



# Best Environment Practices in SJVN Projects

*Souvenir*





## CMD's Message

SJVN, which took birth as a single Project and single State Company a few decades ago, has now matured into its full adulthood as a fully diversified transnational Power Sector Company in all types of conventional and non-conventional forms of energy along with power transmission business. With a total portfolio of 7690.51 MW, out of which 2016.51 MW is under Operation, 2980 MW is under Construction, 482 MW is under Pre- Construction & Investment approval and 2212 MW is under Survey & Investigation stage, SJVN aims to be a 5000 MW company by 2023, 12000 MW Company by 2030 and 25000 MW company by 2040.

To achieve this portfolio for the benefit of the company and the welfare of the nation, hydro power projects play crucial role. However, merely developing hydropower projects without paying adequate attention to the environment would go against SJVN's deep-found values of environmental conservation. The need to promote practices that integrate environmental concerns in development plans are being universally acknowledged by policy-makers. The need is even more emergent in a developing country like India, where the challenge to maintain healthy landscapes with the benefits that they deliver may come in conflict with expanding infrastructure development works.

SJVN believes in giving equal importance to all three pillars of sustainable development – economic development, social development and environmental development. As enshrined in its vision, SJVN has addressed itself to developing affordable clean power. SJVN's policy has always been centered towards carrying the goodwill and good wishes of the communities through its journey of growth. Hence, SJVN also considers it its mission to develop and operate projects in a socio-environment friendly manner, and taking care of the environment has always been one of the top-priorities of SJVN. SJVN understands that hydropower development benefits the society especially when innovative measures to mitigate and improve the environment are undertaken. SJVN has consistently complied with all applicable environmental legislations and norms, has always mitigated environmental risks and adopted the best environmental practices.

Nathpa Jhakri Hydro Power Station (NJHPS) and Rampur Hydro Power Station (RHPS) have undertaken remarkable measures for the improvement of the environment. These exemplary efforts have long been acknowledged with several awards and accolades. I am proud to say that NJHPS and RHPS projects have emerged as the torch-bearers of sustainable development for hydropower projects in India, leading the way and showing how hydropower projects can be developed whilst caring for the environment. The activities undertaken at NJHPS and RHPS inspire us at SJVN to continue to take diligent measures for the improvement of the environment at other projects.

I recall what Late Kofi Annan, the seventh Secretary-General of the United Nations once said: "Our biggest challenge in this new century is to take an idea that seems abstract – sustainable development – and turn it into a reality for all the world's people." SJVN has successfully completed this challenge at NJHPS and RHPS, and made sustainable development a reality at these projects.

Today, as SJVN has grown and diversified not only within the country but in neighbouring countries as well, it becomes vitally important for the company to remain robust in implementing measures to improve the environment at the projects in a similar fashion to NJHPS and RHPS, which have become a benchmark for the industry. Therefore, SJVN is committed to maintain and improve environmental performance at our projects.

I am happy to present before you a compilation of measures taken by NJHPS and RHPS to improve the environment, which I believe you will appreciate as a good read.

I cannot help but recall a quote by renowned Kenyan environmentalist and Nobel Laureate, Late Wangari Maathai on this occasion:

"The environment and the economy are really both two sides of the same coin. If we cannot sustain the environment, we cannot sustain ourselves".

So, let us develop a healthy relationship with the environment and respect Mother Nature that has blessed us with an abundance of natural resources, and with life itself. Let us be inspired by the efforts made at NJHPS and RHPS and help nurture the nature.

