts to bare minimum.

1.4.2 Operation phase

Likely impacts during operation phase are

- Flood control in Mulshi Lake (positive impact)
- Reduced water levels on one portion of Mulshi Lake during summer months
- Fire and explosion
- Availability of power (positive impacts)
- Change in socioeconomic status (positive impact)

Suitable measures are proposed to manage/mitigate the negative impacts.

1.5 ENVIRONMENT MANAGEMENT PLAN

1.5.1 Construction phase

1.5.1.1 Blasting

Blasting activity has potential to result in noise & air pollutions and cause injuries to workers if not executed properly. Hence a number of safety measures are planned. Few of them are listed below:

- Expert advise from Central Water and Power Research Station (CWPRS) – Pune or similar agency of national reputation
- Use of Experienced and licensed blaster during actual work
- Apropriate safe practises will be deployed
- It is proposed to detonate the explosives by resorting to the best prevailing blasting techniques and practices to ensure maximum possible safety.
- It is proposed to carry out blasting operations in such as way that detonators will not be simultaneously activated but with some time lag using Short and Long delays so that the noise level (dB) and vibrations (ppv) will be within permissible limits.
- It is proposed to avoid blasting operation in late night hours in case there are objections from local habitants.

1.5.1.2 Noise pollution

Sources of noise pollution are during the blasting operations for tunnel excavation, movement of dumpers transporting construction material and rock crushers.

Blasting

Adequate Remedial measures will be taken during blasting. In the proposed project, blasting operations are not in the immediate neighborhood of any residential area/colonies.

Dumpers

Constant movement of dumpers/vehicles transporting construction materials is another source of noise. This can be reduced by insisting on the contractor/s to use vehicles that

are in good condition. Also it is proposed to avoid movement of these vehicles during late night hours to the extent possible and minimise the disturbances to the nearby residents.

Rock crushers

Rock crushers will be used to crush the excavated rocks into aggregates which can be used as construction material in the same project. These will be located within TPC land and away from residential colonies. Also it is proposed to limit the rock crushing activities to day time only so that the effects will be bearable (as compared to night time).

By these measures it will be possible to minimise the adverse affects.

1.5.1.3 Air pollution

Sources of air pollution are during the blasting operations for tunnel excavation, movement of dumpers transporting construction material and rock crushers.

Blasting

Dust flying during blasting will be minimized using appropriate blasting techniques as advised by the authorities.

Dumpers

Movement of dumpers during cosntruction phase will create dust pollution. It is proposed to spray water which will act as a dust suppressant at regular intervals along the route.

Rock crushers

Rock crushing activity will release suspended particles into the atmosphere. It is proposed to locate these rock crushers within TPC land and away from residential colonies. This will reduce the adverse impact.

1.5.1.4 Water pollution

During construction, runoff from the construction site is normally a potential source of water pollution. Such pollution may persist entirely during the initial phase of construction when site work is in progress. During this stage the rainwater runoff would carry more soil/silt than normal, which if unchecked will cause silting problem in the course of its journey (streams).

Construction management would include the following steps to ensure that above mentioned impacts are kept to bare minimum:

- Cofferdam will be constructed first; its top level will be at 595 m. With this it will be possible to carry out the activities for bund construction between latter half of March and first half of June when the Lake level is lower than 595 m.
- Stage I of the work involves of construction of bund at both the banks. Stage II involves construction of bund in the middle portion of the water way and will be done after Stage I.

- Excavation in soil and soft rock for construction of bund for Lake partitioning will be carried out from second half of March to first half of June (prior to onset of monsoon) when the Lake level is depleted to lower than 595 m. The excavated material will be removed from the construction site (within the Mulshi Lake) and disposed off within TPC land above full supply level. Part of the excavated material can be used for backfilling as well as in the cofferdam during the Stage II construction of the bund.

- Undertake surface excavation for valve house and power house foundations during non-monsoon periods and clear the site of the excavated material.

- Excavate soil and rock for construction shafts during non-monsoon. Construct reinforced concrete steining in the portion between ground level and rock level to prevent the seepage of water into the tunnel. Subsequently columns are erected for supporting temporary superstructure so that the roofs cover the excavation area of shafts. Tunnelling activity is proposed to be carried out throughout the year (monsoon and non-monsoon). Excavated material will be removed from the site with combination of

  - trolleys (inside the tunnel)
  - crane which will lift excavated the material from the shaft location of the tunnel (about 20 – 40 m below the ground)
  - dumpers which will come near the shafts (below the roofs) and with the help of crane will be filled with the excavated material

With this arrangement, chances of rainwater entering the tunnel during construction is minimum.

1.5.1.5 <u>Disposal of excavated material</u>

Excavated materials will be generated during the bund construction for Mulshi Lake partitioning and tunnelling work between surge shaft on tunnel no.1 and upstream of new power house. Total quantity of excavated material is expected to be about 50000 m^3, which includes the excavation for bund construction in Lake partitioning, valve house foundation, 1.52 km long & 2.6 m - 2.3 m (finished diameter) tunnel and penstock encased in concrete at both ends of the tunnel. Approximate quantity of hard rock and soil material which will be excavated is expected to be 25000 m^3 each.

It is proposed to utilise part of the

- excavated material (rock) as aggregates for concreting
- excavated material (rock) in the construction of bund
- excavated material (soil) as backfill
- excavated material (soil & soft rock) in construction of Stage II cofferdam
- excavated material in the TPC land above the FSL of Lake. During the laying of the excavated material it will be compacted to prevent the soil being washed off into the Lake during the rains.

1.5.1.6 Domestic waste

Other potential source of water pollution is normally from the temporary accommodation of the construction workers. Approximately 300 temporary contract workers are expected to be involved in construction phase. Since most of the construction workers will be from the nearby villages migration of workers from outside is not envisaged for this project. Facilities presently available with the villages will continue to be used during construction activities and hence no sanitation problem is expected during construction period. However, arrangement for septic tank/pit will be made during the construction phase of the project.

For skilled workers of Contractor/s who are not from the local villages, proper accomodation arrangements will be made by the Contractor/s or place in the TPC colony will be made available to them so as to use existing sanitation facility.

For TPC's own staff (supervising the construction), existing accomodation facilities available in Bhira camp are adequate.

1.5.2 Operation phase

1.5.2.1 Water impacts

This will be due to the proposed Lake partitioning and altered generation pattern due to the proposed augmentation scheme. As a result of changed generation pattern, water releases from the power houses will be different from what is existing today. These are discussed in the following paragraphs along with the mitigation measures.

Affect on upstream users (due to Lake partitioning)

Mulshi Lake partitioning scheme consists in construction of a bund across the Lake near Palse village. This will result in the bifurcation of the Lake during the summer months (April, May and first half of June) when the Lake level falls below the present MDDL of 590 m. Water will be pumped from one side of the bund to the Davdi side. This will result in depletion of the Lake on one side to 584 m whereas on Davdi side, the MDDL will remain at 590 m.

At present a 15 villages are dependent for their drinking water needs on the Mulshi Lake. With the Lake partitioning scheme, during the summer months water will further recede by 150 - 200 m (horizontally) than at present on one side of the bund whereas on Davdi side there will not be any recedence.

TPC has permitted Maharashtra Jeevan Pradhikaran (MJP) to supply Mulshi Lake water to 15 villages.

Some of these villages are located on Davdi side of the bund. Hence there is no necessity to extend the existing suction pipes of the pumps which supply water to these villages.

However, it will be necessary to extend the suction pipes of the pumps for supplying water to the other villages as the water will recede in future to a level of 584 m during the summer months.

TPC will bear the expenses for extending the suction pipes and installation of new pumps (if required) so that villagers are not inconvenienced during the summer months.

Affect on downstream users

There is no adverse impact on the downstream users In fact the 80 MW capacity generating station of state Electricity Board whose generation depends on water availability from TPC. This power station will also get additional water in summer for power generation. This will help in mitigating power shortage in MSEB distribution area.

Adequacy of existing tail race channel

With the augmentation of the Bhira power house, the water level in the tail race channel will increase by about 0.60 m corresponding to the additional discharge of 17.85 m^3/sec. Hence it is necessary to raise the height of the channel by 0.60 m so that there will be no spilling of water.

It is proposed to undertake this work during the implementation of the project.

1.5.2.2 Fire and explosion

Hydro power plant has very little scope for fire and explosion hazards. But measures has been taken to minimise the risk even if it happens by accident. Any of the oil/chemical spills would be contained around equipment housing. This will be collected and disposed off in an environment friendly manner.

1.5.2.3 Impact of noise pollution

There will be increase in noise due to operation of turbine. The noise will be minimised by selecting the latest technology, by providing acoustic enclosure to machine, worker will be provided with ear mufflers.

1.5.2.4 Air pollution

There will not be any kind of air pollution during the operation phase. There will not be any impact on existing baseline parameter.

1.5.3 Management

Important features for management will be the following:

- Meteorology data collection
- Environmental monitoring
- Periodic maintenance
- Occupational safety and health
- Plantation/afforestation programme

1.6 Conclusions and Recommendations

1.6.1 Conclusions

- As the proposed scheme is extension of the existing scheme, there is no need to construct a new dam. Hence there is no submergence of land due to the proposed scheme.
- The proposed tunnel will be within the TPC premises. There is no requirement to acquire forest or private land as it is possible to locate the construction shafts (required for the construction of tunnel), valve house, penstock and power house within TPC land.
- There is no requirement to cut trees as majority of the work is under ground. There are shrubs in the location of construction shafts, valve house and penstock.
- Impacts during construction phase are minor and reversible.
- As hydro power is a clean source of energy, there will not be any emissions from the proposed project and will not degrade the ambient air quality.
- Due to draw down of water from one side of partition wall, water level on that side will go down but the quantity of water remaining in the lake (113MCM) will be sufficient to maintain aquatic life.
- Due to the Mulshi Lake partitioning, there will be lowering of maximum draw down level (MDDL) on one portion of the Lake in future. Hence, it will be necessary to extend the suction pipes of the pumps for supplying water to the villages.
- Due to the altered generation pattern, there will be no adverse impact on the downstream users. Additional water will be available to MSEB generating station for power generation.
- There will be increased generation during peak hours. .
- The socio economic status will be further enhanced due to availability of power and employment.
- Existing transmission system is adequate to evacuate the additional power.
- Excavated material can be used in the construction of bund, tunnel and power house. .

1.6.2 Recommendations

It is proposed to

- Undertake various safety measures during blasting activity so as to minimize noise & air pollutions and injuries to workers.
- Follow proper construction sequence so that water pollution can be minimised.
- Utilise vehicles/dumpers which are in good condition so that noise and air pollution can be minimum.
- Install fire fighting system conforming to Tariff Advisory Committee (TAC) guidelines.

- Extend the suction pipes of the existing pumps for supplying water to the villages and install new pumps (if required) so that villagers are not inconvenienced during the summer months.
- Reuse of excavated material within site for bund construction, power house construction.

TCE Consulting Engineers Limited

A TATA Enterprise

Environmental Impact Assessment Report

For

Generation Augmentation at Bhira Hydro Station

TATA

The Tata Power Company Ltd.

August 2007

LIST OF ABBREVIATIONS

c/s	- Cross-section
FSL	- Full Supply Level
HRT	- Headrace tunnel
km	- kilo metre
kV	- Kilo Volt
kW	- kilo Watts
kWh	- kilo-Watt-hour
MDDL	- Maximum Draw-Down Level
MCM	- Million cubic metres
MERC	- Maharashtra Electricity Regulatory Commission
MSDC	- Maharashtra State Distribution Company
MSPGC	- Maharashtra State Power Generation Company
MU	- Million units
MW	- Mega Watts
MWL	- Maximum Water Level
sec	- Second
TPC	- Tata Power Co. Ltd.
WCS	- Water Conductor System
BOPH	- Bhira Old Power House
BPSU	- Bhira Pumped Storage Unit

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REVISION STATUS SHEET

REVISION NO.	MONTH AND YEAR OF ISSUE	DETAILS OF REVISION
P0	JULY 2007	DRAFT REPORT
R1	AUGUST 2007	FINAL REPORT

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- Use of Experienced and licensed blaster during actual work
- Apropriate safe practises will be deployed
- It is proposed to detonate the explosives by resorting to the best prevailing blasting techniques and practices to ensure maximum possible safety.
- It is proposed to carry out blasting operations in such as way that detonators will not be simultaneously activated but with some time lag using Short and Long delays so that the noise level (dB) and vibrations (ppv) will be within permissible limits.
- It is proposed to avoid blasting operation in late night hours in case there are objections from local habitants.

1.5.1.2 Noise pollution

Sources of noise pollution are during the blasting operations for tunnel excavation, movement of dumpers transporting construction material and rock crushers.

Blasting

Adequate Remedial measures will be taken during blasting. In the proposed project, blasting operations are not in the immediate neighborhood of any residential area/colonies.

Dumpers

Constant movement of dumpers/vehicles transporting construction materials is another source of noise. This can be reduced by insisting on the contractor/s to use vehicles that

are in good condition. Also it is proposed to avoid movement of these vehicles during late night hours to the extent possible and minimise the disturbances to the nearby residents.

Rock crushers

Rock crushers will be used to crush the excavated rocks into aggregates which can be used as construction material in the same project. These will be located within TPC land and away from residential colonies. Also it is proposed to limit the rock crushing activities to day time only so that the effects will be bearable (as compared to night time).

By these measures it will be possible to minimise the adverse affects.

1.5.1.3 Air pollution

Sources of air pollution are during the blasting operations for tunnel excavation, movement of dumpers transporting construction material and rock crushers.

Blasting

Dust flying during blasting will be minimized using appropriate blasting techniques as advised by the authorities.

Dumpers

Movement of dumpers during cosntruction phase will create dust pollution. It is proposed to spray water which will act as a dust suppressant at regular intervals along the route.

Rock crushers

Rock crushing activity will release suspended particles into the atmosphere. It is proposed to locate these rock crushers within TPC land and away from residential colonies. This will reduce the adverse impact.

1.5.1.4 Water pollution

During construction, runoff from the construction site is normally a potential source of water pollution. Such pollution may persist entirely during the initial phase of construction when site work is in progress. During this stage the rainwater runoff would carry more soil/silt than normal, which if unchecked will cause silting problem in the course of its journey (streams).

Construction management would include the following steps to ensure that above mentioned impacts are kept to bare minimum:

- Cofferdam will be constructed first; its top level will be at 595 m. With this it will be possible to carry out the activities for bund construction between latter half of March and first half of June when the Lake level is lower than 595 m.
- Stage I of the work involves of construction of bund at both the banks. Stage II involves construction of bund in the middle portion of the water way and will be done after Stage I.

- Excavation in soil and soft rock for construction of bund for Lake partitioning will be carried out from second half of March to first half of June (prior to onset of monsoon) when the Lake level is depleted to lower than 595 m. The excavated material will be removed from the construction site (within the Mulshi Lake) and disposed off within TPC land above full supply level. Part of the excavated material can be used for backfilling as well as in the cofferdam during the Stage II construction of the bund.

- Undertake surface excavation for valve house and power house foundations during non-monsoon periods and clear the site of the excavated material.

- Excavate soil and rock for construction shafts during non-monsoon. Construct reinforced concrete steining in the portion between ground level and rock level to prevent the seepage of water into the tunnel. Subsequently columns are erected for supporting temporary superstructure so that the roofs cover the excavation area of shafts. Tunnelling activity is proposed to be carried out throughout the year (monsoon and non-monsoon). Excavated material will be removed from the site with combination of

  - trolleys (inside the tunnel)
  - crane which will lift excavated the material from the shaft location of the tunnel (about 20 – 40 m below the ground)
  - dumpers which will come near the shafts (below the roofs) and with the help of crane will be filled with the excavated material

With this arrangement, chances of rainwater entering the tunnel during construction is minimum.

1.5.1.5 <u>Disposal of excavated material</u>

Excavated materials will be generated during the bund construction for Mulshi Lake partitioning and tunnelling work between surge shaft on tunnel no.1 and upstream of new power house. Total quantity of excavated material is expected to be about 50000 m^3, which includes the excavation for bund construction in Lake partitioning, valve house foundation, 1.52 km long & 2.6 m - 2.3 m (finished diameter) tunnel and penstock encased in concrete at both ends of the tunnel. Approximate quantity of hard rock and soil material which will be excavated is expected to be 25000 m^3 each.

It is proposed to utilise part of the

- excavated material (rock) as aggregates for concreting
- excavated material (rock) in the construction of bund
- excavated material (soil) as backfill
- excavated material (soil & soft rock) in construction of Stage II cofferdam
- excavated material in the TPC land above the FSL of Lake. During the laying of the excavated material it will be compacted to prevent the soil being washed off into the Lake during the rains.

1.5.1.6 Domestic waste

Other potential source of water pollution is normally from the temporary accommodation of the construction workers. Approximately 300 temporary contract workers are expected to be involved in construction phase. Since most of the construction workers will be from the nearby villages migration of workers from outside is not envisaged for this project. Facilities presently available with the villages will continue to be used during construction activities and hence no sanitation problem is expected during construction period. However, arrangement for septic tank/pit will be made during the construction phase of the project.

For skilled workers of Contractor/s who are not from the local villages, proper accomodation arrangements will be made by the Contractor/s or place in the TPC colony will be made available to them so as to use existing sanitation facility.

For TPC's own staff (supervising the construction), existing accomodation facilities available in Bhira camp are adequate.

1.5.2 Operation phase

1.5.2.1 Water impacts

This will be due to the proposed Lake partitioning and altered generation pattern due to the proposed augmentation scheme. As a result of changed generation pattern, water releases from the power houses will be different from what is existing today. These are discussed in the following paragraphs along with the mitigation measures.

Affect on upstream users (due to Lake partitioning)

Mulshi Lake partitioning scheme consists in construction of a bund across the Lake near Palse village. This will result in the bifurcation of the Lake during the summer months (April, May and first half of June) when the Lake level falls below the present MDDL of 590 m. Water will be pumped from one side of the bund to the Davdi side. This will result in depletion of the Lake on one side to 584 m whereas on Davdi side, the MDDL will remain at 590 m.

At present a 15 villages are dependent for their drinking water needs on the Mulshi Lake. With the Lake partitioning scheme, during the summer months water will further recede by 150 - 200 m (horizontally) than at present on one side of the bund whereas on Davdi side there will not be any recedence.

TPC has permitted Maharashtra Jeevan Pradhikaran (MJP) to supply Mulshi Lake water to 15 villages.

Some of these villages are located on Davdi side of the bund. Hence there is no necessity to extend the existing suction pipes of the pumps which supply water to these villages.

However, it will be necessary to extend the suction pipes of the pumps for supplying water to the other villages as the water will recede in future to a level of 584 m during the summer months.

TPC will bear the expenses for extending the suction pipes and installation of new pumps (if required) so that villagers are not inconvenienced during the summer months.

Affect on downstream users

There is no adverse impact on the downstream users In fact the 80 MW capacity generating station of state Electricity Board whose generation depends on water availability from TPC. This power station will also get additional water in summer for power generation. This will help in mitigating power shortage in MSEB distribution area.

Adequacy of existing tail race channel

With the augmentation of the Bhira power house, the water level in the tail race channel will increase by about 0.60 m corresponding to the additional discharge of 17.85 m^3/sec. Hence it is necessary to raise the height of the channel by 0.60 m so that there will be no spilling of water.

It is proposed to undertake this work during the implementation of the project.

1.5.2.2 Fire and explosion

Hydro power plant has very little scope for fire and explosion hazards. But measures has been taken to minimise the risk even if it happens by accident. Any of the oil/chemical spills would be contained around equipment housing. This will be collected and disposed off in an environment friendly manner.

1.5.2.3 Impact of noise pollution

There will be increase in noise due to operation of turbine. The noise will be minimised by selecting the latest technology, by providing acoustic enclosure to machine, worker will be provided with ear mufflers.

1.5.2.4 Air pollution

There will not be any kind of air pollution during the operation phase. There will not be any impact on existing baseline parameter.

1.5.3 Management

Important features for management will be the following:

- Meteorology data collection
- Environmental monitoring
- Periodic maintenance
- Occupational safety and health
- Plantation/afforestation programme

1.6 Conclusions and Recommendations

1.6.1 Conclusions

- As the proposed scheme is extension of the existing scheme, there is no need to construct a new dam. Hence there is no submergence of land due to the proposed scheme.
- The proposed tunnel will be within the TPC premises. There is no requirement to acquire forest or private land as it is possible to locate the construction shafts (required for the construction of tunnel), valve house, penstock and power house within TPC land.
- There is no requirement to cut trees as majority of the work is under ground. There are shrubs in the location of construction shafts, valve house and penstock.
- Impacts during construction phase are minor and reversible.
- As hydro power is a clean source of energy, there will not be any emissions from the proposed project and will not degrade the ambient air quality.
- Due to draw down of water from one side of partition wall, water level on that side will go down but the quantity of water remaining in the lake (113MCM) will be sufficient to maintain aquatic life.
- Due to the Mulshi Lake partitioning, there will be lowering of maximum draw down level (MDDL) on one portion of the Lake in future. Hence, it will be necessary to extend the suction pipes of the pumps for supplying water to the villages.
- Due to the altered generation pattern, there will be no adverse impact on the downstream users. Additional water will be available to MSEB generating station for power generation.
- There will be increased generation during peak hours. .
- The socio economic status will be further enhanced due to availability of power and employment.
- Existing transmission system is adequate to evacuate the additional power.
- Excavated material can be used in the construction of bund, tunnel and power house. .

1.6.2 Recommendations

It is proposed to

- Undertake various safety measures during blasting activity so as to minimize noise & air pollutions and injuries to workers.
- Follow proper construction sequence so that water pollution can be minimised.
- Utilise vehicles/dumpers which are in good condition so that noise and air pollution can be minimum.
- Install fire fighting system conforming to Tariff Advisory Committee (TAC) guidelines.

- Extend the suction pipes of the existing pumps for supplying water to the villages and install new pumps (if required) so that villagers are not inconvenienced during the summer months.
- Reuse of excavated material within site for bund construction, power house construction.

CHAPTER - 2

INTRODUCTION

2.1 BACKGROUND

The Tata Power Company - TPC, (earlier called Tata Electric Companies) pioneered the generation of electricity in India more than nine decades. Today, it is the country's largest private power utility, established as a licensee in Mumbai and with ambitious expansion plans from being essentially Mumbai-centric to a major national player, in the field of power.

TPC is active in all aspects of Power, be it Thermal, Hydro, Solar and Wind Energy and in Generation, Transmission & Distribution.

2.1.1 Existing Power Generation Capacity of Tata Power Company

TPC has three thermal power generating stations, 3 hydro power generating stations and 2 wind mill stations. The installed capacity at Thermal Power Stations namely Trombay, Jojobera and Belgaum is 1330 MW, 428 MW and 81 MW respectively. The hydropower station namely Khopoli, Bhivpuri and Bhira which were commissioned in 1914, 22, 27 has generating capacity of 72MW, 75MW and 300 MW, respectively. The generation capacity of wind mill station is 67MW. The total generation capacity of TPC at present is 2348 MW.