**(Nand Lal Sharma)**  
**Chairman & Managing Director**



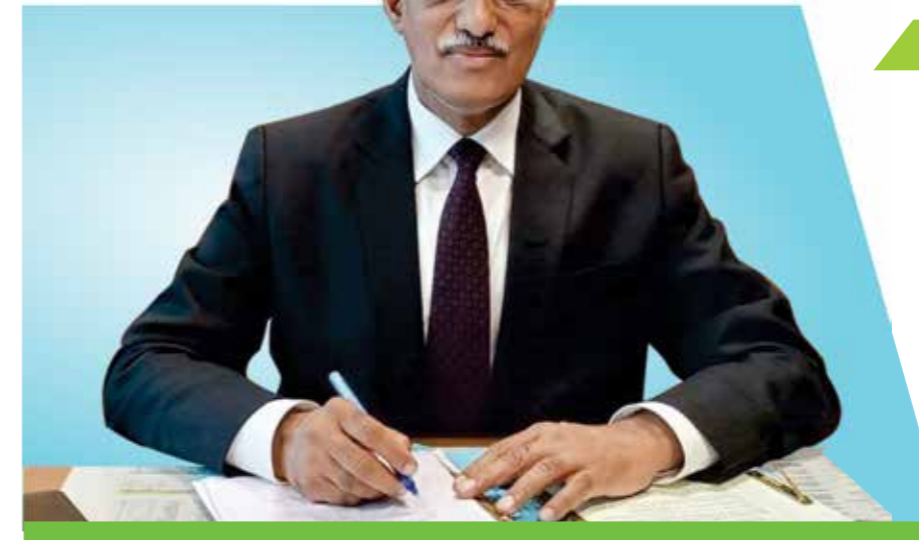
## MESSAGE

SJVN began its journey with a single hydro power project and has expanded its horizons by venturing into thermal, solar and wind power generation. With 5 power plants in operation generating more than 2016.51 MW of electricity and 5674 MW under various stages of construction and implementation, SJVN is on the roadmap to achieving our shared vision of becoming a 5000 MW Company by 2023, 12000 MW Company by 2030 and a 25000 MW Company by 2040. This remarkable journey would not have been possible without the dedication & efforts of our employees.

SJVN has always adopted a proactive approach for balanced growth at all its projects. This policy of sustainable development and the mantra of “Development without Destruction” was envisaged by SJVN at Nathpa Jhakri Hydro Power Station (NJHPS), and effectively replicated again at Rampur Hydro Power Station (Rampur HPS). The impeccable measures taken by SJVN to improve the environment at its projects are one of the reasons why SJVN has always received overwhelming support from the local communities. The importance of the environment cannot be emphasised enough. No development is true development if it causes irreversible damage to the environment. I would like to express my gratitude towards the personnel who have strived to improve the environment at project sites.

It is heart-warming to know that Corporate Environment Department & Corporate Communications have jointly prepared a souvenir which briefly describes the efforts made at NJHPS and Rampur HPS for environmental welfare. I sincerely hope that this handbook facilitates to increase environmental sensitivity and creates awareness among its readers.

**(Geeta Kapur)**  
**Director (Personnel)**



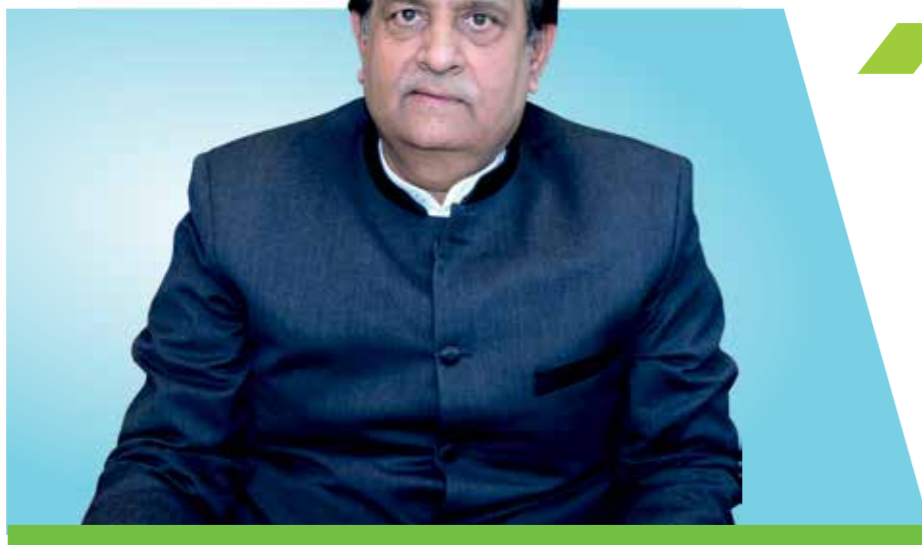
## MESSAGE

SJVN is a globally admired & diversified Power Sector Company that aims to be a 5000 MW company by 2023, 12000 MW by 2030 and 25000 MW by 2040. In pursuit of this great endeavor, it is in the best interest of our nation that we mitigate the environmental impacts associated with construction of projects, while at the same time ensure biodiversity conservation, support ecosystem services and promote innovative engineering measures to build a green infrastructure.