2.1.2 The Tata Power Company and Mumbai

During the course of the last nine decades, the energy produced by TPC has energised Mumbai's vitals - reliably and economically, helping the city achieve and retain its premium status as the commercial capital of India. The challenging task of meeting the ever-growing power needs of the industrial metropolis of the country has been possible because of efficient generation, transmission and distribution of energy, and constant upgrading of technology.

2.1.3 Power Status

TPC is licensed to generate, transmit and distribute power to the city of Mumbai and its suburbs. From Colaba in the South to Bassein Creek on the Northern end and Vikhroli on the Central side, the company services the domestic and commercial consumers through its distribution licensees, Brihanmumbai Electricity and Suburban Transport (BEST) and Reliance Energy Limited (REL).

2.1.4 TPC’s Venture into Direct Marketing

The Company also supplies power directly to bulk consumers such as Central and Western Railways, Mumbai Port, refineries, textile mills, fertiliser factories, BARC, Municipal Corporation water pumping plants and other major industries using continuous processes requiring uninterrupted power supply. The latest addition to the list is the commercial district at the Bandra-Kurla Complex and major commercial and residential complexes in the suburbs.

2.1.5 Network of Reliability

As grids ensure stability in power supply, TPC's power systems in Western India are interconnected with the Western Region Grid, including the State Electricity Boards of Maharashtra, Gujarat, Madhya Pradesh, Goa and Tarapur Nuclear Power Station.

2.1.6 TPC's concern towards environment

Long before the present global ecological concern, TPC realised its moral and corporate responsibility towards environmental protection. It started off over thirty years ago with eco-restoration and eco-development programmes in its area of operation in the Western Ghats, particularly in the catchment areas of the lakes in Mawal and Mulshi Talukas. Since then, over 70 lakh saplings of 60 tree species have been planted in the area. The programme was intensified in 1995. Over 6 lakh trees, mainly evergreen and indigenous species, are being planted regularly, enriching the flora and fauna of the surrounding hills. A green belt of about 1 lakh trees has been raised around the Trombay Thermal power plant and nearby hillsides. Trombay provides sampling & tankers for watering plants. Actively supports pisciculture activities at their hydro stations by assisting in the breeding of fishes like the Mahsheer.

2.2 EXPANSION

With its firm base in Mumbai, TPC has now ventured into new pastures in the country with the objective of becoming a major national player in the years to come.

TPC has already registered its national presence. Its two thermal power plants in Jharkhand and Karnataka are already operational. The Company is pursuing opportunities in setting up IPPs / CPPs on 'Build Own Operate' (BOO) basis.

2.3 NEED FOR ENHANCEMENT OF CAPACITY

There is an urgent need to enhance the capacities (both thermal and hydro) of TPC. This is because:

a. demand for energy during peak time is growing in TPC's licensed area in Mumbai

b. TPC is expanding its consumer base in Mumbai by directly supplying power to residential areas in the suburbs of Mumbai

c. over the last few years, power scenario in Maharashtra has deteriorated. As a result, Maharashtra State Electricity Distribution Company (MSEDC) is enforcing load shedding in its supply areas (majority of areas in Maharashtra). In such a situation, TPC will not be able to buy power from Maharashtra State Power Generation Company (MSPGC) if any need arises. In fact, Maharashtra Electricity Regulatory Commission (MERC) has advised TPC not to buy power from MSEB (vide its order dated 07.12.2004)

2.3.1 Need for Enhancement of Hydro capacity

2.3.1.1 General requirement

At present, in Maharashtra, TPC has 1330 MW of thermal capacity and 447 MW of hydro. Thus the thermal : hydro ratio is 75 : 25. It also draws 250 MW power during peak period from MSEGC to meet the peak power shortage.

TPC has plans to increase its thermal capacity by 250 MW by installation of unit No.8 at Trombay thus adding 250 MW to its capacity. The effective capacity addition is 100 MW due to breakdown of unit no 4 (150 MW).

With this addition, the thermal capacity of TPC at Trombay will increase to 1430 MW. At the present hydro power capacity, thermal: hydro ratio is likely to be in the ratio of 82 : 18.

Experts (from Ministry of Power) have estimated that the ideal energy mix for optimal utilisation of the installed capacity in India is 60% for thermal stations and 40% for hydro power stations. Extending the same logic to TPC, it is necessary to enhance the hydro capacity with proposed hydro capacity addition. It is proposed to maintain the thermal: hydro ratio at least to the existing level of 75 : 25. For this, it is necessary to add some capacity to the existing 447 MW capacity in the hydro power stations.

Demand for power is not constant throughout the day. Demand for power is more during the peak periods and less during the off-peak periods. In Maharashtra, MSEDC has identified two peak periods during a 24 hour period. These peak periods are from 0600 to 1000 hours in the morning and 1800 to 2200 hours in the evening. Thus in 24 hours, there are 8 hours of peak period.

In Mumbai, current load pattern shows more demand for power from 1000 hours to 2200 hours (12 hours base peak period instead of 8 hours). However, within this peak, there are two smaller peaks. These peaks may vary depending on the season (i.e. summer, monsoon and winter). In summer, this peak period (over base peak period) may be more as compared to monsoon and winter.

TPC has estimated demand for electricity to grow by 4% per year in the Mumbai region. As a result, by 2009, there will be increase in demand during peak as well as off-peak periods. With the whole demand curve shifting upwards, the demand of power during the 12 hour base peak period will increase. TPC is planning to bridge this increased requirement by the addition of thermal power. However, it is expected that the magnitude of peak (over base peak) will also be increased. It is proposed to meet part of this increased peak requirement of power (over base peak) by enhancing the generation capacity of TPC's hydro electric power generation facility at Bhira. In order to utilise the power plants (thermal and hydro) optimally (efficiently), it is desirable to use the hydro power stations as peaking power stations and thermal plants as base power stations.

Currently TPC's Bhira hydro power plant operates for more than 8 hours per day. This is mainly because with the present installed capacity of the power station, by running the power station only for 8 hours/day it is not possible to generate the total energy potential of this power plant which is fed by Mulshi Lake. In other words, if Bhira power station is

generating for 8 hours/day, then on an average year, there is every likelihood of spilling of the Lake which is a total waste as far as power generation is concerned. Instead, if the same water is stored in the reservoir, it could be used during non-monsoon period when there is shortage of water as well as of power. Hence, as far as possible, spilling of these should be avoided.

Power sector in India is in for a lot of reforms in the near future. It is expected that in near future, Availability Based Tariff (ABT) will come into the picture. This means that there will be different tariffs for electricity depending on the time of the day, when the power is being consumed. In other words, for power consumed during peak hours, there will be a higher tariff as compared to that consumed in the off-peak hours. Thus, it won't be economically viable to buy short fall power from other sources at higher rates and supply it to TPC consumers. So augmentation of hydro capacity will serve two purpose. Generation of short fall in power from TPC's own source during peak hours and increase in PLF of power plant during off peak hours.

2.3.1.2 Specific requirement at Bhira

Mulshi Lake supplies water to the Bhira power station. In the past there are instances of overflow of this lake in spite of base loading of the Bhira Generating Station. During 2005 this lake has again overflowed continuously causing floods in parts of Pune district.

Considering the present live storage capacity of 523 million cubic metres (MCM) without FSL increase and without Lake partitioning, theoretically it should have been possible to utilise 490 MCM, 480 MCM, 474 MCM, 479 MCM & 479 MCM during 1998-99 to 2000-01, 2001-02, 2002-03, 2003-04 & 2004-05 respectively considering the irrigation/drinking water releases and taking into account evaporation loss (22 MCM). However after studying the past generation pattern, it is observed that non-monsoon utilisation is significantly lesser than the figures indicated above. This is due to the fact that as the live capacity is only 70% of 75% dependable inflows, it does not allow to have the required flexibility so as to utilise the water optimally. This translates into higher water utilisation (resulting in higher generation) during monsoon than what is actually required. There are many instances (past and present) when Bhira station [consisting of Bhira Old Power House (BOPH) and Bhira Pumped Storage Unit (BPSU)] was forced to generate either full day or nearly full day.

It is a known fact that hydro power stations are best suited for peaking operation and thermal power stations for base load operation. With the Mulshi Lake partitioning and capacity augmentation schemes, there will be no necessity to utilise the water to the extent as is being done at present during monsoon. Thus there will be no necessity to base load the Bhira power station.

In spite of base loading, there were instances of spills. With the proposed augmentation along with Lake partitioning scheme, probability of spills in the lakes will be significantly less and these other wise spills can be utilised for power generation.

In order to avoid spilling of Mulshi Lake and subsequent flooding of surrounding areas as well as base loading the station during monsoon, it is necessary to increase storage capacity of the lake itself or transfer water at a higher rate (than that being done/possible

at present) from the Mulshi Lake. It is feasible to enhance the live capacity only up to certain extent (688 MCM) which will satisfy the requirement partly. Hence the other alternative of augmenting the generating capacity has also to be studied in parallel.

Hence, in addition to the Lake partitioning scheme, it is planned to increase the generating capacity of the existing hydro power station at Bhira.

Location map of the proposed power augmentation scheme is shown in Fig.2.1.

2.4 TCE'S ROLE

TPC assigned TCE the task of preparation of Feasibility Report (FR) to enhance the generating capacity at Bhira and Environmental Impact Assessment (EIA) study in view of the proposed project. Studies for preparing FR has been carried out separately and the FR was submitted first.

Present study covers EIA studies only. For continuity some of the technical information/studies which were discussed in detail in the FR have been briefly mentioned in this report.

Scope of the EIA assignment is to :

a. Baseline data collection

b. Identification and evaluation of environmental impact due to the construction activities and operation of the proposed plant

c. Delineate the mitigation measures for the impacts

d. Outline the Environmental Management Plan and post project monitoring requirements

TCE team of engineers along with TPC officers visited the hydro power station at, project site and its surrounding area to collect information required for making this EIA Report.

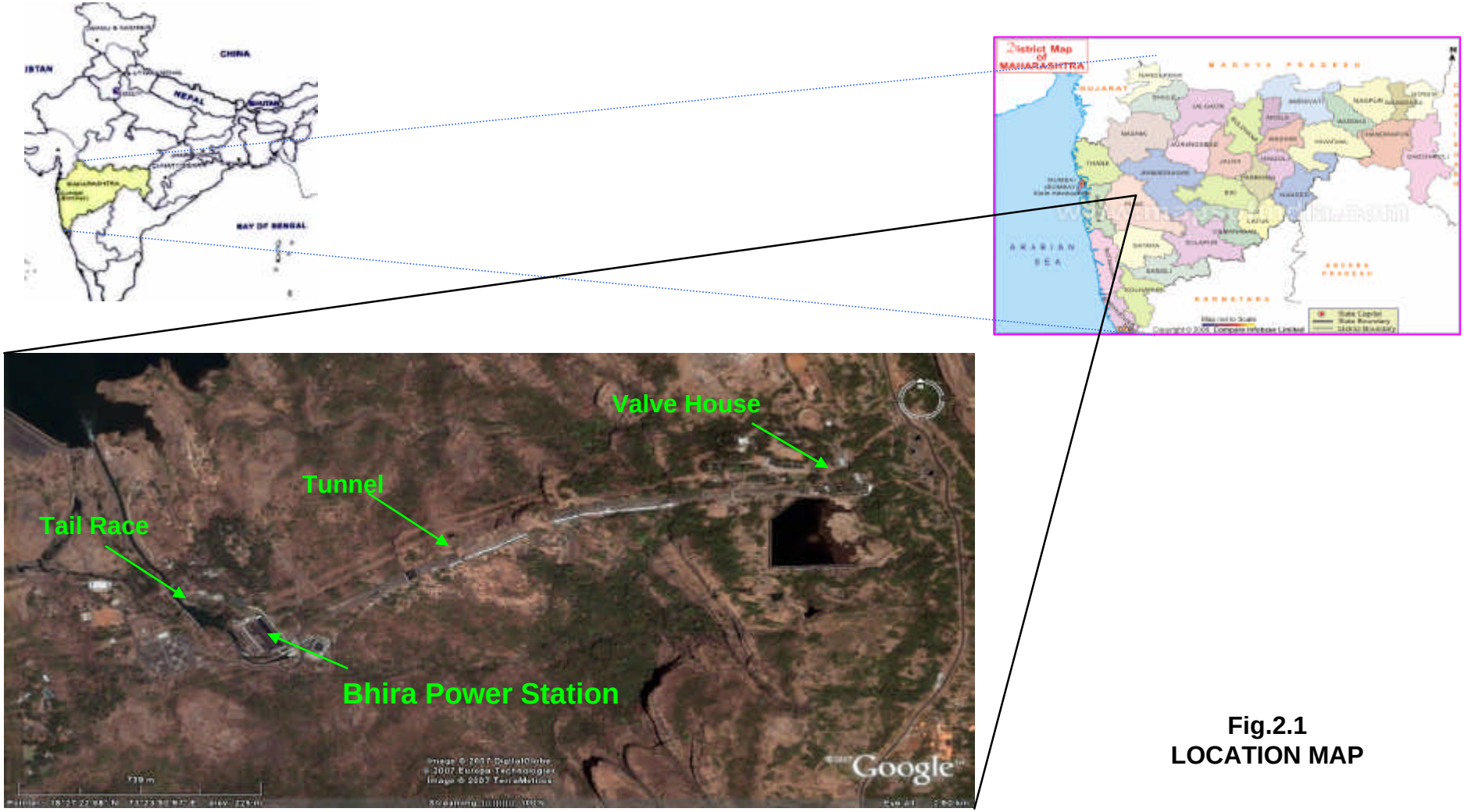


Fig.2.1
LOCATION MAP

CHAPTER - 3

BRIEF DESCRIPTION OF PROPOSED SCHEME

3.1 BRIEF DESCRIPTION OF EXISTING SCHEME

Bhira power station was commissioned in 1927 with 5 units having total of 88 MW capacity. In 1951 another unit of 22 MW was added. Subsequently the units were up-rated to totally generate 132 MW. After rehabilitation the total capacity was further enhanced to 150 MW.

Some part of the Bhira power station is in Pune district and some part in Raigad districts of Maharashtra state. Head works like Mulshi dam, intake, head race tunnel, surge shaft, valve house, part of the penstock system are in Pune district. Downstream part of the penstock, power house and tailrace system are in Raigad district.

Bhira has two power generating stations with the implementation of the 150 MW BPSU in 1997. General arrangement of Bhira scheme is shown in Fig.3.1 and briefly described below.

Mulshi dam situated about 40 km from Pune is a storage dam for Bhira Hydro Power Station. The dam across the rivers Mula and Nila, near village Mulshi, is a Gravity dam constructed in rubble masonry. The dam, 48 m high and 1556 m long, has a gross storage capacity of 753 Mm^3. Present live storage is 523 MCM which will increase by 48 MCM after the full supply level (FSL) is raised from the existing 606.1 m to 607.1 m.

Water conductor system (WCS) of Bhira Old Power House (BOPH) consists of intake, 4.38 km long tunnel followed by surge shaft, short length of tunnel (about 50 m), steel lined galleries (each 50 m long), Valve House No.1 (at Dongerwadi) and penstocks feeding 6 Pelton units.

The tunnel was partially lined. Subsequently during the course of operation lining and rock falls in the tunnel resulted in reduced carrying capacity which affected the power generation. To partially overcome this problem, during low lake level, an auxiliary reservoir of 0.1926 MCM capacity was constructed at Dongerwadi in 1951.

As critical power supply position made it impossible to obtain long outages of the tunnel to carry out repairs in the tunnel (Tunnel No.1), it was decided to construct a new tunnel. Subsequently, construction of the new tunnel (Tunnel No.2) almost parallel to the old tunnel started in 1960 and completed in 1965.

For the BPSU scheme, new tunnel is being used and the rehabilitated old tunnel was again connected to feed the units of BOPH.

Water conductor system for BPSU scheme consists of 4.53 km long, circular shaped, concrete lined tunnel (Tunnel No.2) followed by restricted orifice surge shaft. Steel lined tunnel (diameter 3.7 m and length of about 600 m) was provided between the surge shaft and valve house. A steel penstock which is 3.5 m in diameter, starts from AB-17N. Diameter of the penstock at the middle reach is 3.2 m and it gets reduced to 2.95 m in the lower reach. Vertical axis reversible Francis turbine is housed in the shaft power house.

3.2 OPTIONS CONSIDERED

Mulshi Lake partitioning is a stand-alone scheme independent of the proposed augmentation at Bhira. Thus it can be taken up even without the scheme for enhancing the generating capacity.

However, it is to be noted that without Lake partitioning scheme, in a 75% dependable year, requirement for additional generating capacity will be 30 MW & 80 MW considering non-monsoon & monsoon requirements respectively. Since peak shortages are more pronounced in non-monsoon period, augmentation considering non-monsoon requirement is the governing criteria while determining the additional capacity. Thus it can be inferred that while Mulshi Lake partitioning is necessary for the 75 MW augmentation of the Bhira power station, the same can not be said otherwise.

As per the studies carried out and elaborated in the Feasibility Report, it is proposed to augment the Bhira station by 75 MW.

Two alternatives were studied to select the capacity of the new power plant.

In the first alternative, installing a new 75 MW unit fed by with 75 MW WCS (downstream of tunnel no.1 surge shaft) is studied.

Second alternative being studied is relegating/retaining the unit no.1 (25 MW) of BOPH as a standby (to be used only in case of emergencies) and install a new unit of 100 MW fed by 100 MW WCS (downstream of tunnel no.1 surge shaft). It is observed that unit no.1 of the BOPH being very old is having a very low efficiency of 79%. Also, head loss in the existing penstock no.1 feeding unit no.1 is about 33.3 m. With the new WCS downstream of the tunnel no.1, head loss in the WCS of 100 MW will be significantly lower which will result in additional generation. In addition, as efficiency of the new unit will be about 91% there will be higher generation vis-à-vis the generation through the existing unit no.1. With the installation of 100 MW unit, it will be possible to avoid the cost towards refurbishment of unit no.1.

These alternatives are studied and discussed in detail in the Feasibility Report.

Considering all the factors, it is proposed to install a new 100 MW unit fed by 100 MW WCS (Alternative II)

3.3 MULSHI LAKE PARTITIONING

3.3.1 Background

Present live storage capacity of Mulshi Lake is 523 MCM as against the average inflow of about 800 MCM. In the past there are instances of overflow of this lake in spite of base loading of the Bhira Generating Station. During 2005 also this lake has again overflowed causing floods in parts of Pune district.

One of the solutions to minimise spilling of Mulshi Lake and subsequent flooding of surrounding areas is to increase the live storage capacity of the Lake. This can be made possible by partitioning of the Mulshi Lake.

3.3.2 Description of the proposed scheme

Mulshi Lake partitioning will enable achieving in-effect lowering of MDDL thereby increasing the live storage of the Lake. Partitioning can be done by constructing a bund at a suitable location. Fig.3.2 shows the proposed Lake partitioning scheme. The location and height of the bund is decided such that

- Length of the bund will be minimum.
- Ground levels at location of bund shall be lower than EL 584 m so that Mulshi lake spread extends up to the bund and water can be pumped from one side of the bund (Mulshi Lake side) to the other side of bund (Davdi side) when the lake level falls below 592 m (existing MDDL of 590.09 m will have to be raised to about 591 m considering extra cover requirements due to the increase in velocity in tunnel no.1 due to conveyance of additional discharge).
- Storage capacity of the pond (portion of Mulshi Lake on Davdi side) shall be adequate for at least two days's requirement. This storage capacity should be available above the level at which the existing water conductor system can draw required discharge corresponding to desired generation.

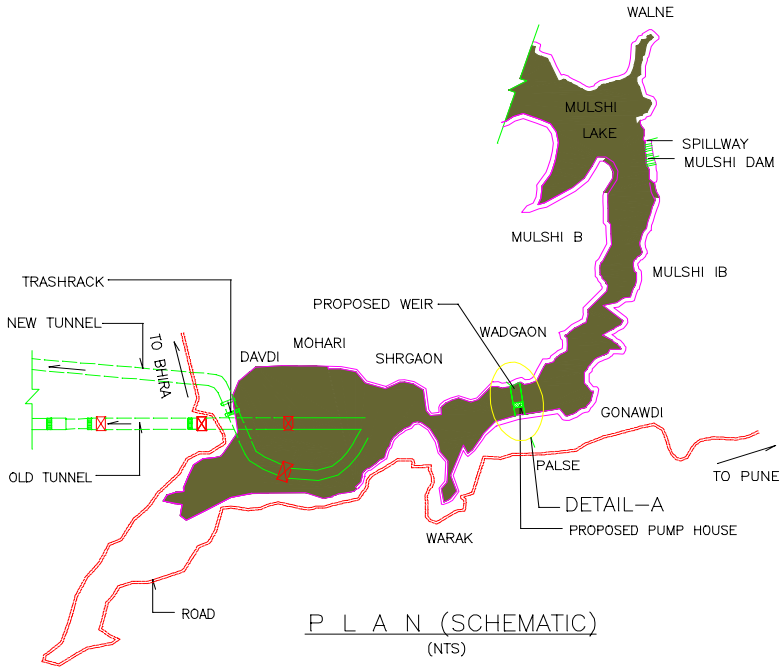


Fig.3.2 - Proposed Mulshi Lake partitioning

Considering the above factors, it is found suitable to locate the bund near Palse village. The proposed bund could be of colgrout masonry. The top level of bund is proposed at El.595.00 m considering storage capacity requirements. As water level in the Lake falls below 595.00 m, to avoid cutting off the pond on Davdi side from the main Mulshi Lake, it is necessary to provide a spillway in the bund/weir to maintain continuity of water passage.

Length of the spillway will be 35 m. The spillway will be provided with 6 nos. of vertical lift gates. Operation platform of the gates is proposed to be at El. 608.00 m. The gates will be in open position till the Lake level is at or above 592 m. When the Lake level falls below 592 m, these gates will have to be closed and pumping has to start.

The pumps can be of vertical turbine or concrete volute type and discharge of about 40 m^3/sec. considering 20 hrs/day pumping. Variation in head is from 3 m to 11 m. As pumps with such a large percentage variation in head are not available, two sets of pumps will be required.

An alternative to this scheme could be to provide single set of pumps with top of bund at El. 595 m. The pump will be having two separate delivery pipes at different levels i.e. when the reservoir water level is between 584 m to 588 m, the delivery will be at El. 595 m and when level is between 588 to 592 m delivery will be 598 m. In this arrangement, capital cost of one set of pump will be saved. However, pumping head will always be higher and will be in the range of 8 m to 12 m.

The pump house can be constructed on bank or in the reservoir. Each arrangement has its own advantages and disadvantages. If the pump house is located on banks, then it can be constructed irrespective of water levels in the Lake whereas if positioned in reservoir, it will require an approach bridge and construction period will be limited to about three months. For the second alternative, no separate approach channel or forebay is required and excavation cost is reduced. After studying both the alternatives, it is proposed to construct pump house in reservoir from cost considerations. In this arrangement, a pump house is proposed to be located in bund after the spillway block near Mulshi - Dongervadi road. For this no separate cofferdam is necessary, as the cofferdam for bund can be utilised for construction of pump house also.

For lake contents between EL 584 to 592 m, the theoretically it is possible to generate with water level at 595 m. However average water level of 593.5 m is considered in the evaluation of benefits.

With this alternative, it is possible to lower the water levels from the present MDDL of 590.09 m by about 6 m and in the process converting a portion of the present dead storage into live storage. This means that in-effect MDDL would be about 584 m.

It is estimated that about 117 MCM (out of 230 MCM) of the present dead storage could be converted into live storage.

3.4 DESCRIPTION OF PROPOSED SYSTEM WITH NEW 100 MW UNIT

3.4.1 Civil system

Proposed system consists of water conductor system consisting of existing tunnel (tunnel no.1), extension of existing Valve house (to accommodate new valve), new branch tunnel, new penstock, new power house and tail race system. Fig.3.3 shows the schematic hydraulic diagram.

3.4.1.1 Water conductor system

Water conductor system to convey the additional discharges are divided into two main stretches namely:

- Stretch between Mulshi Lake and surge shaft near Dongerwadi
- Stretch between surge shaft near Dongerwadi and valve house near auxiliary reservoir
- Stretch between valve house near auxiliary reservoir and power house

Stretch-wise alternatives considered are discussed in detail in Chapter 6 of the Feasibility Report. For continuity, the alternatives available are mentioned below.

a. Stretch between Mulshi Lake and surge shaft near Dongerwadi

Possible alternatives to convey the additional discharges in this stretch are:

i. Utilise the existing tunnel no.1 or tunnel no.2

ii. Construct a new tunnel from Mulshi Lake

It is proposed to opt for Alternative I

b. *Stretch between surge shaft near Dongerwadi and valve house near auxiliary reservoir*

In this stretch, it is proposed to construct a new 2.90 m diameter, 186 m long, steel lined tunnel (designed to carry water to generate 100 MW) starting from the end of existing branch tunnel at the bottom of the surge shaft on tunnel no.1.

c. *Stretch* between valve house near auxiliary reservoir and power house

Alternatives to convey the discharges for the 100 MW unit in this stretch are:

i. Construct a new penstock by dismantling penstock feeding unit no.1

ii. Extend the proposed branch tunnel from valve house

Considering all the factors and the advantages of extending the tunnel branch tunnel vis-à-vis laying a new penstock by dismantling the existing penstock, it is recommended to opt for Alternative II.

Summarising,

- Length of the steel lined branch tunnel between surge shaft and valve house is 186 m. Diameter of the tunnel in this reach is 2.90 m.
- Length of the cut & cover penstock (encased in concrete) between valve house and steel lined tunnel is 76 m. Diameter of the penstock is 2.90 m
- Length of the steel lined tunnel between end of cut & cover penstock and encased penstock (near proposed power house) is 1519 m. Diameter of the tunnel varies between 2.60 m in the upper most reach to 2.30 m in the lower most reach.
- Length of the penstock encased in concrete is 109 m. Diameter is 2.30 m.

3.4.1.2 Power house

Two alternative locations are considered.

a. Accomodating the new unit in the BOPH (6 x 25 MW)

b. New power house on the north west side of the BOPH

Considering all the factors, it is recommended to opt for Alternative II.

3.4.1.3 Tail race system

Tailrace discharge from the 100 MW unit will be released into a new tailrace channel which will be connected to the existing diversion pond from where diversion tunnel of Bhira Tail Race Project (BTRP) starts. The new tailrace channel will be in the form of cut & cover box culvert of about 60 m length. Existing diversion channel will have to carry additional discharge of about 18 cumecs with respect to present discharge of about 75 cumecs, considering combined generation of BPSU and BOPH. Hence the carrying capacity of the diversion channel will have to be augmented either by widening or raising the channel. It will be advantageous to opt for the alternative of raising the channel as this will not disturb the regular operation of the power plant. With the addition of new unit, the water depth in the channel will increase by 0.60 m. The channel height will have to be increased by 0.60 m by constructing side walls on both banks of the channel. The ungated weir constructed on the natural nalla to divert Bhira releases to pick-up pond, will also have to be correspondingly raised to match with top level of the raised wall.

There are two number of radial gates provided across the diversion channel for its isolation in case of any repairs to be carried out. It is proposed that the existing gates will be lifted up to the revised FSL and the hoisting track of these gates will also have to be correspondingly raised. A concrete seal will have to be constructed below the gate seal and a side channel with a gate and hoisting arrangement will have to be constructed to carry the additional discharge. However for undertaking these activities, it is necessary to take complete outage of BPSU, BOPH and BTRP.

At present Bhira power station is releasing about 2 MCM of water distributed over 12 hours on an average basis in non-monsoon months. In future, with additional capacity of 100 MW, the power station is intended to work for 8 hrs. As a result, pick-up pond will receive about 2.7 MCM of water in 8 hrs. Simulation study is carried out considering the carrying capacity of the interconnecting tunnel between pick-up pond and Rawalje forebay, storage capacity of both the ponds and present generation pattern of Rawalje power station. Studies reveal that pick-up pond will not spill with the modified operation pattern of Bhira power station.

3.4.2 Mechanical system

Mechanical system will consist of turbine with its auxiliaries viz. governor, oil pumping system, cooling water system etc. and power house auxiliaries viz. main inlet valve, material handling system, drainage & dewatering system, air conditioning & ventilation system, compressed air system, fire fighting system and instrumentation & control system.

3.4.3 Electrical system

Electrical System for the proposed scheme will consist of Generator, AC system, control and protection, DC System, power evacuation, switchyard generator transformer and other systems like lighting, cabling and earthing.

3.4.4 Hydraulic parameters of proposed 100 MW unit

Rated discharge for the new 100 MW unit is 23.8 m^3/sec. and rated head is 480 m.

3.4.5 Benefits due to proposed scheme/s

Benefits due to proposed scheme/s are summarized below

<u>Mulshi Lake partitioning only</u>

It is possible to have

- 25.5 MU of annual additional generation
- one-time generation of 133 MU
- deferred generation of 193 MU (from monsoon to non-monsoon)

<u>Mulshi Lake partitioning and new 100 MW unit</u>

It is possible to have

- 34.46 MU of annual additional generation
- one-time generation of 133 MU
- deferred generation of 193 MU (from monsoon to non-monsoon)
- 75 MW of peaking power
- Flood control in Pune district
- Additional power generation at Maharashtra State Power Generation Company
- Improved in socio-economic status (Indirect)

Fig.3.1 – General arrangement

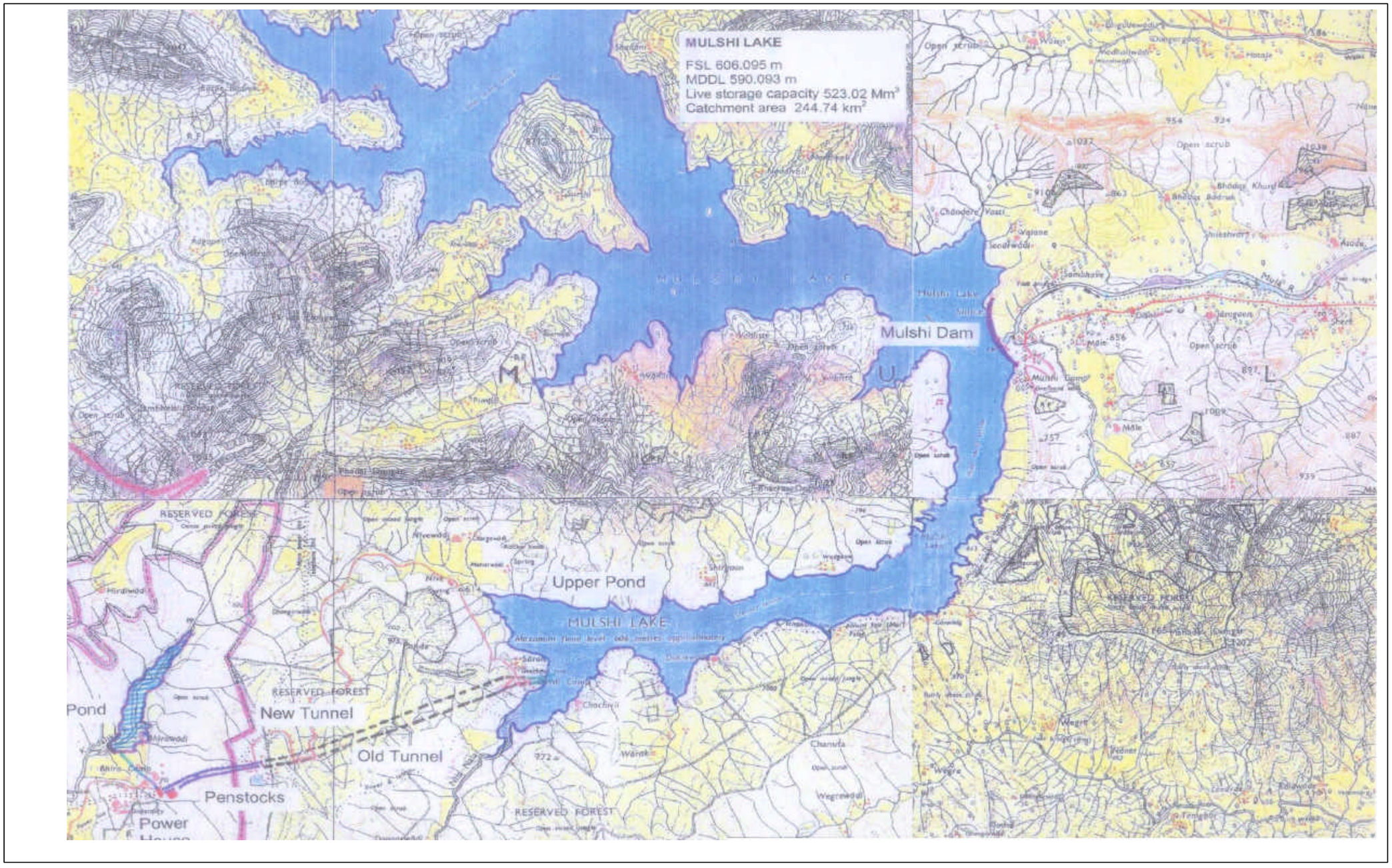
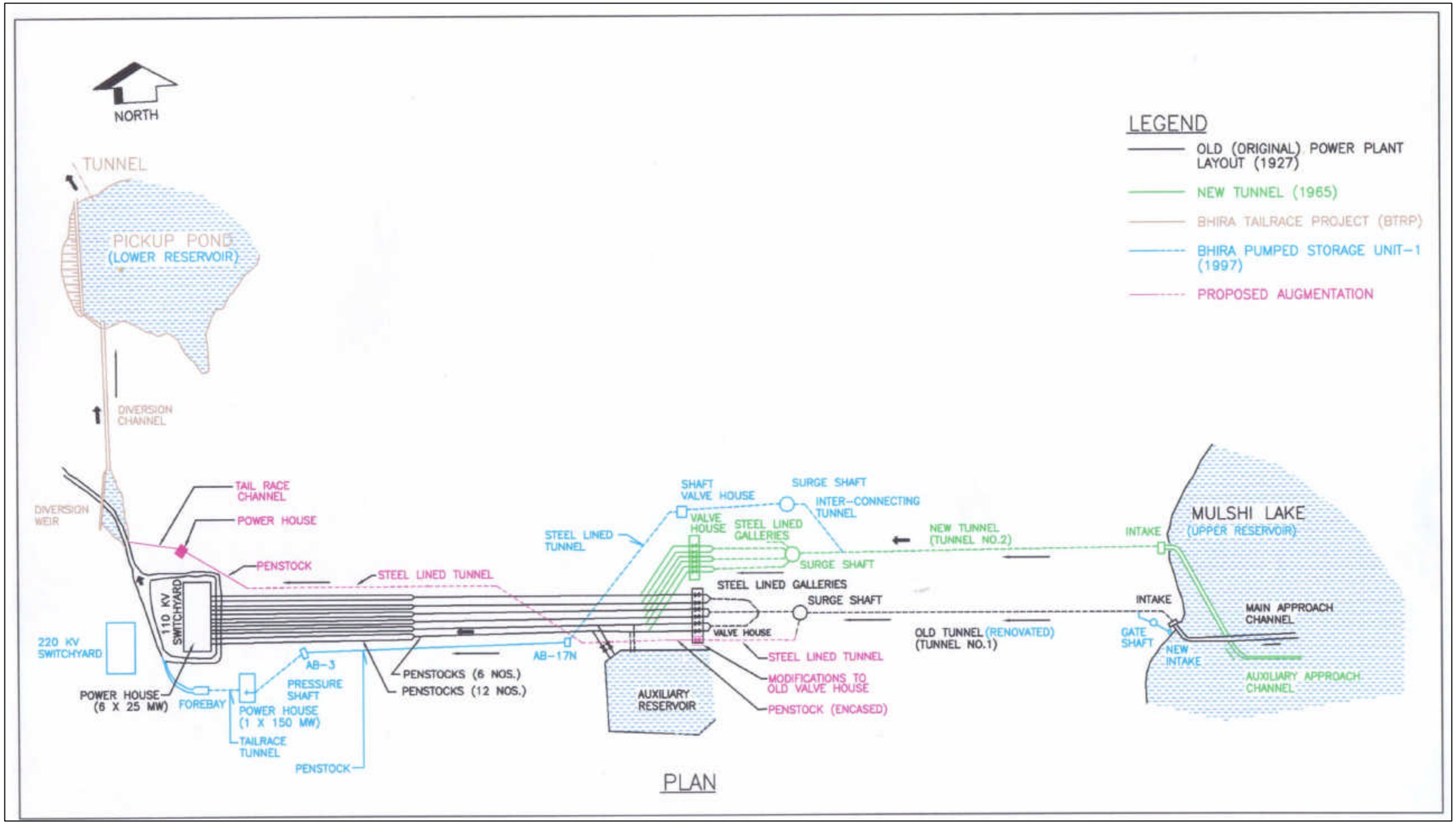


Fig.3.3 - Schematic Hydraulic Diagram



CHAPTER - 4

BASELINE ENVIRONMENTAL CONDITION

4.1 GENERAL

In order to predict anticipated impacts due to any project, it is necessary to obtain baseline information of the environment as it exists, which would serve as a datum.

Inter-action of baseline environment and the anticipated impacts are the basis for the environmental management plan for the activities of the proposed power plant.

This chapter includes existing scenario for various environmental components of the study area.

4.2 PROJECT SITE

TPC intends to augment the Bhira power station by utilising its existing premises to take advantage of available land, head works (Lake, dam and part of existing water conductor system), part of tail race system, transmission system anda other infrastructure required for the augmentation. General arrangement of the of the existing Bhira scheme is depicted in Fig. 3.1.

Components of the existing and proposed scheme are located partlly in Pune and Raigad Districts of Maharashtra State.

Existing head works like Mulshi dam, head race tunnels (no.1 and 2), surge shafts, valve house and part length of penstock are in Pune district.

Part length of penstock (lower reaches), BOPH & BPSU power houses and tail race system of the proposed scheme are part of Raigad district.

The power station is well connected by road to Mumbai. The power houses (BOPH and BPSU) are situated about

- 7 km from state highway
- 28 km from Mumbai - Goa national highway no.17 (from Kolad)
- 28 km from Kolad railway station (Konkan Railway)

Geographical location of power station is approximately 18^0 27' N latitude and 73^0 23' E longitudes. The location of proposed site is shown in Fig. 2.1.

4.3 METHODOLOGY

A general reconnaissance survey of the study area was done before the selection of sites for environmental monitoring. The area covered took into consideration accessibility to the sampling sites, topography of the area, major habitation and location of sensitive areas. Some of the recently generated data from secondary sources were also collected and used as baseline information.

4.4 BASELINE DATA

Baseline status of environmental quality in the vicinity of project expansion site serves as a basis for identification and prediction of impact. The baseline environmental quality status is assessed through field studies within the study area for various components of environment, viz. air, noise, water, land, biological and socio-economic. Baseline environmental quality of the study area of 10 km radius from the proposed project have been identified through network method. The cause - condition - effect are devised for the individual environmental components as well as overall impact.

Baseline data collection for each of the environmental components is based on the location of proposed project and anticipated distance of the significant impact. Study area is defined for each of the environmental components independently taking into consideration the vulnerability of the environmental component with respect to the activity of proposed expansion.

4.4.1 Physiography and drainage

The power station is fed by water stored in the Mulshi Lake located in Mulshi taluka of Pune district. After power generation water is released into the tail race channel which joins the Patalganga river. Topography of study area is indicated in Fig. 3.1. Surrounding areas of the plant were studied for assessing the baseline environmental conditions.

It is found that there is no national park, biosphere reserve, sanctuary, habitat for migratory birds, archaeological site and airports within 10 km radius of the study area.

Source of water for existing power plant is Mulshi Lake which will be utilised for the proposed scheme as well. There is no requirement to construct any new dam or lake which may necessitate resettlement of people of the area.

4.4.2 Climate

The climatology of study region is typical to that of the west-coast of India with regular and seasonal rainfall during monsoon. The year may be divided into four seasons namely:

- winter season from December to February
- hot season from March to May
- monsoon season from June to September and
- post-monsoon season includes October and November

Temperature starts climbing up from March onwards and it reaches its maximum in the month of May. Air is more humid in power house area (which is about 100 m above mean sea level) as compared to the head works area which is about 600 - 620 m above mean sea level. Air is more humid in monsoon, post-monsoon and summer seasons as compared to winter season.

4.4.3 Meteorology

Meteorological station for studies was established at centrally located guest house inside the premises of Bhira power plant during the air quality monitoring period for post monsoon season. This site was hindrance free and open from all direction. Site specific meteorological data were collected for

wind speed, wind direction, maximum & minimum temperature, relative humidity (RH), and rainfall. The collected meteorological data for post-monsoon season were analysed for hourly variation.

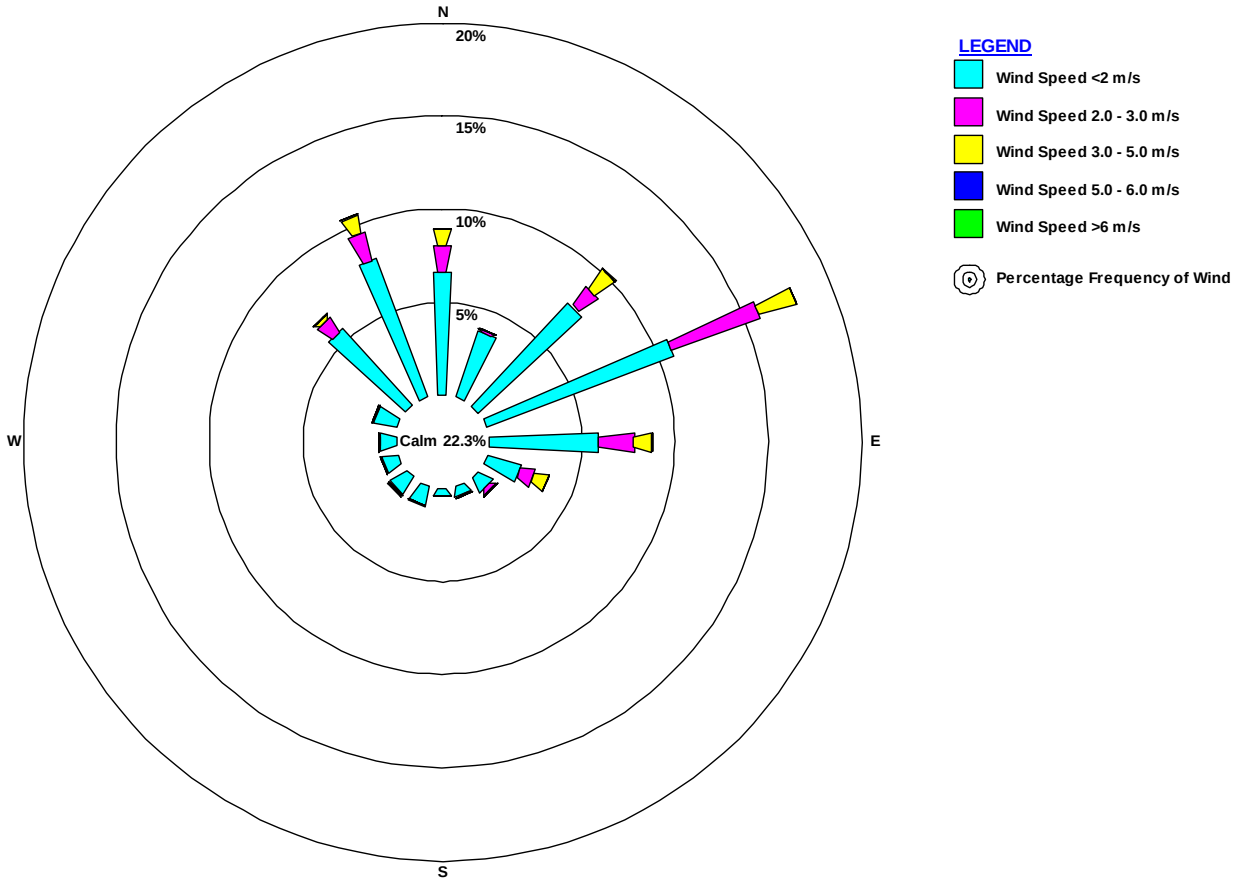
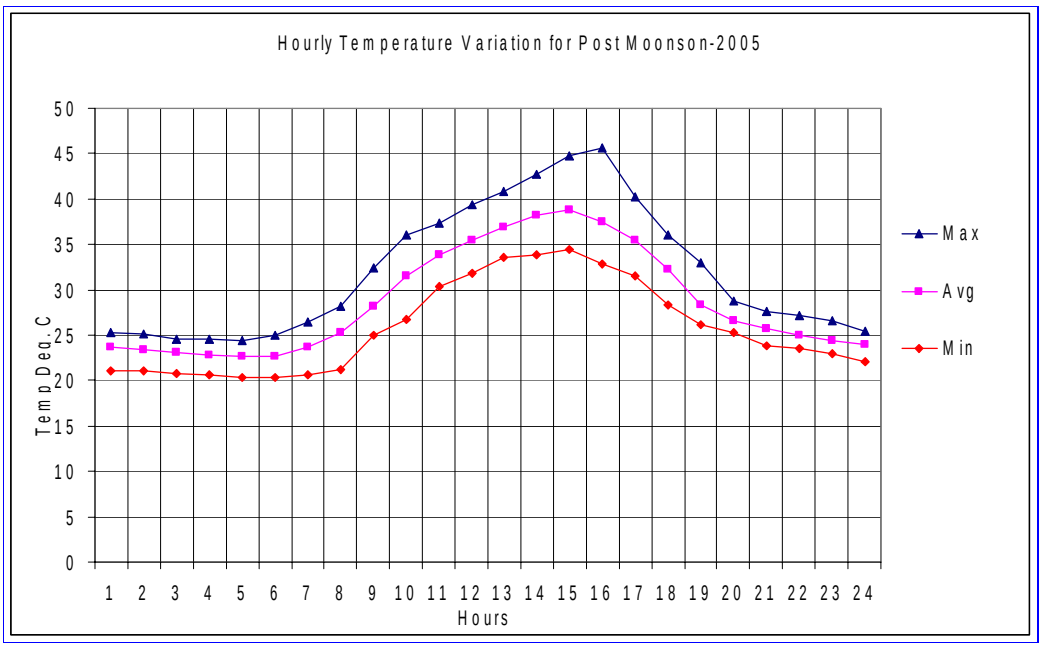


Fig. 4.1 – Windrose diagram for post-monsoon of 2005

Fig. 4.2 - Hourly Variation of Temperature at site



Collected data on wind speed and direction were analysed and wind rose diagram was drawn with the help of in-house software. Prevailing wind direction at site is from NE sector during post-monsoon season. Hourly variation of wind speed and wind direction is shown in Fig. 4.1.