Undertaking such effective engineering and environmental measures is no easy task. However, SJVN took this challenge as an opportunity at Nathpa Jhakri and Rampur Hydropower Stations to show-case how sustainable development can successfully be implemented. Use of Geo-textiles for restoration of muck dumping sites is one such innovative measure that was successfully implemented by SJVN and is being replicated in all our future projects.

I congratulate all SJVN employees who have worked relentlessly in pursuit of achieving world-class environmental standards at NJHPS and RHPS and hope that this compilation of environmental good practices will motivate and arouse environmental sensitivity in its readers.

**(Surinder Pal Bansal)**  
**Director (Civil)**



MESSAGE

SJVN has always been deeply committed in its concerns for the environment. The efforts made at NJHPS and RHPS for conservation, mitigation and sustainability of environment have proved that it is possible to conceive a company with strong environmental ethics and yet continue to remain profitable over many years.

I would like to express my heartiest gratitude to all SJVN personnel who were involved during construction and commissioning of NJHPS and RHPS, and congratulate them for developing these projects while ensuring environmental conservation.

I hope the readers will thoroughly enjoy and appreciate the successful efforts being documented in this souvenir to showcase environmental best practices at NJHPS and RHPS.

**(Akhileshwar Singh)**  
**Director (Finance)**



MESSAGE

All forms of electricity generation have an environmental impact on our air, water and land. Hydro power projects, though fall under renewable category, are often wrongly perceived as a threat to the environment. I am proud to state however, that due to the exemplary efforts made at Nathpa Jhakri Hydro Power Station (NJHPS) and Rampur Hydro Power Station (RHPS), SJVN has confuted any such myths.

SJVN has shown the world that development and operation of hydro power projects while doing environmental-good is possible. Well-planned and meticulous measures to improve the environment and the numerous energy-conservation measures at NJHPS and RHPS provide engineers across the nation with the inspiration and knowledge to develop better, more efficient, “greener” and more sustainable hydro power projects. These efforts exhibit exceptional execution of measures for the improvement of the environment.

SJVN aims to be a 5000 MW company by 2023, 12000 MW Company by 2030 and 25000 MW company by 2040. In this mission, it is imperative that it does not forget its core value of caring for the environment.

It is a matter of great pride and honor that the herculean efforts made at NJHPS and RHPS to improve the environment are being compiled in the format of this souvenir. I hope going through this compilation will be a pleasurable, as well as an enriching educational experience.

**(Sushil Sharma)**  
**Director (Electrical)**



## MESSAGE

SJVN has always been deeply committed to the concerns for the environment at its projects. I find that the level of commitment to the environment in SJVN is much beyond the laid down laws and rules for the industry. It has always remained involved in improving the environmental quality at its projects. The company has remained engaged in maintaining ecological sustainability of the project areas, which goes a long way towards achieving wider national interests.

The measures to improve the environment at Nathpa Jhakri Hydro Power Station (NJHPS) and Rampur Hydro Power Station (RHPS) have been implemented with due diligence, methodologically and systematically.

I extend my good wishes to SJVN to continue to undertake such measures for the benefit of the environment, which eventually is towards the overall sustainable development of the nation.

It is always good to document such works for posterity. I congratulate SJVN for compiling this souvenir and wish the reader a pleasant reading experience.

**(A.K. Srivastava)**  
**Chief Vigilance Officer**

## OUR SHARED VISION

5000 MW BY 2023, 12000 MW BY 2030 & 25000 MW BY 2040

### CORPORATE VISION

To be the best-in-class Indian Power Company, globally admired for developing affordable clean power and sustainable value to all stakeholders.

### CORPORATE MISSION

To drive socio-economic growth and optimise shareholders' and stakeholders' interests by : • Developing and operating projects in cost effective and socio-environment friendly manner. • Nurturing human resources talent with care. • Adopting innovative practices for technological excellence. • Focusing on continuous growth and diversification.

## ENVIRONMENT POLICY STATEMENT

SJVN reaffirms its commitment towards sustainable power generation and transmission with utmost care for environment.

### TOWARDS THIS COMMITMENT, SJVN WILL ENDEAVOUR TO:

- Conduct all its activities in an environmentally responsible manner and comply with applicable legal requirements, guidelines, directives and other commitments.
- Continually improve its management systems to prevent pollution and seek new and innovative ways to mitigate environmental impacts of its past, present and future activities.
- Develop and maintain efficient two-way communication with the stakeholders and collaborate with them in resolving environmental concerns.
- Minimize waste generation, promote efficient use of resources and contribute towards reduction of Green House Gas (GHG) emissions.
- Promote environmental awareness among its employees, contractors and suppliers and ensure that they have the training, knowledge, skills, resources, and equipment to meet the environmental commitments.



## ACKNOWLEDGEMENT

SJVN, an environment conscious organization has always laid great emphasis on ensuring minimum environment impact from its Hydro Projects. The Mission and Objective of our organization also strongly focuses on being Best-in-class Global Power Company developing affordable clean power with minimum ecological disturbances. Environmental mitigation measures for sustainable development of hydro power have been successfully implemented.

SJVN's flagship Power Stations, 1500 MW NJHPS and 412 MW RHPS have adopted varied measures to ensure minimum impact of construction and operational activities of the project on environment. The introduction of State of Art Geo Green Erosion Control Blanket for restoration of Muck Dumping sites of RHPS was a path breaking endeavor to enable revegetation and also provides solution to erosion problem and slope stabilization. SJVN's State of Art Environment Laboratory at Jhakri is the corner stone company's pollution abatement and control efforts.

SJVN had adopted Clean Development Mechanism during construction of RHPS to contribute in reduction of Carbon Dioxide emission in the environment. Also, for other Projects under construction such as 66 MW Dhaulasidh HEP & 210 MW Luhri Stage-I HEP, the annual reduction in CO2 from the environment is expected to be 8.5 lakh tonnes. Various initiatives such as Grid connected 1 MW Solar Power Plant at Wadhal, 310 KW Solar Power Plant at Surge Shaft of NJHPS and 60 KW Solar Power Plant at RHPS contributes in harnessing the renewable energy and is another effort towards ensuring good impact of the Power Stations on environment.

The initiatives of both the Power Stations in the field of environment have been appreciated by the World Bank. It gives me immense pleasure to be part of this souvenir that archives successful initiatives undertaken by NJHPS & RHPS to contribute in green and clean vicinity around the Power stations. This souvenir is an effort to record successful environmental mitigation measures so that same exemplary standards shall be maintained while marching ahead towards achieving the shared vision of 5000 MW by 2023, 12000 MW by 2030 and 25000 MW by 2040.

**(D.P Kaushal)**  
Head of Department  
Corporate Human Resources



## ACKNOWLEDGEMENT

SJVN Limited has always been dedicated to safeguard the environment and to ensure that development goes hand-in-hand with the conservation of the environment. SJVN holds its Environment Policy in high regard and to ensure that effective environmental mitigation measures are taken SJVN has a dedicated Environment Department with personnel posted at respective project sites and the Corporate Headquarters.

It brings me immense pleasure to present this souvenir, which is a humble effort in briefly describing the measures meticulously taken by SJVN at NJHPS and RHPS for improvement of the environment. I congratulate and greatly acknowledge the contributions of Corporate Communications, HR Department; the personnel in the Environment Department, ably guided by the respective Head of Projects, at NJHPS and RHPS; and lastly my team - the Corporate Environment Department - for working together and preparing this souvenir.