Mean daily maximum temperature during post-monsoon season raises up to 45.7°C and minimum falls comes down to as low as 20.4°C. Twenty four hourly variation of maximum, minimum and average temperature at site is shown in Fig. 4.2.

Relative Humidity at site varies between maximum of 88.7% and minimum of 58.3%. Maximum, minimum and average hourly RH variation at site is shown in Fig. 4.3.

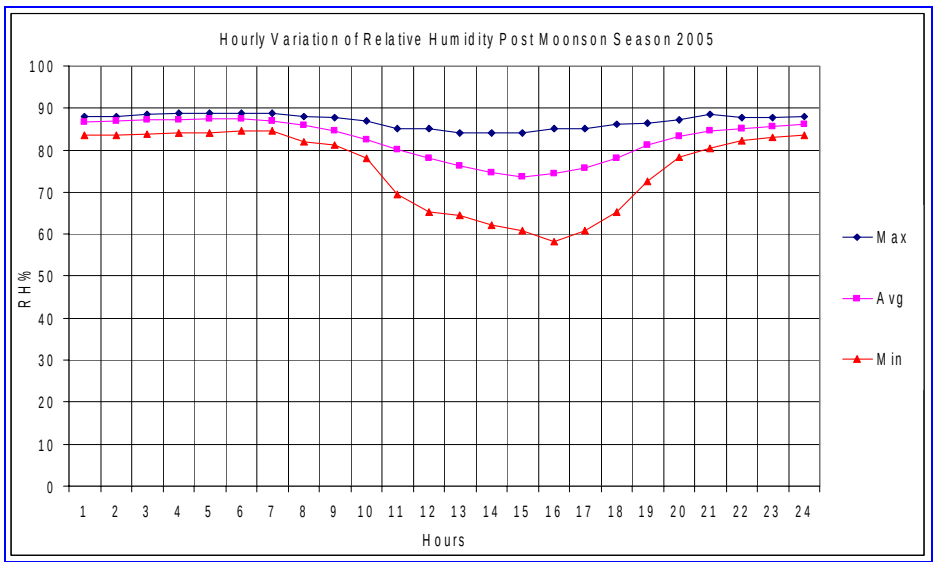
Summary of some important micro-meteorological parameter recorded at site is shown in Table - 4.1.

Table - 4.1

SUMMARISED METEOROLOGICAL DATA (POST MONSOON -2005)

Sr. No.	**Parameter**	**Post monsoon 2005**		
		Max. Value	Average Value	Min. Value
1	Wind speed, m/s	4.5	0.7	0
2	Temperature, °C	45.7	28.8	20.4
3	Humidity, %	88.7	82.5	58.3

Fig. 4.3 - Hourly Variation of Relative Humidity at Site



4.4.4 Ambient air environment

4.4.4.1 Study area

Reconnaissance survey of the study area covering 10 km radius was carried out before selecting sampling site for field environmental monitoring and secondary data collection. Sampling sites were finalised after the visit of study area for ambient air, noise, and soil and water quality monitoring stations.

Ambient Air Quality Monitoring Stations (AAQMS) were selected considering MoEF guidelines pertaining up wind and down wind direction, quadrants, topography of the area, sensitive locations and major habitation, if there was any. Based up on the criteria mentioned in former line, five AAQMS were selected for air quality monitoring.

The ambient air quality was monitored during the post-monsoon season of 2005 at all AAQMS. Locations of the monitoring stations are indicated in Fig.4.4. Details of AAQMS with direction and distance from the proposed source are given in Table - 4.2.

Table - 4.2

DETAILS OF AAQMS

Sr. No.	Location	Distance From The Plant (km)	Direction W.R.T. Project Site
1	Plant Site (Guest House - Bhira)	0	Central
2	Dongerwadi	5 km	E
3	Adharwadi	4 km	SE
4	Saje	7 km	SW

5	Koshimbale	6 km	NW

4.4.4.2 **Methodology**

Samples were collected twice a week during post-monsoon of 2005 (October – November). Samples of 24 hourly duration were collected for monitoring of SPM, RPM, SO_2 and NO_X. One hourly sample was collected on each monitoring day for CO. EIA report is based on the ambient air quality data generated for post-monsoon of 2005.

Each sample was collected based on the 24 hourly continuous sampling basis. The monitoring program was scheduled to cover all the days to get the representative concentration of the area. Analysis and methodology used for the monitoring was based on the procedure mentioned in the National Ambient Air Quality Standards (NAAQS) given by the Ministry of Environment and Forests (MoEF). Ambient air quality monitoring result for complete monitoring period is depicted in Appendix – 4.1. Locations for air quality monitoring stations are shown in Fig. 4.4. Analysis and measurement methods used for ambient air quality monitoring are indicated in Table - 4. 3.

Table - 4.3

ANALYTICAL / MEASUREMENT METHODS

POLLUTANTS	**METHODS**	**BIS CODES**
Suspended Particulate Matter (SPM)	High Volume Air Sampler	5182 (Part – IV) - 1973
Respirable particulate Matter (RPM)	HVS with Cyclone Separator	5182 (Part – IV) - 1973
Sulphur Dioxide (SO_2)	West & Gaeke Method	5182 (Part - II) - 1973
Nitrogen Oxides (as NO_2)	Jacob and Hochheiser Method	5182 (Part – VI) - 1975
Carbon Monoxide (CO)	Flame Ionization Detector	IS: 5182 (Part X)

Maximum, minimum, daily average and 98 percentile monitored values at each location are shown in Table - 4.4. Monitored ambient air quality at all AAQMS was compared with National Ambient Air Quality Standards (NAAQS) for residential and rural area. The National Ambient Air Quality Standards is given in Appendix – 4.2.

Table – 4.4

AMBIENT AIR QUALITY IN THE STUDY AREA

Location		**SPM** ($\mu g/m^3$)	**RPM** ($\mu g/m^3$)	**SO_2** ($\mu g/m^3$)	**NO_X** ($\mu g/m^3$)	**CO** ($\mu g/m^3$)
Plant Site (Guest House-Bhira)	Min	57.0	41.0	5.1	8.2	1054.0
	Average	77.3	52.6	6.0	9.1	1201.0
	Max	102.0	78.0	6.9	10.2	1287.0
	98 Perc.	100.7	74.3	6.9	10.1	1280.8
Dongerwadi	Min	60.0	42.0	5.1	7.9	1084.0
	Average	72.5	53.6	5.9	9.0	1285.0
	Max	95.0	71.0	6.4	10.9	1285.0
	98 Perc.	92.8	69.0	6.4	10.6	1278.8
Adharwadi	Min	72.0	50.0	5.1	8.4	1109.0
	Average	82.6	60.0	5.9	9.3	1229.4
	Max	102.0	74.0	6.8	10.2	1321.0
	98 Perc.	101.1	73.8	6.7	10.2	1315.1
Saje	Min	56.0	40.0	5.0	7.9	1058.0
	Average	72.5	51.3	5.7	8.5	1170.2
	Max	85.0	57.0	6.4	9.5	1268.0
	98 Perc.	84.3	56.8	6.4	9.4	1264.9
Koshimbale	Min	59.0	40.0	5.0	7.6	1059.0
	Average	71.7	50.8	5.8	8.1	1166.0
	Max	90.0	68.0	6.4	8.7	1265.0
	98 Perc.	89.3	68.0	6.4	8.6	1262.6

- Monitoring Period – post-monsoon' 2005

Analysis results indicates that SPM, RPM, SO_2, NO_x values are well within the stipulated NAAQ standards for residential and rural areas. CO remained well below the standard of 10,000 $\mu g/m^3$ for CO in all samples.

4.4.5 Noise environment

Monitoring of noise were carried out at five locations. Noise monitoring were carried out using precision noise level meter (make-Bruel & Kjar, model-2221, Made in Denmark, Digital type) on hourly basis for 24 hours. The location of noise monitoring station (N1 to N5) are shown in Fig. 4.4. The details of noise monitoring locations are shown in Table - 4.5.

Table - 4.5

DETAILS OF NOISE MONITORING STATIONS

Sr. No.	**Location**	**Distance** km	**Direction with respect to Plant Site**
N1	Plant Site (Guest House - Bhira)	0	Central
N2	Dongerwadi	5 km	E
N3	Adharwadi	4 km	SE

Sr. No.	Location	Distance km	Direction with respect to Plant Site
N4	Saje	7 km	SW
N5	Koshimbale	6 km	NW

Noise monitoring was carried out once during the post-moonson season at all noise monitoring locations. Sound levels had been recorded for 24 hours continuously for the duration of fifteen (15) minutes at hourly intervals.

Noise monitoring data has been analyzed for each location. Noise level equivalent value of results is shown in Table - 4.6. The results have been compared with the standard specified in Schedule III, Rule 3 of Environmental Protection Rules. The National Ambient Air Quality Standards (NAAQS) in respect of noise is given in Appendix - 4.3.

Table - 4.6

EQUIVALENT NOISE LEVELS (LEQ) OF THE STUDY AREA (10 KM RADIUS)

Sr. No.	Location	Results dB(A)		
		Day-Night (6 AM - 5 AM)	Day (6 AM - 10 PM)	Night (10 PM – 6 AM)
		LEQ	LEQ	LEQ
1	Plant Site (Guest House - Bhira)	55.6	57.1	50.9
2	Dongerwadi	54.9	56.1	51.7
3	Adharwadi	60.5	62.3	52.4
4	Saje	55.9	57.4	51.1
5	Koshimbale	57.3	58.9	51.3

Monitored noise levels at all the locations coming under rural and residential areas are within the prescribed limit of National Ambient Air Quality Standards (NAAQS) in respect of noise.

4.4.6 Water environment

Mulshi Lake is the source of surface water in the study area and is located about 6 kms from the power houses. Water is transmitted through tunnel and penstock up to the power houses and utilised for power generation.

4.4.6.1 Water Quality

Water samples from Mulshi Lake and Kundalika river were collected and analysed. Locations of water quality sampling stations are shown in Fig. 4.4. Results of analysed surface water quality are given in Table - 4.7.

Table - 4.7

SURFACE WATER ANALYSIS RESULTS (POST-MONSOON OF 2005)

Sr. No.	Parameters	Mulshi Lake	Kundalika River	IS:10500 Permissible limit
1	Temperature,^{0}C	24	22	25
2	pH Value	6.8	6.9	6.5 – 8.5
3	Turbidity, NTU	3	4	10
4	Magnesium (as Mg), mg/l	21.1	15.3	100
5	Alkalinity (as CaCO3), mg/l	26.4	31.9	600
6	Chlorides (as Cl), mg/l	5.50	6.04	1000
7	Sulphate (as SO4), mg/l	0.25	0.25	400
8	Nitrate (as NO3), mg/l	0.11	0.12	100
9	Fluoride (as F), mg/l	0.37	0.44	1.5
10	Sodium (as Na),mg/l	1.20	1.34	--
11	Potassium (as K),mg/l	0.39	0.48	--
12	Total Nitrogen ,mg/l	0.12	0.13	--
13	Total Phosphorous, mg/l	1.40	1.50	--
14	Dissolved Oxygen, mg/l	4.9	5.0	--
15	Chemical Oxygen Demand,mg/l	17.6	17.1	--
16	BOD3, at 27°C, mg/l	5.3	5.1	--
17	Phenol (as C6H5OH), mg/l	BDL	BDL	0.002
18	Iron (as Fe), mg/l	0.012	0.109	1.0
19	Copper (as Cu), mg/l	0.010	0.012	1.5
20	Cadmium (as Cd), mg/l	0.012	0.012	0.01
21	Lead (as Pb), mg/l	BDL	BDL	0.05
22	Zinc (as Zn), mg/l	0.001	0.002	15
23	Total Coliform, Nos./100ml	3	7	--
24	Faecal Coliforms. Nos/100ml	0	2	--
25	Zooplankton	6	5	--
26	Phytoplankton	10	7	--

* BDL : Below Detection Limit

Groundwater samples were collected from Rawalje, Nagshet-Koshimble and Adar-Wadi. These ground water samples were analysed for various parameters and results are given in Table - 4.8.

Table - 4.8

GROUND WATER ANALYSIS RESULTS POST MOONSON-2005

Sr. No.	Parameters	Location			IS:10500 Permissible limit
		Rawalje	*Nagshet-Koshimble*	*Adar-Wadi*	
1	Temperature, ^{0}C	22	21	23	25
2	pH Value	7.3	7.1	7.1	6.5 – 8.5
3	Turbidity, NTU	3	4	3	10
4	Magnesium (as Mg), mg/l	72.4	41.2	44.8	100
5	Alkalinity (as CaCO3), mg/l	107.8	84.7	75.9	600
6	Chlorides (as Cl), mg/l	19.10	7.55	7.55	1000
7	Sulphate (as SO4), mg/l	1.50	0.50	0.25	400
8	Nitrate (as NO3), mg/l	0.10	0.09	0.12	100
9	Fluoride (as F), mg/l	0.46	0.40	0.29	1.5
10	Sodium (as Na),mg/l	17.80	6.70	3.98	--
11	Potassium (as K),mg/l	2.35	0.25	0.45	--
12	Total Nitrogen ,mg/l	0.12	0.10	0.12	--
13	Total Phosphorous, mg/l	2.1	2.1	1.7	--
14	Dissolved Oxygen, mg/l	4.1	4.0	3.9	--
17	Phenol (as C6H5OH), mg/l	BDL	BDL	BDL	0.002
18	Iron (as Fe), mg/l	0.220	0.214	0.037	1.0
19	Copper (as Cu), mg/l	0.029	0.033	0.023	1.5
20	Cadmium (as Cd), mg/l	0.013	0.009	0.011	0.01
21	Lead (as Pb), mg/l	BDL	BDL	BDL	0.05
22	Zinc (as Zn), mg/l	0.007	0.020	0.066	15
23	Total Coliform, Nos./100ml	2	0	2	--
24	Faecal Coliforms. Nos/100ml	0	0	0	--

* BDL : Below Detection Limit

Fig. 4.4 - Location for AAQMS, Noise, Water and Soil Sampling Stations

Water quality is assessed based up on the parameters specified for Indian Standard 10500 (drinking water standards). Characteristics of water quality of ground water samples were agreeable with the permissible levels of the drinking water.

4.4.7 Soil environment

In order to assess the soil quality in the plant site and study area, 4 soil samples were collected from various locations. Details of soil sampling stations are given in Table - 4.9.

Table - 4.9

DETAILS OF SOIL SAMPLING LOCATIONS

Sample No.	Location	Type of Land
S1	Bhira	Agricultural land
S2	Nagshet - Koshimble	Agricultural Land
S3	Mulshi	Agricultural land
S4	Rawalje	Agricultural land

Detailed soil investigation was carried out for study area. Soil samples were collected from five locations during the study period. Locations of soil sampling stations are shown in Fig. 4.4. Physico-chemical analysis of soil samples was carried out to assess the quality of soil. Their results are furnished in Table - 4.10.

Table - 4.10

PHYSICO-CHEMICAL CHARACTERISTICS OF SOIL (POST-MONSOON 2005)

Sampling Location :		**Bhira**	**Nagshet - Koshimble**	**Mulshi**	**Rawalje**
Sr. No.	**Parameters, units**				
1	Appearance	Dark Brown	Dark Brown	Dark Brown	Light Brown
2	Texture	Clay loam	Clay loam	Clay loam	Clay loam
3	Sand, %	28.6	29.6	22.3	26.7
4	Silt,%	34.5	30.6	36.1	33.7
5	Clay,%	36.9	39.8	41.6	39.6
6	Organic Matter,%	1.52	1.92	1.77	1.47
7	Electric conductivity,ms/cm	0.07	0.08	0.07	0.06

Sampling Location :		Bhira	Nagshet - Koshimble	Mulshi	Rawalje
8	Bulk Density,gm/cc	1.12	1.21	1.16	1.02
9	Moisture content, %	1.25	1.37	1.29	1.30
10	Porosity,%	40.3	35.4	38.2	43.0
11	Nitrogen,mg/gm	0.36	0.31	0.22	0.22
12	Phosphrous, %	0.51	0.84	0.80	0.66
13	Potassium,(%)	0.25	0.22	0.02	0.10
14	Sodium Adsorption Ratio	4.90	0.43	0.63	3.58
15	pH (1:10 suspension)	7.6	7.3	7.0	8.0
16	Water Holding capacity,(%)	36.3	44.08	40.3	31.3
17	Permeability,cm/sec	0.0270	0.0320	0.0320	0.0330
18	Sodium (as Na),mg/gm	2.1250	0.1477	0.1933	1.1285
19	Chloride (as Cl),mg/gm	0.0001	0.0001	0.0001	0.0001
20	Total Alkalinity,mg/gm	0.0004	0.0002	0.0002	0.0004
21	Iron (as Fe),mg/gm	0.5561	0.5730	0.5840	0.6130
22	Cadmium (as Cd),mg/gm	BDL	BDL	BDL	BDL
23	Zinc (as Zn),mg/gm	0.0263	0.0290	0.0266	0.0202
24	Copper (as Cu),mg/gm	0.1113	0.2899	0.2979	0.2585
25	Lead (as Pb),mg/gm	BDL	BDL	BDL	BDL
26	Total Chromium (as Cr),mg/gm	BDL	BDL	BDL	BDL

Soil of the area varies in colour from dark brown to light brown. Soil pH plays an important role in the availability of nutrients for microbial activities and growth of plants. The pH values of the soil samples vary from 7 to 8. Electrical conductivity (EC) is a measure of the soluble salts and ionic activity in the soil.

Soil Samples were analysed for various chemical parameters. In the tested soil samples, available N, P & K values varies from low to high. Soil samples collected from agriculture land have medium organic carbon content while soil sample of proposed site indicated low content of organic carbon.

4.4.8 Seismology

The study area falls under the seismic zone-III. A massive earthquake struck Maharashtra on September 30, 1993 measuring 6.4 on Richter scale with epicentre at Killari in Latur district. Extensive damage was caused to life and property in the districts of Latur and Osmanabad. The earthquake killed 7,928

people & 15,847 livestock and injured 16,000 people. In Latur and Osmanabad, 52 villages were razed to ground wherein 27,000 houses, amenities and related infrastructure facilities were totally damaged. Nearly 2,20,000 houses in the adjoining villages of Latur and Osmanabad and 11 other districts of Solapur, Satara, Sangli, Beed, Parbhani, Ahmednagar, Nanded, Kolhapur, Aurangabad, Pune and Nashik suffered varying degrees of damage.

On December 10, 1967 an earthquake struck Koyna in Maharashtra. The intensity of this quake was recorded at 6.5 on Richer Scale. Small earthquakes of the intensity ranging from 2.7 to 4.1 were recorded by IMD at Koyna, Satara and Chandrapur region of Maharashtra.

4.4.9 Socio economic environment

Socio-economic study of the area is a part of environmental impact assessment study for the proposed power project. Socio-economics, a component of environment includes description of demography, available basic amenities like housing, health care services, transportation, education and cultural activities. Information on the above said parameters has been collected to define the socio-economic profile of the study area (10-km radius).

A reconnaissance survey of the study area was conducted during the study period considering the socio-economic condition of the study area. Data about the villages were collected both from secondary and primary sources. The secondary sources of data were primarily the Census data (year 2001) supplied by the Registrar General of India. For primary data, villages were visited along the Kundalika river near the power plant. Data was collected from villagers and Gram Panchayat officials. Information was also collected from some industries and farms/plantations.

List of villages falling within the study area with details of population characteristics and land use pattern is furnished in Appendices – 4.4, 4.5, 4.6 & 4.7. Summary of population characteristics, literacy and occupational pattern for the year 2001 of the study area are given in Table - 4.11:

Table - 4.11

DEMOGRAPHIC DETAILS WITHIN 10 KM RADIUS OF THE STUDY AREA

Demographic Parameters	Values
Total population	8928
Total male population	4424
Total female population	4504
0 – 6 year population	1427
Total study area (Hectare)	8140
Percentage of SC	4.8
Percentage of ST	12.2
Percentage of literates	56.3

Demographic Parameters	Values
Total population	8928
Percentage of illiterates	43.7
Percentage of female literates	23.9
Percentage of male literates	32.3

Source : Census data 2001

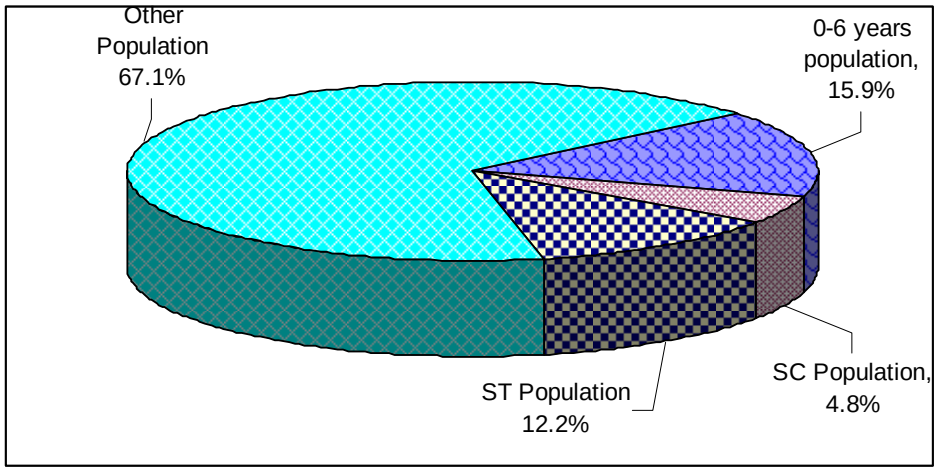
Data shows that, sex ratio of the population is 1018 females per 1000 males. Analysis

results indicate that percentage of 0-6 years population, schedule caste, schedule tribe and other population are 15.9%, 4.8%, 12.2% and 67.1% respectively. Graphical representation of population distribution are shown in the Fig. 4.5.