Looking back, we can find that SJVN has always been dedicated to the cause of environmental welfare. The stories of success at NJHPS and RHPS presented in this souvenir provide a glimpse of how SJVN managed to create a healthy and flourishing socio-physical environment around its project sites, and has received overwhelming appreciation for the same. The lessons learned from NJHPS and RHPS will be the benchmark for the upcoming projects of SJVN.

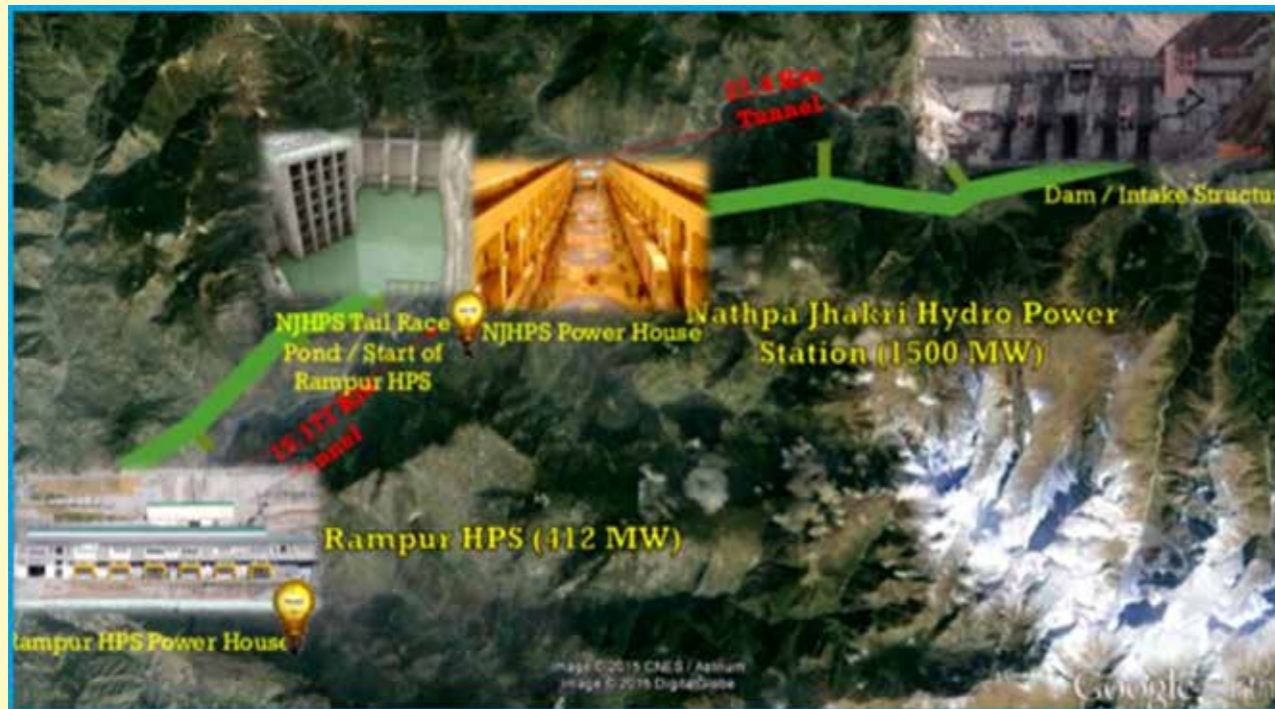
I sincerely hope that this souvenir may contribute towards increasing environmental awareness amongst its readers, and thereby inspire them to do environmental good for sustainable development in his or her own capacity.

**(V. Sankaranarayanan)**  
Head of Department  
Corporate Environment

## SJVN Profile

SJVN Limited, a Mini Ratna, Category-I and Schedule- 'A' CPSE under administrative control of Ministry of Power, Govt. of India, was incorporated on May 24, 1988 as a joint venture of the Government of India (GoI) and the Government of Himachal Pradesh (GoHP). SJVN has established its mission to drive socio-economic growth and optimize shareholders' and stakeholders' interest by developing and operating projects in cost effective and socio-environment friendly manner. Working towards this mission, at Nathpa Jhakri Hydro Power Station (NJHPS) and Rampur Hydro Power Station (RHPS) the best in class environmental mitigation measures were adopted showcasing that development activities and environment conservation can go hand in hand.