Legends used for demographic profiles are as follows:

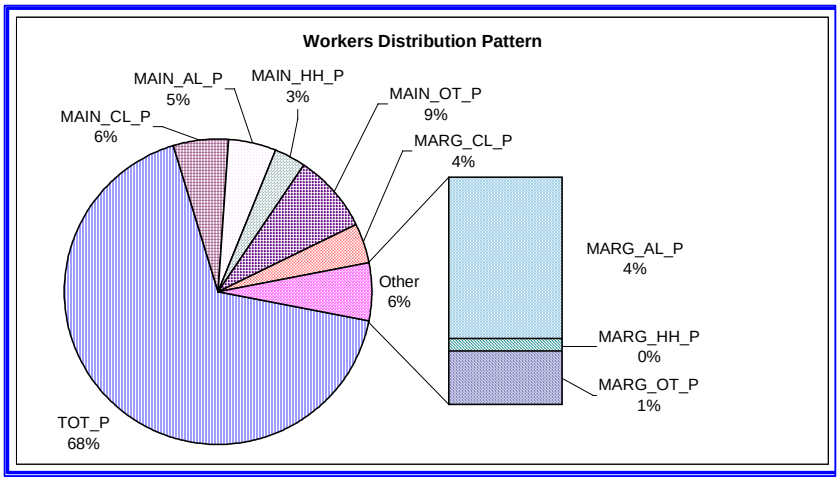
M:	Male	ST:	Scheduled Tribes
F:	Female	HH:	Hose Hold
Tot_M:	Total Male	CL:	Casual Labour
Tot_F:	Total Female	OT:	Over Time
P_06:	Population within 6 years	Work:	Workers
P:	Population	Marg:	Marginal
SC:	Scheduled Caste	Lit:	Literates
		ILL:	Illiterates

Fig. 4.5 - Population Distribution pattern,



Considerable portion (about 32%) of the total population falls under workers categories. Distribution of various categories of workers is shown in Fig.4.6.

Fig. 4.6 - Workers distribution pattern



Population of non-workers was highest at 68% followed by 22% main workers and 10% marginal workers. Non worker population cover all persons, who are engaged in unpaid home duties and do not know other work or have not done any work at all during the last one year. Main worker is a person, who works for major part of the year. Marginal worker is a person who works for a period of less than 6 months in a year. Detailed village wise workers distribution pattern is shown in Appendix - 4.5. Population wise distribution of workers is shown in Fig. 4.7.

4.4.9.1 Literacy status

Population of the study area shows variation in distribution of literates and illiterate percentages. It is found that 55% of the total population are literate and remaining 45% population is illiterate. Female literacy rate was 23%, which is lower than the male literacy rate of the study area. Detailed literacy pattern of the study area is included in Appendix - 4.7. Distribution pattern of literacy rate for all category of population is shown in following Fig.4.6.

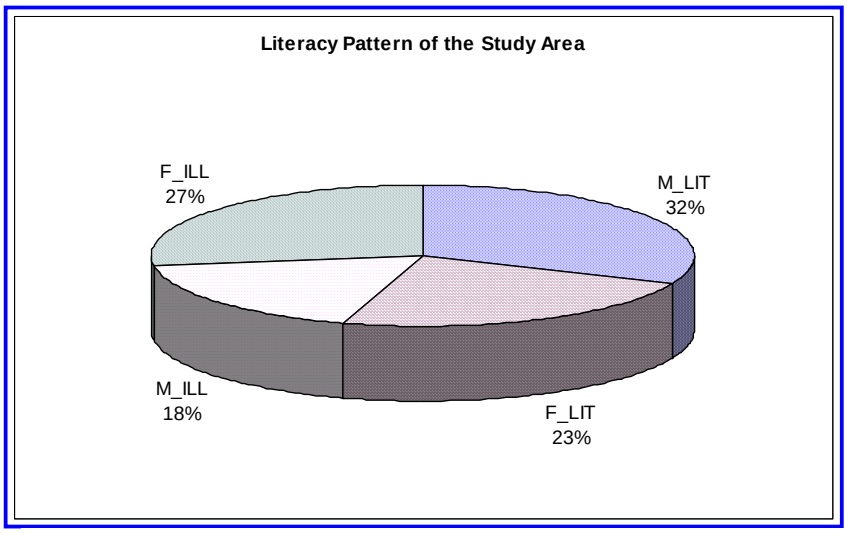


Fig.4.7 - Literacy pattern of the study area

4.4.9.2 Agriculture and amenities

Economic resources of the area includes agriculture, irrigation, live stock and animal husbandry, forest, industries, transport and communication, medical and public health. All villages area electrified and medical facilities are adequate.

Land has been classified according to the different uses of rural areas. The land has been classified into irrigated, un-irrigated, culturable waste, area not available for cultivation and forestland type. Land use pattern of the study area is shown in Fig. 4.8.

Major source of income is from agriculture produce. There are no industries in the area. There is only single crop taken in the area - viz. Rice, Nachani and Vari. Vegetables are grown on the river bed during dry season.

4.4.10 **Land use pattern**

Total study area for this project is about 8140 Ha. There is no forest area in any of the villages falling within 10 km of the study area. Details of land-use pattern for the study area is shown in Appendix - 4.6. Figure - 4.8 shows the agriculture land use pattern in the study area.

Fig. 4.8 indicates that only 7% of land area is coming under irrigation as compared to 8% un-irrigated area. It is found that major chunk of land area (38%) belongs to culturable waste which is currently waste land but can be used for cultivation. 29% of total land area is not under cultivation which can be brought under cultivation with availability of irrigation facilities.

Major portion of the land area is coming under un-irrigated land category. Nearly 7% of land area comes under irrigated land category. This indicates that majority of surrounding population is having sources of income other than agriculture also. Agriculture is mainly depending upon monsoon rain.

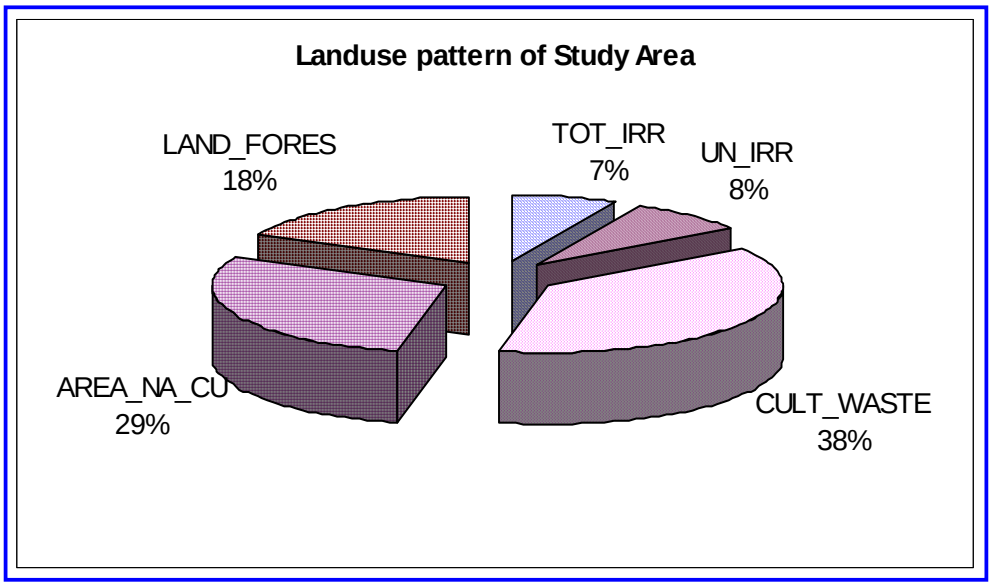


Fig. 4.8 - Land use pattern

Observation of detailed land use of the study area using satellite imagery and its interpretation is given in Appendix - 4.8.

4.4.11 Water bodies

Major water body in the study area are

- Mulshi Lake on the upstream side and
- Kundalika river downstream of the power house

4.5 SATELLITE DATA ANALYSIS AND ITS INTERPRETATION

4.5.1 Approach

Satellite image analysis was carried out for the preparation of land use/ land cover map of the study region. Study region is located in the districts of Raigad and Pune, Maharashtra. Approach for satellite data analysis adopted is the well-proven image processing procedures. Analysis was preceded with a ground survey, which comprised of data collection of ground features along with the respective geographical position in terms of latitudes and longitudes. Interpretation of the satellite data was supplemented by these ground truth studies.

Satellite data used has the following specifications:

- Satellite and Sensor: IRS P-6, LIS III (L-3)
- Date on which the image was taken: 03-Nov-05

The said time period of acquisition of the satellite data has been deliberately been chosen to depict the vegetation and other ground features at its best. Image processing software used is the professional version of ERDAS IMAGINE 8.4 under Windows NT. A Pentium 1V based computing machine with high processing speed and graphic facilities under the operating system of Windows NT is used for the image processing and interpretation.

4.5.2 Methodology

Detailed description of methodology followed for the generation of landuse-landcover map is as follows. IRS P6 data were extracted using the ERDAS Imagine's extract utility. Raw satellite data was subjected to the enhancing steps such as edge enhancement and histogram equalisation. Built-in functions of the image processing software was used to obtain the best classification results. Satellite data were geo-referenced by adopting the raster to raster geo-coding. For geo-referencing, the ground control points (GCP) recorded by Global Positioning System (GPS) during ground truthing of the study area were used. The GCPs were taken at locations well spread across the study region, and hence enabled to obtain very high geo-referencing accuracy. UTM projection system was applied to the image.

The geo-referenced image was viewed under different band combinations in the viewer of ERDAS IMAGINE and different features were demarcated based upon the tone, texture shape, size, association etc. Locational maps of study region and ground truthing data were also used for reference. Field studies proved to be very helpful in correctly demarcating the features. For

classification, 'supervised classification' was adopted. Classified features were verified with ground truth data. Land use/ land cover maps depicting the classified ground features for different areas of interest were subsetted from the master classified image. Circular regions with project site as center and radial distances of 50 kms, as shown in the subsequent sections, were few of the derived areas of interest. The proportional presence of different land uses in terms of statistical percentages was also derived for the said areas of interest. Appropriate legends were used to represent the various categories of landuse-landcover, and are written on the prepared landuse-landcover maps as indicated in Appendix - 4.8.

4.6 BIOLOGICAL ENVIRONMENT

Environmental Impact Assessment studies needs monitoring of each and every environmental component. Apart from other environmental components, biological environment is an important and integral part of EIA study, as whatever changes due to industrial activities takes place in the surrounding environment, affects both living and non-living component of environment. Assessment of terrestrial ecosystem concentrates on the tree and herbaceous layer vegetation because these are relatively conspicuous and easy to identify.

Study area fall under Sahyadri ranges. Forests located in the study area are fragmented due to variety of human interferences. The increasing anthropogenic activities may lead to degradation of the existing natural ecosystem. Considering the sensitivity of Sahaydri range, relevant ecological study has been carried out, so that necessary care and management could be introduced. Proper measures mentioned in environmental management plan (EMP) will be helpful in improving the surrounding ecosystem.

Baseline data for flora has been collected, which includes information on both plant species and plant communities. In the present study, information has been collected on existing plant species for site monitoring and management purposes. Information on distribution pattern of tree species has been collected to establish the interrelationship between species for prevailing environmental factors for post-development monitoring and management.

A reconnaissance survey of the study area was planned during the study period of post- moonson of 2005 to establish the existing baseline ecological condition of the study area. Collected information on flora and fauna is based up on field survey carried out during study period and discussions with local villagers.

Study area is near Mumbai - Goa national highway. Geographically it is situated on western edges of the Deccan Plateau on 73^0 23' E and 18^0 27' N. Vegetation of Bhira is of mixed deciduous and semi-evergreen type.

An inventory of flora and fauna species were collected from secondary source. The same are shown in Tables – 4.12 and 4.13.

Table - 4.12

INVENTORY OF PLANTS SPECIES OF THE STUDY AREA

Sr. No.	Name of plant	Family	Habit	Vernacular Name
1.	*Acacia catechu* Willd	Mimosaceae	T	Khair
2.	*Adina cordifolia*		T	Hed
3.	*Agave americana* Burger	Agaaceae	S	Ghaypat
4.	*Albizzia procera* (Roxb.) Benth.	Mimosaceae	T	Kinayee
5.	*Bambusa arundinaceae* Willd.	Poaceae	Bamboo	Kalak
6.	*Bassia latifolia* Roxb.	Sapotaceae	T	Moha
7.	*Bauhinia recemosa* Lamk.	Caesalpiniaceae	Tl	Apta
8.	*Begonia crenata* Dryand.	Begoniaceae	H	Ambati
9.	*Blumea lacera* (Clarke) Hook. f.	Asteraceae	H	Bhamrut
10.	*Bombax ceiba* L.	Bombacaceae	T	*Sawari, Sawar*
11.	Bridelia spinosa	Euphorbiaceae	T	
12.	Bridelia squamosa *(Lamk.) Geh.*	Euphorbiaceae	T	Asana
13.	*Butea monospema* (Lamk.) Jaub.	Fabaceae	T	Palas
14.	*Butea superba* Roxb.	Fabaceae	C	Palas Vel
15.	*Calatropis gigantea* (L.) R. Br.	Asclepiadaceae	S	Ruhi
16.	*Calycopteris floribunda* L.	Combretaceae	C	Ukshi
17.	*Cappiris horida*	Capparaceae	C	Ghawadi
18.	*Careya arborea* Roxb.	Myrtaceae	T	Kumbha
19.	*Carissa carandas* Grah.	Apocynaceae	S	Karvanda
20.	*Caryota urens* L.	Arecaceae	T	Bherli Mad
21.	*Cassia fistula* L.	Caesalpiniaceae	T	Bahava
22.	*Celosia argentea* L.	Amarantheceae	H	Kurdu
23.	*Clerodendrum innermi* (L.) Gaetn.	Verbenaceae	S	

Sr. No.	Name of plant	Family	Habit	Vernacular Name
24.	*Clerodendrum srratum* (L.) Moon	Verbenaceae	S	Bharangi
25.	*Derris indica* (Lam.) Bennett.	Fabaceae	T	Karanj
26.	*Dillenia indica* L.	Dilleniaceae	T	Karambal
27.	*Dioscorea bulbifera* L.	Dioscoreaceae	C	Karinda
28.	*Eclipta prostrata* L. f.	Asteraceae	H	Maaka
29.	*Entanda pursaetha* DC.	Fabaceae	C	Garbi, Garmabi
30.	*Eragrostis unioloides* (Retz.) Nees	Poaceae	H	Chimniche Pohe
31.	*Erinocarpous nimmoanus* Graham.	Tiliaceae	T	Chera
32.	*Erythrina indica* L.	Fabaceae	T	Pangara, Paranga
33.	*Euphorbia nerifolia* L.	Euphorbiaceae	S	Nivdunga
34.	*Ficus arnottiana* (Miq.) Miq.	Moraceae	T	Payar
35.	*Ficus arnottiana* (Miq.) Miq.	Moraceae	T	Payar
36.	*Ficus benghalensis* L.	Moraceae	T	Wad
37.	*Ficus recemosa* L.	Moraceae	T	Umbar
38.	*Ficus religiosa* L.	Moraceae	T	Pimpal
39.	*Garcinia indica* Choiss.	Clusiaceae	T	Kokam
40.	*Garuga pinnata* Roxb.	Burseraceae	T	Kakad
41.	*Gmelina arborea* Roxb.	Verbenaceae	T	Shivan
42.	*Holarrhena antidysenterica* (Roth.) A. DC.	Apocynaceae	S	Pandhara Kuda
43.	*Holoptelea integrifolia* Planch.	Urticaceae	T	Wavala
44.	*Ixora brachiata* Roxb.	Rubiaceae	T	Lokhandi
45.	*Jasminum arborescens*	Oleaceae	C	Kusari
46.	*Lagerstroemia parviflora* Roxb.	Lythraceae	T	Nana Bondara
47.	*Lagerstroemia speciosa* (L.) Pers.	Lythraceae	T	Taman

Sr. No.	Name of plant	Family	Habit	Vernacular Name
48.	*Lantana camara* Var. *aculeata* (L.) Mold.	Verbenaceae	S	Ghaneri,
49.	*Lasiosiphon eriocephlus* (Graham.) Decaisne.	Thymelaceae	S	Rametha
50.	*Leea indica* L.	Leeaceae	S	Dinda
51.	Leonotis nepetiifolia		H	
52.	*Loranthus flacatous* L.	Loranthaceae	Parasite	Bandgul
53.	*Malotus philippinensis* (Lamk.) Muell-Arg.	Euphorbiaceae	T	Shendri
54.	*Mangifera indica* L.	Anacardiaceae	T	Amba
55.	*Morinda citrifolia* L.	Rubiaceae	T	Bartondi, Alu
56.	*Mucuna pruriens* (l.) DC.	Fabaceae	CH	Khaj-kuili
57.	*Musa superba*	Musaceae	S	
58.	*Oxytenanthera ritchiei*	Poaceae	Bamboo	Chiva
59.	*Schleichera oleosa* (Lour.) Oken.	Sapindaceae	T	Kusumb
60.	*Sterculia urens* Roxb.	Sterculiaceae	T	Siadhol
61.	*Staxhyterpheta jamaicensis*	Lamiaceae	H	
62.	*Solanum violacae*	Solanaceae	H	Chichurdi
63.	*Syzygium cumini* (L.) Skeels	Myrtaceae	T	Jambhul
64.	Tectona grandis	Verbenaceae	T	Teak
65.	Terminalia belleirca *Roxb.*	Combretaceae	T	Hela, Bhela , Behla
66.	*Terminalia chebula* Retz.	Combretaceae	T	Hirda
67.	*Terminalia crenulata* Roth.	Combretaceae	T	Kinjal
68.	Terminalia tomentosa *Wt. & Arn.*	Combretaceae	T	Ain
69.	Thespesia populnia *Soland.*	Malvaceae	T	Ran Bhend
70.	*Tinospora cordifolia* (Willd.) Miers.	Menispermaceae	C	Gulve

Sr. No.	Name of plant	Family	Habit	Vernacular Name
71.	*Urena lobata* L.	Malvaceae	H	
72.	*Vitex negundo* L.	Verbenaceae	T	Nigdi
73.	*Vitis rapenda* Wt. & Arn.	Vitaceae	C	Gendal
74.	*Woodfordia fruiticosa* (L.) Kurz.	Lythraceae	S	Dhayati
75.	*Wrightia tinctoria* R. Br.	Apocynaceae	T	Kala Kuda
76.	Zizyphus mauritiana *Lamk.*	Rhamnaceae	S	Bor

Fauna

Wild animals are not observed within the vicinity of the plant site or near by villages. General birds and pet animals are found in the area. General list of fauna is furnished in Table – 4.13.

Table - 4.13

LIST OF FAUNA AT THE STUDY AREA

Sr. No.	Common Name	Scientific Name	Vernacular Name
1.	Barking Deer	*Muntiacus muntjak*	Bhekar
2.	Indian Hare	*Lepus nigricollis*	Sasa
3.	Indian Wild Boar	*Sus scrofa*	Ran Dukkar
4.	Jackal	*Canis aureus*	Kolha
5.	Leopard	*Panthera pardus*	Bibtya
6.	Indian Fox	*Vulpus bengalensis*	Khokad
7.	Mouse Deer	*Tragulus meminna*	Pisori
8.	Civet	*Paradoxurus hermaphroitus*	Udmanjar
9.	Indian Cobra	Naja naja	Nag
10.	Viper	*Vipera russelli*	Ghonas
11.	Common Rat Snake	*Ptyas mucosus*	Dhaman
12.	Common Green Whip	*Ahartulla nasutus*	Harantol
13.	Common Indian Monitor	*Varanus bengalensis*	Ghorpad

Appendix – 4.1

AMBIENT AIR QUALITY MONITORING REPORT

Monitoring Location : Guest House- Bhira

Sr. No.	Date of Monitoring	*Ground Level Concentration*				
		SPM µg/m^3	RPM µg/m^3	SO_2 µg/m^3	NOx µg/m^3	CO µg/m^3
1	17-10-2005	69	42	6.1	8.2	1215
2	18-10-2005	75	56	5.7	9	1250
3	24-10-2005	68	46	6.2	9.5	1287
4	25-10-2005	82	61	6.8	9.3	1185
5	31-10-2005	84	52	6.3	8.9	1145
6	01-11-2005	72	47	5.4	9.2	1235
7	08-11-2005	68	41	5.9	8.4	1109
8	09-11-2005	76	52	6.2	9.8	1259
9	15-11-2005	57	41	5.1	8.2	1054
10	16-11-2005	96	58	6.2	9.7	1258
11	25-11-2005	102	78	6.9	10.2	1158
12	26-11-2005	79	57	5.6	9.1	1257
Minimum		57.0	41.0	5.1	8.2	1054.0
Average		77.3	52.6	6.0	9.1	1201.0
Maximum		102.0	78.0	6.9	10.2	1287.0
98th Percentile		100.7	74.3	6.9	10.1	1280.8

Monitoring Location : Dongerwadi

Sr. No.	Date of Monitoring	**Ground Level Concentration**				
		SPM µg/m^3	RPM µg/m^3	SO_2 µg/m^3	NOx µg/m^3	CO µg/m^3
1	17-10-2005	64	43	6.1	8.4	1204
2	18-10-2005	72	52	5.7	8.7	1158
3	24-10-2005	80	62	6.2	9.5	1254
4	25-10-2005	68	52	5.9	8.0	1157
5	31-10-2005	60	42	5.9	8.6	1108
6	01-11-2005	75	58	6.2	9.6	1285
7	08-11-2005	95	71	5.6	10.9	1174
8	09-11-2005	70	59	5.1	7.9	1084
9	15-11-2005	68	45	6.1	9.2	1196
10	16-11-2005	85	62	5.1	8.6	1257
11	25-11-2005	60	46	5.9	9	1124
12	26-11-2005	73	51	6.4	9.4	1109
Minimum		60.0	42.0	5.1	7.9	1084.0
Average		72.5	53.6	5.9	9.0	1285.0
Maximum		95.0	71.0	6.4	10.9	1285.0
98th Percentile		92.8	69.0	6.4	10.6	1278.8