Beginning with a single project, i.e. India's largest 1500 MW Nathpa Jhakri Hydro Power Station (NJHPS) in Himachal Pradesh, SJVN has commissioned projects totalling 2016.51 MW of installed capacity including wind and solar power. Also, an 86 km. long 400 kV D/C transmission line has been commissioned through a Joint-Venture of SJVN with IL&FS and the POWERGRID.



Project layout map of NJHPS & RHPS

## 1500 MW NATHPA JHAKRI HYDRO POWER STATION (NJHPS)





## MESSAGE

SJVN believes that it is its duty to pass on to future generations a healthy global environment in which all forms of life can thrive and pursuing this belief Nathpa Jhakri Hydro Power Station is marching ahead with environmental initiatives at all forefronts by spreading common understanding in people to change their attitude towards environment and value the gift from environment. The air we breathe, water we drink, sunrays that reach us, the food we consume, all are from environment.

In order to keep environment healthy, 1500 MW Nathpa Jhakri Hydro Power Station being the flagship project of SJVN has adopted various other energy conservation initiatives like intelligent lighting system, installation of Solar Power Panel for In-House consumption, Bio gas and Vermin Compost Plant for utilization of Biodegradable waste. Other initiatives include use of leakage water from its water conductor system to meet all its drinking water requirements of township, offices and power house complex with a motive to minimize wastage of water. In surrounding area, NJHPS has rehabilitated a large number of natural water sources which caters the requirement of local population. Besides this, NJHPS also executes drives for afforestation/plantation in & around project areas for conservation of ecology.

NJHPS has also supported local administration in maintaining hygiene by providing Sewerage Treatment Plant of 1.00 MLD capacity for entire Jhakri village as well as nearby area. NJHPS also promotes the use of recycled materials by making pencils and office files from waste paper.

Our Mother Earth is under relentless onslaught of various egregious pollution causing forces which are threatening its very existence thereby ours. We at NJHPS act as very first line of defense. "God has gifted us with Mother Nature who nourishes us at every point and the responsibility of saving her lies on all our shoulders."

(Ravi Chander Negi)  
Head of Project - NJHPS

## INTRODUCTION

The foundation stone for Nathpa Jhakri Hydro Electric Project was laid at Jhakri by the then Prime Minister of India on 13<sup>th</sup> April, 1989.



NJHPS Reservoir



NJHPS Dam



Nathpa Dam Intake Structure



TRT Outfall

The Project was conceived in 1960s by HPSEB, however investigations started much later on in 1970s under the central assistance scheme. Initially, the project was planned with a smaller installation of 1020 MW (6 x 170 MW), however, subsequently, the capacity of the project was revised to 1500 MW (six generating units each of rate capacity 250 MW) as a result of optimization studies and same was granted Techno-Economic Clearance by Central Electricity Authority in 1986.

At the time of operation, the project was rechristened to Nathpa Jhakri Hydro Power Station (NJHPS). The project has been a cornerstone of SJVN's commitment towards conservation of environment

as well as rehabilitation of land oustees and has received numerous commendations. World Bank has specifically appreciation NJHPS for its Environment Management and R&R measures, and during one of its project review, has categorically stated that- *“Nathpa Jhakri Project has several environmentally beneficial aspects. The environmental impacts of the project, considering its generation capacity are very low. The success of the resettlement activity undertaken in this project is quite rare for India, and can be considered as one of the best examples of resettlement implementation in bank assisted projects in India. It should be considered as an example for other projects. Reuse of muck in construction of a number of access roads and a school playground are also commendable initiatives. Avenue and other plantation in the township are also very satisfactory”*.

At NJHPS, we simply resonate with the ethos of Government of India and Government of Himachal Pradesh in pursuing development strategies while also taking into consideration the vulnerability of the Himalayan region and the need for environmental protection.