AMBIENT AIR QUALITY MONITORING REPORT

Monitoring Location : Adharwadi

Sr. No.	Date of Monitoring	Ground Level Concentration				
		SPM µg/m³	RPM µg/m³	SO_2 µg/m³	NOx µg/m³	CO µg/m³
1	17-10-2005	84	58	6	9.1	1205
2	18-10-2005	75	56	5.4	9.6	1248
3	24-10-2005	80	61	6.2	9.2	1285
4	25-10-2005	76	58	5.8	10.2	1285
5	31-10-2005	85	62	6.3	9.5	1245
6	01-11-2005	98	74	5.9	9.1	1174
7	08-11-2005	72	53	6.8	10.1	1285
8	09-11-2005	82	60	6	9.5	1157
9	15-11-2005	102	73	5.6	8.7	1109
10	16-11-2005	78	52	6.1	9.1	1294
11	25-11-2005	72	50	5.1	8.4	1145
12	26-11-2005	87	63	5.7	9.1	1321
Minimum		72.0	50.0	5.1	8.4	1109.0
Average		82.6	60.0	5.9	9.3	1229.4
Maximum		102.0	74.0	6.8	10.2	1321.0
98th Percentile		101.1	73.8	6.7	10.2	1315.1

Monitoring Location : Saje

Sr. No.	Date of Monitoring	Ground Level Concentration				
		SPM µg/m³	RPM µg/m³	SO_2 µg/m³	NOx µg/m³	CO µg/m³
1	17-10-2005	72	51	6.1	8.5	1145
2	18-10-2005	82	57	5.4	8.1	1254
3	24-10-2005	76	56	6.2	8.4	1245
4	25-10-2005	68	43	5.6	9.1	1186
5	31-10-2005	62	48	5.6	8.2	1058
6	01-11-2005	78	56	5.3	8.7	1120
7	08-11-2005	85	56	6.1	8.9	1214
8	09-11-2005	70	48	5.2	9.5	1121
9	15-11-2005	56	40	5.7	7.9	1089
10	16-11-2005	81	56	6.3	8.7	1168
11	25-11-2005	62	48	5.0	7.9	1268
12	26-11-2005	78	56	6.4	8.6	1174
Minimum		56.0	40.0	5.0	7.9	1058.0
Average		72.5	51.3	5.7	8.5	1170.2
Maximum		85.0	57.0	6.4	9.5	1268.0
98th Percentile		84.3	56.8	6.4	9.4	1264.9

AMBIENT AIR QUALITY MONITORING REPORT

Monitoring Location : Koshimbale

Sr. No.	Date of Monitoring	Ground Level Concentration				
		SPM µg/m^3	RPM µg/m^3	SO_2 µg/m^3	NOx µg/m^3	CO µg/m^3
1	17-10-2005	72	54	6.2	7.6	1145
2	18-10-2005	68	42	5.8	8.1	1254
3	24-10-2005	71	54	5.6	8.4	1196
4	25-10-2005	62	45	5.2	7.8	1142
5	31-10-2005	67	42	5.9	7.9	1059
6	01-11-2005	75	49	6.1	8.3	1158
7	08-11-2005	59	40	5.1	7.6	1124
8	09-11-2005	62	42	5.0	7.6	1095
9	15-11-2005	82	68	6.3	8.4	1184
10	16-11-2005	65	48	5.7	8.1	1245
11	25-11-2005	90	68	6.4	8.7	1265
12	26-11-2005	87	58	6.0	8.1	1125
Minimum		59.0	40.0	5.0	7.6	1059.0
Average		71.7	50.8	5.8	8.1	1166.0
Maximum		90.0	68.0	6.4	8.7	1265.0
98th Percentile		89.3	68.0	6.4	8.6	1262.6

Appendix – 4.2

NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

Pollutants	**Time-weighted average**	**Concentration in ambient air**			**Method of measurement**
		Industrial Areas	*Residential, Rural & other Areas*	*Sensitive Areas*	
Sulphur Dioxide (SO_2)	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3	Improved West and Geake Method Ultraviolet Fluorescence
	24 hours**	120 µg/m^3	80 µg/m^3	30 µg/m^3	
Oxides of Nitrogen as (NO_2)	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3	Jacob & Hochheiser Modified (Na-Arsenite) Method
	24 hours**	120 µg/m^3	80 µg/m^3	30 µg/m^3	Gas Phase Chemi luminescence
Suspended Particulate Matter (SPM)	Annual Average*	360 µg/m^3	140 µg/m^3	70 µg/m^3	High Volume Sampling, (Average flow rate not less than 1.1 m3/minute).
	24 hours**	500 µg/m^3	200 µg/m^3	100 µg/m^3	
Respirable Particulate Matter (RPM) (size less than 10 microns)	Annual Average*	120 µg/m^3	60 µg/m^3	50 µg/m^3	Respirable particulate matter sampler
	24 hours**	150 µg/m^3	100 µg/m^3	75 µg/m^3	
Lead (Pb)	Annual Average*	1 µg/m^3	0.75 µg/m^3	0.50 µg/m^3	ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	1.5 µg/m^3	1.00 µg/m^3	0.75 µg/m^3	
Ammonia1	Annual Average*	0.1 mg/ m^3	0.1 mg/ m^3	0.1 mg/m^3	
	24 hours**	0.4 mg/ m^3	0.4 mg/m^3	0.4 mg/m^3	
Carbon Monoxide (CO)	8 hours**	5 mg/m^3	2 mg/m^3	1 mg/ m^3	Non Dispersive Infra Red (NDIR)
	1 hour	10 mg/m^3	4 mg/m^3	2 mg/m^3	Spectroscopy
*	Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.				
**	24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.				

NOTE:

1. National Ambient Air Quality Standard: The levels of air quality with an adequate margin of safety, to protect the public health, vegetation and property.
2. Whenever and wherever two consecutive values exceeds the limit specified above for the respective category, it would be considered adequate reason to institute regular/continuous monitoring and further investigations.
3. The standards for H2S and CS2 have been notified separately vide GSR No. 7, dated December 22, 1998 under Rayon Industry - for details please see Sl. No. 65 of this document.

[S.O. 384(E), Air (Prevention & Control of Pollution) Act, 1981, dated April 11, 1994]
[EPA Notification: GSR 176 (E), April 02, 1996]

4. 1. Included vide Notification SO. 955 (E), Air (Prevention & Control of Pollution) Act, 1981 dated October 14,1998)

Appendix – 4.3

NATIONAL AMBIENT NOISE QUALITY STANDARDS

Area Code	*Category of Area/ Zone*	*Limit in dBA (Leq)**	
		Day Time	*Night Time*
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

Notes:

1. Day time shall mean from 6 a.m. to 10 p.m.
2. Night time shall mean from 10 p.m. to 6 a.m.
3. Silence zone is defined as an area comprising not less than 100 metres around hospitals, educational institutes and courts. The silence zones are zones which are declared as such by the competent authority.
4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

* dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

A "decibel" is a unit in which noise is measured.

"A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

Leq: It is an energy mean of the noise level over a specified period.

Appendix – 4.6

LAND USE PATTERN OF THE STUDY AREA (In Hectares)

Name	AREA	TOT_IRR	UN_IRR	CULT_WASTE	AREA_NA_CU	LAND_FORES
Kamath	319	0	125.98	58.72	81.14	53.54
Ambivali	324	0	27	161	61	75
Nandgaon	389	0	50	189	100	50
Kalamboshi	358	0	53	146	64	95
Rawalje	426	0	39	74	251	62
Saje	820	0	60	478	179	103
Vile	738	0	86	384	171	96
Sanaswadi	764	0	60	251	143	310
Bhagad	700	0	60	433	131	76
Yerad	289	0	36	150	55	48
Nive	917	136	0	44	66	26
Warak	554	52.21	9.72	47.96	158.97	36.27
Mulshi Kh.	761	171.00	0	31	40	131
Tamhini Bk	758	138.69	0	158.90	546.33	92.25
Palase	23	29.00	0	123	45	38

TOT_IRR – Irrigated Land
UN_IRR – Unirrigated Land
CULT_WASTE – Land under culturable waste
AREA_NA_CU – Area not available for cultivation
LAND_FORES – Area under forest

Appendix – 4.7

LITERACY PATTERN OF THE STUDY AREA

Name	TOT_P	P_LIT	M_LIT	F_LIT	P_ILL	M_ILL	F_ILL
Kamath	272	120	67	53	152	53	99
Ambivali	249	277	160	117	248	95	153
Nandgaon	867	407	233	174	460	191	269
Kalambosh	360	249	126	123	111	45	66
Rawalje	985	757	438	319	228	82	146
Saje	597	285	164	121	312	120	192
Vile	976	561	325	236	415	162	253
Sanaswadi	750	373	208	165	377	148	229
Bhagad	511	316	153	163	195	70	125
Yerad	348	172	92	80	176	65	111
Nive	917	374	255	119	543	261	282
Warak	554	315	177	138	239	96	143
Mulshi Kh.	761	483	287	196	278	110	168
Tamhini Bk	758	332	200	132	426	159	267
Palase	23	6	4	2	17	5	12

Abbreviations

TOT_P Total Population

P_ILL Population Illiterate

P_LIT Population Literate

M Male Population

F Female Population

Appendix – 4.8

FIELD SURVEY AND GROUND FEATURES

Region for analysis is chosen in and around Bhira Generating Station. Detailed field survey was carried out, in November 2005 in order to understand the land use features. The GPS readings and observations of land features were taken at locations lying within 25 km radius around the project site (Bhira Generating Station).

Table - 1 enumerates the land features and its corresponding GPS readings of all the ground truthing locations selected for the study.

Table - 1

LAND USE FEATURES WITHIN 25 KM RADIUS FROM BHIRA GENERATING STATION

Sr. No.	GPS reading			Category	Description	District/Taluka/ Place
	Latitude	Longitude	Altitude (Ft)			
1	18°39.065' N	73°17.622' E	112	Water body	Ambi River with greenish turbid water	Parli Village Sudhagad Taluka Raigad District
2	18°39.613' N	73°17.726' E	138	Agricultural Land	Cultivated harvested ricefield	Parli Village Sudhagad Taluka Raigad District
3	18°39.650' N	73°17.722' E	151	Wasteland	Wasteland	Parli Village Sudhagad Taluka Raigad District
4	18°40.057' N	73°17.800' E	136	Built-up area	Parli village market	Parli Village Sudhagad Taluka Raigad District
5	18°41.084' N	73°17.859' E	176	Water body	Stagnant Pond having dirty water with tree cover	Govand Phata Sudhagad Taluka Raigad District
6	18°46.921' N	73°21.267' E	225	Built-up area	Khopoli Generating Station Gate	Khopoli Raigad District
7	18°46.180' N	73°21.090' E	1593	Built-up area	Railway line between Khandala	Vadgaon Maval Taluka

Sr. No.	GPS reading			Category	Description	District/Taluka/ Place
	Latitude	Longitude	Altitude (Ft)			
					Station and Mankil Station	Pune District
8	18°46.130' N	73°21.784' E	1564	Built-up area	Cast Iron Water Pipeline	Vadgaon Maval Taluka Pune District
9	18°46.097' N	73°21.823' E	1558	Dense Forest	Closed Forest Canopy with thick vegetation undergrowths	Vadgaon Maval Taluka Pune District
10	18°46.144' N	73°22.070' E	1652	Built-up area	Khandala Tunnel on Expressway Highway	Vadgaon Maval Taluka Pune District
11	18°46.120' N	73°22.098' E	1675	Wasteland	Open dry barren Grassland	Khandala Maval Taluka Pune District
12	18°45.194' N	73°22.203' E	1892	Sparse Forest/Vegetation	Sparse Vegetation	Khandala Maval Taluka Pune District
13	18°45.191' N	73°22.230' E	1857	Sparse Forest with occasional tree growth	Tree covered with dense canopy cover the Species Ficus arnotiana Linn	Khandala Maval Taluka Pune District
14	18°45.198' N	73°22.177' E	1928	Built-up area	Old Kaccha House	Khandala Maval Taluka Pune District
15	18°45.193' N	73°22.211' E	1877	Sparse Forest with occasional tree growth	The area is completely infested with introduced weeds like Eupatorium glandulosum, Lantana camera etc,	Khandala Maval Taluka Pune District
16	18°44.990' N	73°22.242' E	2107	Dense Forest	Closed Forest with thick undergrowth	Khandala Maval Taluka Pune District
17	18°44.987' N	73°22.233' E	2175	Water Body	Artificial	Khandala

Sr. No.	GPS reading			Category	Description	District/Taluka/ Place
	Latitude	Longitude	Altitude (Ft)			
					Water Storage. Fresh, clear water without any algal bloom	Maval Taluka Pune District
18	18°45.287' N	73°22.230' E	1835	Built-up area	Built-up area; House in Hill top Colony	Khandala Maval Taluka Pune District
19	18°44.983' N	73°22.219' E	2254	Plantation	Tree Plantation with ornamentals like Peltophorun, raintree etc for aesthetic purpose	Khandala Maval Taluka Pune District
20	18°45.435' N	73°22.301' E	1768	Water Body	Shallow Natural Water body. Lake water is Clean without any algal, or weed infestation.	Khandala Talab Maval Taluka Pune District
21	18°45.330' N	73°22.296' E	1803	Thatched House/Settl ement	Human Settlement / Hutmens	Khandala Maval Taluka Pune District
22	18°45.378' N	73°22.269' E	1785	Barren Land	Open barren land but not cultivabale	Khandala Maval Taluka Pune District
23	18°45.476' N	73°22.605' E	1932	Built-up area	Khandala Express Highway Overbridge	Khandala Maval Taluka Pune District
24	18°44.703' N	73°23.705' E	2092	Forest Social forestry	Social forestry by using Acacia auriculiformis	Lonavala Dam Maval Taluka Pune District
25	18°44.676' N	73°23.711' E	2069	Forest Social forestry	Social Forestry by using casuarina	Lonavala Dam Pune District

Sr. No.	GPS reading			Category	Description	District/Taluka/ Place
	Latitude	Longitude	Altitude (Ft)			
					equisitiformis	
26	18°44.676' N	73°23.666' E	2054	Fallow Land	Fallow land, cultivable, but get submerged during monsoon	Lonavala Dam Maval Taluka Pune District
27	18°43.440' N	73°23.718' E	2070	Water body	Stagnant water body, shallow	Bhushi Village Maval Taluka Pune District
28	18°43.228' N	73°23.718' E	2092	Water body	Dam stored water body - clear water	Bhushi Dam Maval Taluka Pune District
29	18°44.219' N	73°24.606' E	2121	Waste Land	Rocky area with sparse ground vegetation. Seen occasionally weeds like Lentana camera, Hyptis suoveolens and dry grass in small pockets	Lonavala Maval Taluka Pune District
30	18°43.401' N	73°23.725' E	2059	Water body	Nalla with people washing clothes	Bhushi Dam Maval Taluka Pune District
31	18°44.944' N	73°24.174' E	2113	Forest Plantation	Agricultural Research Centre. Rainwood Garden	Lonvala Maval Taluka Pune District
32	18°45.895' N	73°25.494' E	2091	Water Body	Walwhan Dam Water Storage	Lonvala Maval Taluka Pune District
33	18°45.813' N	73°25.383' E	1945	Area under green cover	Landscaped garden	Valvhan Dam Garden Maval Taluka Pune District
34	18°45.574' N	73°25.756' E	2040	Built-up	Walwhan	Valvan

Sr. No.	GPS reading			Category	Description	District/Taluka/ Place
	Latitude	Longitude	Altitude (Ft)			
				area	Junction Highway with overbridge	Maval Taluka Pune District
35	18°45.898' N	73°33.754' E	2026	Built-up area	Kamshet Railway crossing	Kamshet Village Maval Taluka Pune District
36	18°46.045' N	73°33.619' E	2001	Thatched House	Kaccha house	Kamshet Village Maval Taluka Pune District
37	18°46.029' N	73°33.633' E	1993	Agricultural Land	Sugar cane crop in seedling stage	Kamshet Village Maval Taluka Pune District
38	18°46.197' N	73°33.569' E	1980	Water body	Indrayani River - turbid green water	Kamshet Village Maval Taluka Pune District
39	18°46.053' N	73°33.594' E	2006	Agricultural Land	Land is under cultivation of different crops like sugarcane, Rice, Bajra etc. the crops are under different stages of their growth cycle such as harvesting, seedling as well as planting.	Kamshet Village Maval Taluka Pune District
40	18°46.068' N	73°33.591' E	1975	Agricultural Land	Cultivable Land -Rice, Sugarcane, Chana, Jawar, Bajari, Methi, Palak	Kamshet Village Maval Taluka Pune District
41	18°46.206' N	73°33.575' E	1987	Built-up area	Indrayani River Bridge	Kamshet Village Maval Taluka Pune District

Sr. No.	GPS reading			Category	Description	District/Taluka/ Place
	Latitude	Longitude	Altitude (Ft)			
42	18°45.757' N	73°33.528' E	2019	Built-up area	Kamshet Village Main market	Kamshet Village Maval Taluka Pune District
43	18°45.707' N	73°40.776' E	1968	Fallow land	Cultivable but fallow land	Takeve Village Maval Taluka Pune District
44	18°45.746' N	73°26.901' E	2046	Barren Land	Stone Quarry	Akshai Village Maval Taluka Pune District
45	18°46.133' N	73°22.020' E	1840	Wasteland	Uncultivable wasteland	Rajmachi Point Maval Taluka Pune District
46	18°47.685' N	73°17.402' E	217	Built-up area	Express Highway meeting National Highway. Landmark Bhushan Steel	Raigad District
47	18°45.877' N	73°33.758' E	2013	Fallow Land	Fallow land-grazing land where onle thorny and shrubby vegetations are seen. Plants like Zizyphus mouritiana, Acacia catechu etc. are common in this area	Kamshet Village Maval Taluka Pune District
48	18°46.959' N	73°21.565' E	1699	Built-up area	Amrutanjan Bridge	Raigad Pune Boundary
49	18°48.010' N	73°19.091' E	220	Barren Land	Barren Land - Hilly area	Sil Gaon Sudhagadh Taluka Raigad District
50	18°46.920' N	73°17.178' E	224	Agricultural Land	Cultivated with rice crops.	Devonava Village

Sr. No.	GPS reading			Category	Description	District/Taluka/ Place
	Latitude	Longitude	Altitude (Ft)			
					Harvesting is just got over	Khalapur Taluka Raigad District
51	18°45.161' N	73°17.035' E	258	Dense Forest	Thick dense forest with species such as Butea monosperma, Tectona grandis etc, with thick canopy cover	Umra Village Khalapur Taluka Raigad District
52	18°44.303' N	73°17.350' E	339	Thatched House	Hutmens's kaccha house	Umra Thajurvadi Khalapur Taluka Raigad District
53	18°44.875' N	73°17.139' E	296	Dense Forest	Thick dense forest with different Strata like ground vegetation, middle story and top canopy cover	Umra Village Khalapur Taluka Raigad District
54	18°44.653' N	73°17.265' E	306	Forest	Plantation	Umra Village Khalapur Taluka Raigad District
55	18°48.078' N	73°19.327' E	195	Water body	Flowing river-Patalganga river	Shil Phata Raigad District
56	18°52.495' N	73°19.032' E	206	Thatched house	Hutment	Palasdari Karjat Taluka Raigad District
57	18°51.237' N	73°19.037' E	227	Fallow land	Open scrubby vegetation	Gundga Village Karjat Taluka Raigad District
58	18°48.763' N	73°18.737' E	201	Wasteland	Wasteland	Hal Village Khalapur Taluka Raigad District
59	18°48.762' N	73°18.766' E	217	Built-up area	Pucca House	Khalapur Taluka Raigad District
60	18°47.995' N	73°19.530' E	207	Built-up	National	Shil phata

Sr. No.	GPS reading			Category	Description	District/Taluka/ Place
	Latitude	Longitude	Altitude (Ft)			
				area	Highway No. 4 near Wartsila Company	Khalapur Taluka Raigad District
61	18°48.055' N	73°17.124' E	225	Built-up area	Express Highway - 10 kms Khopoli Power Station	
62	18°51.354' N	73°13.558' E	117	Built-up area	Express Highway - 20 kms from Khopoli Power Station	
63	18°54.050' N	73°12.032' E	83	Built-up area	Express Highway - 25 kms from Khopoli Power Station	
64	18°55.633' N	73°09.863' E	117	Built-up area	Express Highway - 30 kms from Khopoli Power Station	

SATELLITE DATA INTERPRETATION - CLASSIFICATION

Land use – land cover in the region comprises of various types, referred as classes. The features derived from the satellite image after validation by the ground observations, have been presented as nine classes and are given below. These classifications types are as per the 'level classification' categories followed by National Remote Sensing Agencies (NRSA), -

1. Cultivated Land
2. Fallow Land
3. Built-up Area
4. Water Bodies
5. Barren Area
6. Marshy Land / Low Land
7. Waste land
8. Forest Cover
9. Sparse Forest

The image classified into the above-mentioned nine classes has been given in Fig.1. The land use/cover observed is sparse and dense forest, barren land, water bodies and cultivated land.

The region has high presence of high dense vegetative cover and a number of water bodies. Brief description of each type of the class forming landuse-landcover, derived from the satellite data analysis and the ground observations, is depicted in the classified image.

Several Water bodies are present in the region. These inland water bodies comprise of lakes and streams, artificial water storage .

Region does has significant areas of sparse forest/vegetation and dense forest. Open dry barren grassland is present at locations given in Table - 1.

Region has numerous small rural settlements. Rural settlements are domestic in nature, constituting of huts and small houses.

Built-up areas include roads, bridges, pucca houses and other concrete structures.

Coverage areas of these nine classes of land use existing in the study region have also been derived from the satellite image analysis. Statistical percentage of these various classes, forming the land use/land cover, is given in Table - 2.

Table - 2

LAND USE TYPES AND ITS COVERAGE

Land use types	**Area** sq. km
Built-up Area	1462.25
Sparse Vegetation	1252.55
Cultivated Area	459.85
Waste Land	540.16
Barren Land	262.51
Dense Forest	391.75
Marshy Land	54.11
Fallow Land	814.6
Water Body	216.65

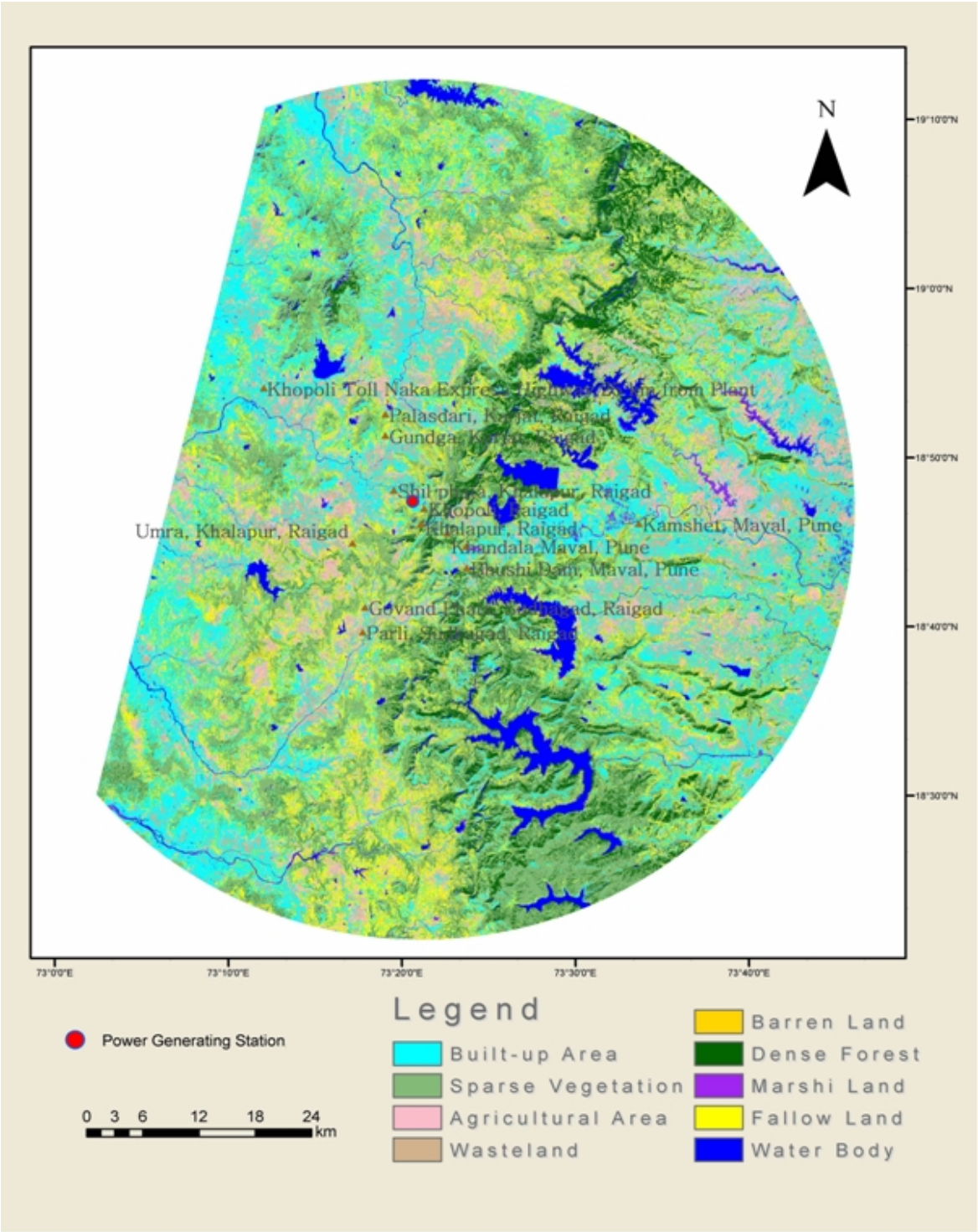


Fig.1 - IRS-P6 (NOVEMBER 2005)

LAND USE IN THE NEIGHBOURHOOD OF THE PROJECT SITE

Appendix – 4.4

POPULATION DETAILS

NAME	Area (Hect)	No_HH	TOT_P	TOT_M	TOT_F	P_06	M_06	F_06	P_SC	M_SC	F_SC	P_ST	M_ST	F_ST
Kamath	319	65	272	120	152	47	23	24	0	0	0	122	56	66
Ambivali	324	54	249	128	121	83	48	35	0	0	0	40	24	16
Nandgaon	389	209	867	424	443	154	81	73	6	3	3	246	124	122
Kalamboshi	358	84	360	171	189	53	29	24	0	0	0	1	0	1
Rawalje	426	254	985	520	465	92	51	41	115	56	59	48	25	23
Saje	820	140	597	284	313	97	40	57	30	12	18	123	62	61
Vile	738	210	976	487	489	157	82	75	70	40	30	232	113	119
Sanaswadi	764	175	750	356	394	131	70	61	0	0	0	0	0	0
Bhagad	700	117	511	223	288	69	32	37	40	14	26	33	18	15
Yerad	289	84	348	157	191	54	28	26	0	0	0	83	39	44
Nive	917	181	917	516	401	148	91	57	41	24	17	140	72	68
Warak	554	92	554	273	281	102	51	51	26	14	12	11	4	7
Mulshi Kh.	761	156	761	397	364	107	59	48	35	15	20	0	0	0
Tamhini Bk	758	160	758	359	399	126	57	69	67	31	36	19	6	13
Palase	23	5	23	9	14	7	2	5	0	0	0	0	0	0

HH House Holds
Tot_P Total Population
Tot_M Total Male Population
Tot_F Total Female Population

P_06 Population 0-6 years age group
M Male
F Female
SC Scheduled Caste

ST Scheduled Tribes

Appendix – 4.5

WORKERS DISTRIBUTION PATTERN

Name	TOT_P	MAIN WORK_P	MAIN_ CL_P	MAIN_AL _P	MAIN_HH _P	MAIN_OT _P	MARG WORK_P	MARG_C L_P	MARG_A L_P	MARG_H H_P	MARG_O T_P	NON_ WORK_P
Kamath	272	145	58	72	1	14	23	19	3	1	0	104
Ambivali	249	107	51	5	0	51	54	51	1	0	2	184
Nandgaon	867	285	134	86	3	62	87	10	2	0	75	495
Kalamboshi	360	154	102	37	4	11	0	0	0	0	0	206
Rawalje	985	232	31	25	3	173	135	15	107	6	7	618
Saje	597	141	34	5	2	100	72	23	8	15	26	384
Vile	976	109	23	17	4	65	350	135	167	11	37	517
Sanaswadi	750	312	283	1	1	27	83	31	38	2	12	355
Bhagad	511	12	0	0	3	9	224	56	163	1	4	275
Yerad	348	185	52	20	1	9	103	71	25	0	7	163
Nive	917	496	279	84	0	133	48	2	45	0	1	373
Warak	554	344	288	31	6	19	0	0	0	0	0	210
Mulshi Kh.	761	502	445	8	6	43	2	0	0	2	0	257
Tamhini Bk	758	203	105	10	5	83	179	132	26	6	15	376
Palase	23	15	13	2	0	0	0	0	0	0	0	8

TOT_P Total Population
Work_P Workers Population
P Population
CL Casual Laborers
HH House Holds
OT Over Time
Marg Marginal
AL All time labors

CHAPTER - 5

ENVIRONMENTAL IMPACT ASSESSMENT

5.1 CLASSIFICATION OF IMPACTS

Overall environmental impacts are broadly divided into impacts during

- construction phase
- operation phase

Both quantitative and qualitative impacts are assessed for various environmental components. Details of impact identification, prediction and assessment are given in the following paragraphs.

5.2 CONSTRUCTION PHASE

During construction, activities like

- clearing of land for constructions shafts
- excavation for construction shafts
- construction of cofferdam for Mulshi Lake partitioning
- excavation in soil and soft rock for construction of bund for Mulshi Lake partitioning
- tunnelling which includes drilling & controlled blasting and concreting
- fabrication & erection of steel ferrules for penstock and lining in tunnel
- extension of existing valve house which includes excavation in soil and rock
- dismantling of existing old office building (which includes dismantling of masonry walls & roof, and excavation in soil & rock) for the new power house
- excavation in soil & rock for short length of new tail race channel which will discharge into the existing tail race channel

will have to be carried out.

Temporarily, some of the environmental parameters may get disturbed during the construction phase. Equipments such as compressors, cranes, DG sets, concrete placers, drilling machines, pneumatically operated monkers, saws, vibrators and crushers will be used during the construction phase. Impact of construction activities are discussed below:

5.2.1 Water pollution

Construction work for proposed augmentation is likely to last for a period of about 3 years. Peak labour demand is expected to be about 300 unskilled and 50 skilled staff. Unskilled labourers will be mostly employed from adjoining villages. However, skilled staff will mostly belong to contractors to whom construction work will be entrusted.

During construction, runoff from the construction site is normally a potential source of water pollution. Such pollution may persist entirely during the initial phase of construction when site work is in progress. During this stage the rainwater runoff would carry more soil/silt than normal, which if unchecked will cause silting problem in the course of its journey (streams).

Construction management would include the following steps to ensure that above mentioned impacts are kept to bare minimum:

- Cofferdam will be constructed first; its top level will be at 595 m. With this it will be possible to carry out the activities for bund construction between latter half of March and first half of June when the Lake level is lower than 595 m.
- Stage I of the work involves of construction of bund at both the banks. Stage II involves construction of bund in the middle portion of the water way and will be done after Stage I.
- Excavation in soil and soft rock for construction of bund for Lake partitioning will be carried out from second half of March to first half of June (prior to onset of monsoon) when the Lake level is depleted to lower than 595 m. The excavated material will be removed from the construction site (within the Mulshi Lake) and disposed off within TPC land above full supply level. Part of the excavated material can be used for backfilling as well as in the cofferdam during the Stage II construction of the bund.
- Undertake surface excavation for valve house and power house foundations during non-monsoon periods and clear the site of the excavated material.
- Excavate soil and rock for construction shafts during non-monsoon. Construct reinforced concrete steining in the portion between ground level and rock level to prevent the seepage of water into the tunnel. Subsequently columns are erected for supporting temporary superstructure so that the roofs cover the excavation area of shafts. Tunnelling activity is proposed to be carried out throughout the year (monsoon and non-monsoon). Excavated material will be removed from the site with combination of
  - trolleys (inside the tunnel)
  - crane which will lift excavated the material from the shaft location of the tunnel (about 20 – 40 m below the ground)
  - dumpers which will come near the shafts (below the roofs) and with the help of crane will be filled with the excavated material

  With this arrangement, chances of rainwater entering the tunnel during construction is minimum.

Other potential source of water pollution is normally from the temporary accommodation of the construction workers. Approximately 300 temporary contract workers are expected to be involved in construction phase. Since most of the construction workers will be from the nearby villages migration of workers from outside is not envisaged for this project. Facilities presently available with the villages will continue to be used during construction activities and hence no sanitation problem is expected during construction period. However, septic tank/pit if required, the arrangement will be made available during the construction phase of the project.

For skilled workers of Contractor/s who are not from the local villages, proper accomodation arrangements will be made by the Contractor/s.

For TPC's own staff (supervising the construction), existing accomodation facilities available in Bhira camp are adequate.

Construction activity for this project is expected to be about 3 years and hence temporary in nature. Hence, impact of construction activities is not likely to have significant impact on the quality of surface and ground water.

5.2.2 Disposal of excavated materials

Excavated materials will be generated during the bund construction for Mulshi Lake partitioning and tunnelling work between surge shaft on tunnel no.1 and upstream of new power house. Total quantity of excavated material is expected to be about 50000 m^3, which includes the excavation for bund construction in Lake partitioning, valve house foundation, 1.52 km long & 2.6 m - 2.3 m (finished diameter) tunnel and penstock encased in concrete at both ends of the tunnel. Approximate quantity of hard rock and soil material which will be excavated is expected to be 25000 m^3 each.

It is proposed to

- utilise part of the excavated material (rock) as aggregates for concreting
- utilise part of the excavated material (rock) in the construction of bund
- utilise part of the excavated material (soil) as backfill
- utilise part of the excavated material (soil & soft rock) in construction of Stage II cofferdam
- lay remaining portion of the excavated material in the TPC land above the FSL of Lake. During the laying of the excavated material it will be compacted to prevent the soil being washed off into the Lake during the rains.

5.2.3 Air impact

Major source of air pollution during the construction period is from the rock crushers, DG sets and movement of vehicles for construction activity. Emissions from vehicular movement and stationary sources like generator sets are expected in the form of both particulates and gaseous form. Air borne dust emissions from earth and soil work and vehicular movements are also expected. The exhaust emission of DG set may include SO2 and NOx along with the dust emissions resulting from vehicles operating at site. Proper maintenance of DG sets and dust suppression by spraying of water will reduce these impacts considerably.

The emission from vehicles will depend on road conditions, type and capacity of the vehicles used. Impact due to additional vehicles plying during the construction period will be temporary in nature and their impact on air quality will be limited to construction period and during the part of the day when the construction activities are being carried out. It is proposed to utilise the vehicles which are maintained properly and having emission levels below the prescribed levels. Use of vehicles with registration of pollution under control will help in minimising the impacts. There will not be any impact on air quality once the construction period is over.

5.2.4 Noise impact

Equipment such as compressors, cranes, DG sets, concrete placers, drilling machines, pneumatically operated monkers, saws, vibrators and crushers will be the source of noise during construction phase.

Major sources of the noise pollution due to construction activity is during the excavation, blasting, movement of vehicles for transporting construction materials & excavated materials, concrete mixers, etc.

Noise generated from all construction activities will be restricted to daytime working hours. Generally noise will be limited within the site boundary except for noise from the trucks entering and leaving the site. The noise from the controlled blasting operation will also be limited within site boundary.

Further noise impact during construction period will be temporary in nature and will be limited to the construction period only.

5.2.5 Ecological impact

Proposed steel lined tunnel is an extension of the branch tunnel and will be constructed downstream of the surge shaft on tunnel no.1 to the upstream of proposed power house. There is no necessity to cut down any trees for the proposed construction shafts as at these locations are devoid of trees with vegetation being limited to only shrubs. The tunnel will be about 25 - 40 m below the ground. The tunnel will pass below the TPC land. As the proposed surface penstock (encased in concrete), valve house (extension) and proposed power house are within TPC land, there is no requirement to acquire private/forest land. As the proposed power house will be in the location of existing old office building (which will be dismantled), there is no necessity to clear any virgin land for the power house which may involve cutting of trees.

Impact of construction activities for proposed augmentation will be limited to close vicinity of construction site only i.e. within the existing premises of TPC.

As mentioned earlier most of the construction labourers will be employed from local villages. This will minimise temporary requirement of land, amenities, infrastructures and fuel needs. This provision will reduce the residual impacts on surrounding terrestrial ecology.

During construction, machinery and construction labour will have to be mobilised. The operation of construction equipments will generate noise and gaseous pollutants within the close vicinity. However, since these activities will be limited to daytime only, impacts on existing wild life of the surrounding area is minimal.

From the above discussions it can be concluded that ecological impact envisaged is minimal due to construction phase of the proposed augmentation.

5.2.6 Socio-economic impact

Construction workers will be employed mainly from the adjoining villages. Therefore, no additional amenities or infrastructural facilities will be required for local construction workers. Skilled personnel required during construction will be accommodated in quarters available at Bhira Camp.

There will be considerable positive impacts on social life of the local people. Population in the nearby villages depends mainly on the agricultural work. Agricultural work of local populace is mainly monsoon dependent seasonal work. This income is basically coming from rain fed one-season crops. Construction activities of proposed augmentation will create temporary employment for the local people. Since most of the construction workers would be made available from the surrounding villages, females can also be employed which will ensure higher female employment along with other weaker sections of society. This will increase the per capita income of the population located within the study area till the construction period is over. Hence, socio-economic impacts on the surrounding area are expected to be positive.

Details of workers to likely to be involved during construction phase of the project is shown in Table – 5.1.

Table - 5.1

NUMBER OF PERSONS TO BE EMPLOYED

Employer	Skilled employees	Unskilled employees (labourers)
TPC	15	-
Contractor	50	300

5.3 OPERATION PHASE

5.3.1 Flood control in Mulshi Lake

5.3.1.1 Background

Present live storage capacity of Mulshi Lake is 523 MCM as against the average inflow of 800 MCM. In the past there are instances of overflow of this lake in spite of base loading of the Bhira Generating Station. During monsoon of 2005 also this lake has again overflowed causing floods in parts of Pune district.

5.3.1.2 Options available to minimise spills

In order to avoid spilling of Mulshi Lake and subsequent flooding of surrounding areas including parts of Pune district, it is necessary to

- increase live storage capacity of the Lake and
- increase the live storage capacity and concurrently transfer water at a higher rate (than that is being done/possible at present) from the Mulshi Lake

First option of increasing the live storage capacity can be achieved by

- increasing the FSL of the Lake
- reducing the dead storage of the lake by lowering of the MDDL

Second option of transferring the water at a higher rate can be achieved by augmenting the capacity of the Bhira station.

These alternatives are discussed in detail in the "Feasibility Report for Generation Augmentation at Bhira".

With the second option as it is possible to deplete the reservoir at a faster rate, it will be possible to have better control over lake levels and will help avoiding the spills and subsequent flooding of the surrounding areas. The withdrawal of the water is proposed to be utilised meaningfully for the generation purpose. This will also help in part mitigation of the energy shortages. Synchronous with Option I, this option is advantageous and studied further considering following aspects as

a. it does not involve any land acquisition
b. it helps in reducing spilling of Mulshi Lake and subsequent flooding of adjoining area
c. the excess water can be utilised for meaningful purpose i.e. power generation during dry season when the power is required the most

Following paragraphs substantiate the argument.

Normal spilling

After the implementation of the BPSU scheme in 1997, spilling of Mulshi Lake has reduced. However, some spilling has occurred as given in Table - 5.2.

Table - 5.2

MULSHI LAKE SPILLING DATA (SINCE 1997-98)

Year	**Spilling volume** MCM
1997-98	81.55
1998-99	0
1999-00	0
2000-01	0
2001-02	0
2002-03	0
2003-04	0
2004-05	76.85
2005-06	404.90

Considering all the years (1997-98 to 2005-06), it is observed that on an average, yearly spill is about 63 MCM. Even if the spill during monsoon of 2005 is excluded (being an abnormal monsoon), average yearly spill is about 20 MCM. With the Mulshi Lake partitioning and augmentation of the power station, it is possible to avoid these spills. Thus this can be termed as a benefit due to Mulshi lake partitioning and proposed augmentation. The benefit will translate into 23 MU of additional generation.

2005 spills

During 2005, the first overflow occurred in July itself. Prior to this, lake level was building up during the latter half of July even with full generation at BOPH and BPSU continuously. This can be observed from the inflow data of Mulshi Lake (refer Table - 5.3). Total spills in monsoon amounted to nearly 405 MCM. It is to be noted that for many days during the period under consideration (June to September 2005) when rainfall and corresponding inflows were very high, Bhira power station was generating at full capacity for 24 hours a day. Discharge through the turbine for was about 75 m^3/sec. Thus it is obvious that with the existing capacity, it is not possible to transfer the water from the Mulshi Lake faster than this rate.

Table – 5.3

MULSHI INFLOW & SPILL DETAILS DURING 2005 MONSOON

Month	**Inflow** MCM	**Generation** MU	**Water utilised for generation** MCM	**Spills** MCM	**Total spills** MCM
June	161.11	58.52	49.19	0	404.90
July	588.99	165.48	139.59	48.33	
August	423.57	232.39	195.76	242.90	
September	303.20	207.91	175.38	113.67	

Instead, if the Bhira station had Lake partitioning scheme coupled with the additional generating capacity, it would have been possible to withdraw/transfer additional 18 m^3/sec. from the Mulshi Lake. With this, a simulation study is carried out to determine the lake contents in each month starting with June. With additional capacity, it is possible to transfer extra 15.55 & 46 MCM of water in a month with 8 hrs/day & 24 hrs/day generation.

Simulation is done with Mulshi Lake operation considering

- Lake partitioning scheme only and
- Lake partitioning scheme and new100 MW scheme.

From the simulation studies it is found that with

- Only Lake partitioning scheme the spill would have been 298.93 MCM
- Lake partitioning coupled with new100 MW scheme, there would have been spill of 185.81 MCM.

However, it is to be noted that it is not feasible to operate the reservoir exactly as per theory as the inflows & lake levels are dynamic processes and hence difficult to predict. This will invariably result in higher spills vis-à-vis that calculated by the simulation. It is likely that there would have been extra spill of about 30 - 50 MCM over that given above with the corresponding schemes during the 2005 monsoon.

It is evident that with the proposed Lake partitioning and new 100 MW schemes, it would have been possible to restrict the spills to about 225 MCM. Thus when compared with the actual spill of 405 MCM, 180 MCM of water would have been utilised for power generation which would have generated about 212 MU. Even considering the fact that the high inflows due to very high rain falls over prolonged period were once in 50-year or so phenomena, converting the 212 MU on an annual basis, additional generation would be about 4 MU annually. This is in addition to the 23 MU due to normal average annual reduction in spilling. Thus there would be about 27 MU of additional generation due to reduction in spilling.

Thus the proposed augmentation scheme will minimise chances of Mulshi Lake overflowing and will also utilise these possible spills for power generation. Hence this scheme has a positive impact on the environmental settings of the Mulshi Lake as well as national economy.

5.3.2 Additional generation

With the proposed Mulshi Lake partitioning coupled with augmentation scheme, there will be increase in annual energy generation in Bhira. These are detailed in “Feasibility Report for Generation Augmentation at Bhira”. Components which contribute to this increase are:

- One-time benefit (first year) due to Lake partitioning
- Deferred generation from monsoon to non-monsoon
- Reduction in spilling attributed to Lake partitioning
- Reduction in spilling attributed to the 75 MW component to the 100 MW unit
- Relegation of unit no.1 in BOPH (which is having higher head loss, lower efficiency) to stand-by duty

It is found that in all, there will be

- new generation of 133 MU in the first year (one-time benefit)
- annual increase in generation of 34.46 MU
- deferred generation of 193 MU

5.3.3 Water

5.3.3.1 Quantity of water

In hydropower generation, raw material is the water stored in the reservoirs/lakes during monsoon season. In case of the proposed project, raw material is the water stored in the Mulshi Lake. There is no loss of water during its journey from these lakes to the tail race channel through the turbines housed in the power house. After the power is generated, the released water (from power house) is available for generation in Ravalje Power Station (RPS) that is located downstream of the Bhira power plant, industrial uses, drinking purpose, agricultural and any other uses in the down stream areas.

5.3.3.2 Effect on upstream users (due to Lake partitioning)

As explained briefly in Chapter 3, Mulshi Lake partitioning scheme consists in construction of a bund across the Lake near Palse village. This will result in the bifurcation of the Lake during the summer months (April, May and first half of June) when the Lake level falls below the present MDDL of 590 m. Water will be pumped from one side of the bund to the Davdi side. This will result in depletion of the Lake on one side to 584 m whereas on Davdi side, the MDDL will remain at 590 m.

At present a number of villages are dependent for their drinking water needs on the Mulshi Lake. With the Lake partitioning scheme, during the summer months water will further recede by 150 - 200 m (horizontally) than at present on one side of the bund whereas on Davdi side there will not be any recedence.

TPC has permitted Maharashtra Jeevan Pradhikaran (MJP) to supply Mulshi Lake water to the following villages:

- Valne
- Nandivali
- Pomgaon
- Sonarwadi & Nanivali
- Shedani & Dattawadi
- Chandivali & Shiravali
- Mulapur & Kumbheri
- Wadgaon & Shirgaon
- Waghwadi
- Vandre
- Nive & Sarole Mohri
- Adgaon & Barpe
- Gotha & Susale
- Vadiste & Limbarwadi
- Ahirwadi & Pimpri

Out of these, Wadgaon, Shirgaon, Nive and Sarol are located on Davdi side of the bund. Hence there is no necessity to extend the existing suction pipes of the pumps which supply water to these villages.

However, it will be necessary to extend the suction pipes of the pumps for supplying water to the other villages as the water will recede in future to a level of 584 m during the summer months.

TPC will bear the expenses for extending the suction pipes and installation of new pumps (if required) so that villagers are not inconvenienced during the summer months.

5.3.3.3 Effect on downstream users

With the proposed augmentation scheme duration of power generation will be reduced to 8 hrs/day from the current 10 hrs/day during non-monsoon. Thus there will be alteration with respect to the existing water releases pattern. Height of the existing tail

race channel will have to be increased by 0.60 m to convey the increased discharges. With this modification to the tail race, chances of spills or flooding of surrounding areas are not expected. Thus impact of flooding or water spillage on surrounding environment is not expected.

At present the water released from Bhira power houses is collected in the pick-up pond of RPS. In future also, with the implementation of proposed augmentation scheme, there is no change in this aspect. Total quantity of water released in a day remains the same. There will be change (increase) in the rate of water releases.

As the pick-up pond has sufficient storage capacity, increased discharge rate from Bhira power houses will not result in spilling of water. Hence there is no necessity to alter the generation pattern of RPS which at present generates for 4 hrs/day. At present, as there are no residential colonies between Bhira power plant and pick-up pond of RPS people are not utilising the water in this stretch. People living downstream of RPS utilise the water for drinking, irrigation and industrial purposes. Since no change is envisaged in the generation pattern of RPS due to the proposed scheme the altered discharge pattern of Bhira power plant will not have any adverse impact on downstream users.

5.3.3 Noise impact

Noise impacts are mainly from the following

- Turbine Generator
- Compressor
- Pump house

The turbine generator would be housed in closed buildings, which would considerably reduce the transmission of noise from the turbine generators to the outside environment. Generally there would not be any operators near the turbine generator on a continuous basis. However, maintenance personnel working within the turbine generator building would be provided with adequate protection against noise in the form of ear plugs and will be encouraged to use them.

All the equipment in hydropower power plant are designed / operated to have the noise level not exceeding 85 - 90 dB(A) measured at a distance of 1.5 m from the equipment.

Acoustic lining and enclosures will be provided to generators sets that will reduce noise of working environment drastically. The residual noise effects could be minimised by using noise protective devices.

Further, as the location of the proposed power house is well inside TPC land, chances of noise reaching outside is minimal. Hence, impact of the proposed augmentation on surrounding environment is expected to be negligible.

5.3.4 Solid, liquid or gaseous emission

There will be no emission in the form of solid or gaseous phase, which could pollute the surrounding area. Over the years, with improvement in technology, equipments using oil as lubricant has come down. For example, erstwhile mechanical governors (which use oil) are now replaced by electronic governors; anti-friction bearings are used in the mechanical equipments. However, floor washing may add insignificant contamination of

oil and grease used for lubrication. Frequency of such cleaning/maintenance operations are limited to 3 - 4 times a year depending on the necessity.

To the extent possible, oil and grease content will be separated out using cotton wastes and disposed off. As a result, quantity of effluent discharged to the tail race channel will be insignificant. Thus there will be negligible impact on the quality of water in the tail race channel.

5.3.5 Air quality

The proposed augmentation of hydro power will not have any pollutant emission like NO_x, SO_2 and SPM to the atmosphere. This is because raw material/ resource used for power generation is clean water which is collected as runoff from catchment areas and stored in the Mulshi Lake. The process is repeated each year.

5.3.6 Power availability

Power supply situation in the TPC licensed area (where the power from the power plant is supplied) will improve during the peaking periods, as proposed schem will ensure additional supply of electricity. Other services and industries will improve their outputs during peaking period as electric power is the wheel for economic development.

5.3.7 CDM Benefits

Bhira augmentation project has potential for CDM benefits. However, CDM is part of a separate study and beyond the scope of present EIA study report.

5.3.8 Ecology and sensitive locations

Gas, solid or liquid emissions are not envisaged due to the augmentation of Bhira power station. Hence, there will not be any adverse impact on flora and fauna of the surrounding area.

5.3.9 Land use pattern

Proposed steel lined tunnel will be constructed below TPC land. There is no necessity to cut down any trees for the proposed construction shafts as at these locations are devoid of trees with vegetation being limited to only shrubs. Proposed tunnel will be about 25 - 40 m below the ground. The tunnel will pass below the TPC land. As the proposed surface penstock (encased in concrete), valve house (extension) and proposed power house are within TPC land, there is no requirement to acquire private/forest land. As the proposed power house will be in the location of existing old office building (which will be dismantled), there is no necessity to clear any virgin land for the power house which may involve cutting of trees. Thus, proposed activities will not lead to any change in the environmental settings of the area.

5.3.10 Socio-economic impact

Most of the people around the site have an income directly or indirectly from agriculture and other service related work. Some of them are employed with existing unit of TPC also. There would not be any addition of employment during the operational phase.

Hence, overall impact on socio-economic condition is expected to be positive.

5.4 SUMMARY OF IMPACTS

The environmental impact due to construction and operational phase of the proposed 100 MW scheme is summarised in Table - 5.4.

Table - 5.4

IMPACT MATRIX FOR CONSTRUCTION AND OPERATION PHASE

Activity ⇨ / Parameter ⇩	CONSTRUCTION PHASE	OPERATION PHASE						
		Water Consumption	Gaseous & Fugitive emission	Effluent Discharge	Heat Radiation	Operation of equipment	Plant Operation	Plantation and Green Belt
Water quality								
Air quality	✹							
Solid Waste	✹							
Noise	✹						✹	
Socio-economic	O						⊙	
Ecology	✹							
Employment	O						⊙	
Land use pattern								
Infrastructure & Amenities	⊙						⊙	

O - Major Positive ⊙ - Minor Positive
✪ - Major Negative ✹ - Minor Negative
- No Impact or Insignificant

An inventory of flora and fauna of the surrounding area is tabulated in Chapter 4 – Baseline Environmental Condition. The proposed lake partitioning and generation augmentation schemes are not virgin projects (new development) in which case there would have been likelihood of complete change in environmental settings. Activities of these schemes include small scale levelling and clearing of land which is limited within the existing TPC premises. Findings of the over all impact indicates that residual but temporary impacts would be minor during the construction phase of the project. These minor impacts would subside once construction period is over. During the operational phase, it is found that that there will be no impact on the downstream users due to the reduction in the duration of water released from Bhira power plant (due to the reduced period of power generation). Hence, existing environmental settings of the surrounding area will remain unaltered.

CHAPTER - 6

ENVIRONMENTAL MANAGEMENT PLAN

6.1 GENERAL

This chapter proposes an environment management plan for the proposed augmentation of hydro power project. Objective of environment management plan during the construction and operational phase of the project is to ensure that good engineering practices are followed so as to minimise any adverse environmental impacts. Certain operation phase environmental management plan has been proposed so as to achieve/ ensure:

- environmental control measures are in place and operating satisfactorily
- impacts on the environment and the effectiveness of mitigation measures adopted are being monitored

6.2 CONSTRUCTION PHASE

Impacts are due to

- Blasting
- Noise
- Air pollution
- Water pollution
- Disposal of excavated material
- Domestic waste

Measures to manage/mitigate these impacts are described in the following paragraphs.

6.2.1 Blasting

Blasting activity has potential to result in noise & air pollutions and cause injuries to workers if not executed properly. Following safety measures are planned.

- Before proceeding with the blasting plan, expert advice will be sought from the Central Water and Power Research Station (CWPRS) – Pune or similar agency of national reputation.
- Contractor will be instructed to strictly adhere to such recommendations.
- Contractor will be asked to employ a competent and experienced supervisor and licensed blaster in-charge of each set of operation, who shall be held personally responsible to ensure that all safety regulations are taken into consideration.
- All workmen and the personnel at site are excluded from an area within 200 m radius from the firing point, at least 15 minutes before firing time by sounding warning whistle.
- Area where blasting operation has to be carried out will be inspected by the supervisor after 30 minutes subsequent to the blasting. Workmen will not be allowed to go to the blasting area till the harmful fumes (toxic gases) are evacuated entirely.

- Blasting of rock near any existing buildings, equipment or any other property will be done under cover and all necessary muffling arrangements will be made. Blasting may preferably be done with small charges only or a trench will have to be cut by chiselling prior to the blasting operation, separating the area under blasting from the existing structures.
- Firing will be supervised by a Licensed Blaster/Supervisor and shall be strictly carried out in accordance with the "Blast charge" recommended by CWPRS.
- A wooden tamping rod with a flat end will be used to push cartridges home. Charges will be placed firmly into place and not rammed or pounded. After a hole is filled to the required depth, balance of the hole will be filled with stemming which may consist of sand or stone dust or similar inert material.
- It is proposed to detonate the explosives by resorting to the best prevailing blasting techniques and practices to ensure maximum possible safety.
- Holes for charging explosives will be drilled with pneumatic drills, the drilling pattern being so planned that rock pieces after blasting will be suitable for handling without secondary blasting.
- It is proposed to carry out blasting operations in such as way that detonators will not be simultaneously activated but with some time lag using Short and Long delays so that the noise level (dB) and vibrations (ppv) will be within permissible limits.
- It is proposed to avoid blasting operation in late night hours in case there are objections from local habitants.

6.2.2 Noise pollution

Sources of noise pollution are movement of dumpers transporting construction material and rock crushers.

6.2.2.1 Blasting

Remedial measures are explained in para 6.2.1. In the present project, blasting operations are not proposed in the immediate surrounding of residential colonies.

6.2.2.2 Dumpers

This can be reduced by insisting on the contractor/s to use vehicles that are in good condition. Also it is proposed to avoid movement of these vehicles during late night hours to the extent possible and minimize the disturbances to the nearby residents.

6.2.2.3 Rock crushers

These will be located within TPC land and residential colonies are not in the immediate neighbourhood. Also it is proposed to limit the rock crushing activities to day time only so that the affects will be bearable (as compared to night time).

6.2.3 Air pollution

Sources of air pollution are during the movement of dumpers transporting construction material and rock crushers.

6.2.3.1 Blasting

Remedial measures are explained in para 6.2.1. In the present project, blasting operations are not in the immediate surroundings of residential colonies.

6.2.3.2 Dumpers

It is proposed to spray water which will act as a dust suppressant at regular intervals along the route. This can be reduced by insisting on the contractor/s to use vehicles that are in good condition.

6.2.3.3 Rock crushers

Standing instruction shall be given to locate rock crushers within TPC land and away from residential colonies. This will reduce the adverse impact.

6.2.4 Water pollution

During construction, runoff from the construction site is normally a potential source of water pollution.

Construction management would include the following steps to ensure that above mentioned impacts are kept to bare minimum:

- Cofferdam will be constructed first; its top level will be at 595 m. With this it will be possible to carry out the activities for bund construction between latter half of March and first half of June when the Lake level is lower than 595 m.
- Stage I of the work involves of construction of bund at both the banks. Stage II involves construction of bund in the middle portion of the water way and will be done after Stage I.
- Excavation in soil and soft rock for construction of bund for Lake partitioning will be carried out from second half of March to first half of June (prior to onset of monsoon) when the Lake level is depleted to lower than 595 m. The excavated material will be removed from the construction site (within the Mulshi Lake) and disposed off within TPC premises above full supply level. Part of the excavated material will be used for backfilling as well as in the cofferdam during the Stage II construction of the bund.
- Undertake surface excavation for valve house and power house foundations during non-monsoon periods and clear the site of the excavated material.
- Excavate soil and rock for construction shafts during non-monsoon. Construct reinforced concrete steining in the portion between ground level and rock level to prevent the seepage of water into the tunnel. Subsequently columns will be erected for supporting temporary superstructure so that the roofs cover the excavation area of shafts. Excavated material will be removed from the site with combination of
    - trolleys (inside the tunnel)
    - cranes will lift excavated the material from the shaft location of the tunnel (about 20 – 40 m below the ground)
    - dumpers will come near the shafts (below the roofs) and with the help of crane will be filled with the excavated material

With this arrangement, chances of rainwater entering the tunnel during construction will be minimumised.

6.2.5 Disposal of excavated material

Total quantities of excavated material from bund construction, partitioning and tunnelling are expected to be about 50000 m^3. Approximate quantity of hard rock and soil material which will be excavated is expected to be 25000 m^3 each. This excavated material will be utilised in following manner:

- Excavated material (rock) as aggregates for concreting and in the construction of bund
- Excavated material (soil) as backfill and in construction of Stage II cofferdam
- Laying of part of excavated in TPC land above FSL of the lake. During the laying of the excavated material it will be compacted to prevent the soil being washed off into the Lake during the rains.

6.2.6 Domestic waste

Approximately 300 temporary contract workers are expected to be involved during construction phase. Preference shall be given to locals to avoid the migration of workers from outside.

Facilities presently available with the villages will continue to be used during construction activities. However, arrangement for septic tank/pit will be made during the construction phase of the project.

For skilled workers of Contractor/s who are not from the local villages, proper accomodation arrangements will be made by the Contractor/s.

6.3 OPERATION PHASE

Impacts are due to

- Water
- Fire and explosion

Measures to manage/mitigate these impacts are described in the following paragraphs.

6.3.1 Water impacts

This will be due to the proposed Lake partitioning and altered generation pattern due to the proposed augmentation scheme. As a result of changed generation pattern, water releases from the power houses will be different from what is existing today. These are discussed in the following paragraphs along with the mitigation measures.

6.3.1.1 Effect on upstream users (due to Lake partitioning)

To take care of any impact on down stream users, TPC has permitted Maharashtra Jeevan Pradhikaran (MJP) to supply Mulshi Lake water to the following villages:

- Valne
- Nandivali

- Pomgaon
- Sonarwadi & Nanivali
- Shedani & Dattawadi
- Chandivali & Shiravali
- Mulapur & Kumbheri
- Wadgaon & Shirgaon
- Waghwadi
- Vandre
- Nive & Sarole Mohri
- Adgaon & Barpe
- Gotha & Susale
- Vadiste & Limbarwadi
- Ahirwadi & Pimpri

TPC will bear the expenses for extending the suction pipes and installation of new pumps (if required) so that villagers are not inconvenienced during the summer months.

6.3.1.2 Effect on downstream users

As detailed in Chapter 5, para 5.3.3.3 there is no adverse impact on the downstream users due to the proposed scheme. Hence there is no necessity to undertake any mitigation measure in this regard.

6.3.1.3 Adequacy of existing tail race channel

With the augmentation of the Bhira power house, the water level in the tail race channel will increase by about 0.60 m corresponding to the additional discharge of 17.85 m^3/sec. Hence it is necessary to raise the height of the channel by 0.60 m so that there will be no spilling of water.
It is proposed to undertake this work during the implementation of the project.

6.3.2 Fire and explosion

- Any of the oil/chemical spills would be contained around equipment housing. This will be collected and disposed off in an environment friendly manner.
- Existing disaster management plan set up of TPC will be extended to the proposed augmentation project.
- Emergency kit consisting of various appliances and fire protection clothing will be made readily available.
- Fire fighting system will be designed as per the Tariff Advisory Committee (TAC) guidelines. The TAC classifies a hydropower station in 'light hazard' category. The Fire Fighting System (FFS) shall essentially comprise of:

(a) Hydrant system for the power house

(b) High Velocity Water Spray (HVWS) System for transformers

(c) Portable extinguishers for power house

(d) Trolley mounted extinguisher for transformers

Fire water will be sourced from existing cooling water cum fire water tank.

a. *Hydrant System*

The hydrant system will comprise of :

- External and internal hydrant valves with hoses in hose boxes
- Hose reels at internal hydrant locations
- Under ground and above ground fire water piping.
- Panels, cables and instrumentation

The system will be designed to operate automatically on operation of any of the hydrant valve. The system is intended to be used for an incidence of fire assuming higher proportion, uncontrolled by portable extinguishers. The system shall be pressurised and will operate by a set of pumps and related instrumentation and controls.

b. *HVWS System*

Transformers will be protected by HVWS system. The system comprises of pressurised water source, hydraulically operated deluge valve (DV), spray network and bulb-detector network around the transformers and piping. Pressurised water is always available up to the DV. In case of fire the detectors break, the DV opens and water is discharged from the spray nozzles. The system will be designed as per TAC/NFPA. The system will be pressurised and will operate by a set of pumps and related instrumentation and controls.

c. *Portable Extinguishers*

Portable extinguishers of Water Gas Pressure type (9 litres capacity) and 4.5 kg Carbon Dioxide type will be appropriately distributed. Portable extinguishers are intended to be used for fire in incipient stage.

d. *Trolley Mounted Extinguishers for Transformers*

Two nos. of 50 litres trolley mounted foam extinguisher are proposed for transformer fight oil fires, as the area has HSD storage and transformer oil.

6.4 MANAGEMENT

Important features for management will be the following:

- Regular environmental monitoring covering post project monitoring schedule
- Periodic maintenance
- Occupational safety and health
- Meteorology data collection
- Plantation/afforestation program

Each of the above features are described below:

6.4.1 Environment monitoring

In hydro power projects during the operation phase there will not be any adverse impact which will induce water, air and noise pollution. Hence there is no necessity to monitor these.

However at present Maharashtra Pollution Control Board (MPCB) collects water samples from the tail race channel every month and carry out the required tests. This arrangement will be extended to the proposed scheme also.

Air quality monitoring will be carried out during construction phase. Noise level will also be measured during operation phase..

6.4.2 Periodic maintenance

All monitoring equipments will be periodically checked. Wherever required adequate standby will also be kept ready for monitoring.

6.4.3 Occupational Safety and Health

Safety measures will be implemented among employees to prevent and reduce any type of accidents. The existing medical facilities will be extended for routine health check up.

6.4.4 Meteorology

Existing meteorological station of TPC located near the Lake/power house would be equipped to monitor the following parameters:

- Wind speed
- Wind direction
- Relative humidity
- Evaporation loss & Cloud cover
- Rainfall
- Dry and wet bulb temperature

6.4.5 Green belt development and plantation programme

Existing green belt development programme will be extended and implemented. This programme will harmonise and amalgamate the proposed augmentation of the project with its surroundings. The programme will consist of the following elements:

- Maintenance of green belt and vegetative zones in the available areas/wherever possible.
- Plantation of trees and vegetation around the tunnels, open channel and Lake.

Tree species selected for the plantation would be pollutant tolerant, fast growing, deep rooted, and if possible ever green. It is desirable that instead of being a monoculture, suggested green belt should be planted with the heterogeneous plant species. As much as possible introduction of alien plant will be avoided and native plant species would be planted to maintain the existing ecological condition prevailing in the area.

6.4.6 Compensatory afforestation

Proposed steel lined tunnel will be constructed below TPC land. There is no necessity to cut down any trees for the proposed construction shafts as at these locations are devoid of trees with vegetation being limited to only shrubs. Proposed tunnel will be about 25 - 40 m below the ground. The tunnel will pass below the TPC land. As the proposed surface penstock (encased in concrete), valve house (extension) and proposed power house are within TPC land, there is no requirement to acquire private/forest land. As the proposed power house will be in the location of existing old office building (which will be dismantled), there is no necessity to clear any virgin land for the power house which may involve cutting of trees.

However, due to unavoidable circumstances if any trees have to be cut, compensatory afforestation will be carried out.

Thus, proposed activities will not lead to any change in the environmental settings of the area and compensatory afforestation will not be required.

CHAPTER - 7

ENVIRONMENTAL IMPACT STATEMENT

7.1 GENERAL

Criteria selected to decide on the environmental effect of a project are inter-related. This chapter summarises the impact statement. Effect of the project on the environment depends both on the type of project and surrounding environmental setting.

Appropriate measures during construction/operation phase are recommended which include control/mitigation measures regarding

- noise control
- air pollution
- water pollution
- reduction in water levels on one portion of Mulshi Lake

Construction phase does not involve transportation of fill material from long distances as balanced cut and fill is proposed and most of the fill material will be made available from excavated material generated within project boundary.

Local manpower to be used to the maximum possible extent. This will have a positive socio-economic impact to the surrounding area by generating extra income to local villagers during the 3 years of construction period.

Proposed steel lined tunnel is an extension of existing branch tunnel and will be constructed below TPC land. There is no necessity to cut down any trees for the proposed construction shafts as at these locations are devoid of trees with vegetation being limited to only shrubs. Proposed tunnel will be about 25 - 40 m below the ground. As the proposed surface penstock (encased in concrete), valve house (extension) and proposed power house are within TPC land, there is no requirement to acquire private/forest land. As the proposed power house will be in the location of existing old office building (which will be dismantled), there is no necessity to clear any virgin land for the power house which may involve cutting of trees.

However, due to unavoidable circumstances if any trees have to be cut, compensatory afforestation will be carried out.

Bhira augmentation project has potential for Clean Development Mechanism (CDM) benefits. However, CDM is part of a separate study and beyond the scope of present EIA report.

Measures suggested in environmental management plan should be extended for this augmentation project to conserve the surrounding environment.

7.2 WATER POLLUTION / IMPACTS

Construction activity of the proposed project is temporary in nature and not likely to use ground water. Sufficient surface water is available that can be used for construction activities. Various measures which include proper construction sequence are proposed so as to avoid water pollution (during the construction phase).

Unskilled construction workers will be sourced from neighbouring villages; contractor may bring skilled labour and technical staff from outside depending on the skills required for construction and erection of plant & equipment. Suitable arrangement is envisaged to manage all the aspects of temporary settling of those involved in the construction activity. Facilities presently available with the villages will continue to be used during construction activities.

Impact during operation phase is due to lowering of MDDL in one portion of Mulshi Lake due to Lake partitioning scheme. It is proposed to nullify this impact by extending the suction pipes of the pumps which draw water from the Lake and installation of new pumps (if required).

- It is found that altered generation pattern due to proposed augmentation scheme does not have any adverse impact on the downstream users.

7.3 AIR POLLUTION

During construction phase there will be minor but reversible air pollution. Suitable measures will be undertaken to lessen these pollutions. However, proposed augmentation scheme will not release SO_2, NO_x and SPM as a pollutant during the operation phase as hydro power is recognised as a renewable source of energy and which is non-polluting and environmentally benign. The monitored parameters (baseline) are within the limits of NAAQS set by MOEF.

7.4 AFFORESTATION

Present afforestation drive of the TPC will be continued to maintain / enhance the surrounding ecology and landscape.

Necessary environment, health and safety related clearances/approvals, will be taken from respective authorities, wherever and whenever required.