Important salient features of NJHPS include:

- A 62.50 m. high Concrete Gravity Dam on River Satluj River at Nathpa to divert 486 cumecs of water through four intakes.
- A large underground De-silting Complex, comprising four chambers, each 525 m. long, 16.31 m. wide and 27.5 m. deep.
- A 27.394 Km long Head Race Tunnel of 10.15 meter diameter terminating into the Surge Shaft.
- A 301-meter-deep and 21.60 meter diameter Surge Shaft with an opening to the sky.
- Circular steel lined 3 Pressure Shafts of 4.90 meter diameter each, bifurcating into two near the Power House to feed 6 generating units.
- An underground Power House that have 6 vertical axis Francis Turbines of 250 MW each installed to utilize a design head of 426 meters.
- A Tail Race Tunnel of 982-meter length with 10.15 meter diameter.

## ENVIRONMENTAL CONTEXT AND PROJECT LOCATION

The project area and the project's influence area are located in the lower Himalayas and are characterized by rugged topography with steep hills (altitude varying from 850m to 2000m). The area experiences subtropical to sub-Himalayan climate; and is sparsely vegetated. The immediate vicinity of the project supports patches of dense forests, but has a long history of deforestation. The hill slopes are steep and are generally covered with sparse vegetation, overburden and outwash material. Most of the human population in the project's influence area is concentrated in the villages along the highway and the connecting district/village roads.

The location and design of the project is such that it had minimum adverse impacts due to limited acquisition of land involving 405.84 ha, out of which only 187.14 ha was forest land.

## STATUTORY CLEARANCES

The project was accorded Environment Clearance by the then Department of Science & Technology on June 26, 1980. At that time, there was no requirement of Environment Impact Assessment (EIA) Studies, however, NJHPS still implemented several environmental conservation and enhancement measures at site.

Later during 1997, the project was subjected to scrutiny by various statutory bodies at the State and the Centre and a detailed Environment Management Plan (EMP) was prepared and implemented. The prominent environmental regulations/guidelines attracted by the project were Forest (Conservation) Act 1980, Environment (Protection) Act 1986 and later the Environmental Impact Assessment Notification, 1994.

While preparation of EIA Study, all project parameters and baseline environmental condition were analysed for identifying potential impacts during construction and operation stages. A multi-pronged approach was adopted to mitigate the anticipated environmental impacts that occur due to the construction of a hydro project.

Some of critical impacts identified during construction stage were, generation of sewage from labour camps/colonies and effluents from crushers which have potential impacts on water quality. Dust emission from crushers and vehicular movement were the major impacts identified for air quality. Further, there was likelihood of various impacts due to increased human intervention such as impact on terrestrial and aquatic ecosystem for which suitable mitigation and enhancement plans were got formulated.

## ENVIRONMENTAL MITIGATION MEASURES

SJVN meticulously implemented various mitigation and enhancement plans as follows:

- Compensatory Afforestation
- Muck disposal and restoration plan
- Catchment Area Treatment (CAT) Plan
- Fisheries management plan
- Control of pollution from labour camps during the construction phase
- Restoration plan for quarry sites
- Wildlife conservation and protection measures
- Maintenance of water quality
- Control of water-borne diseases
- Slope stabilisation measures
- Development of nursery and green-belt development

In addition to above, necessary arrangements were made by the project authorities through the contractors to provide fuel wood, free of charge, to the labour force during construction stage of the project to avoid indiscriminate felling of trees. Furthermore, various steps were taken to remove the scars of construction by levelling and landscaping of the project area so as to merge with the surroundings. Additionally, construction methodology was optimised and controlled blasting was undertaken. Dugout material from tunnel excavation (referred to as muck) was scientifically dumped on pre-identified muck dumping sites to avoid its spilling into nearby water bodies. These muck dumping sites were stabilised using various engineering measures and plantation of native species. In order to reduce the potential impacts on surface water bodies, all construction camps and colonies were provided with community latrines and sewerage system. Additionally, sedimentation pits were also provided at various locations where tunnel ingress water was likely to flow into nearby water bodies, thereby reducing the chances of increase in its turbidity.

SJVN continues to adopt the latest technologies and practices for the welfare and improvement

of the physical as well as the social environment. Towards this end, the Township at Jhakri has been attached with a dedicated Sewage Treatment Plant (STP).

## COMPENSATORY AFFORESTATION

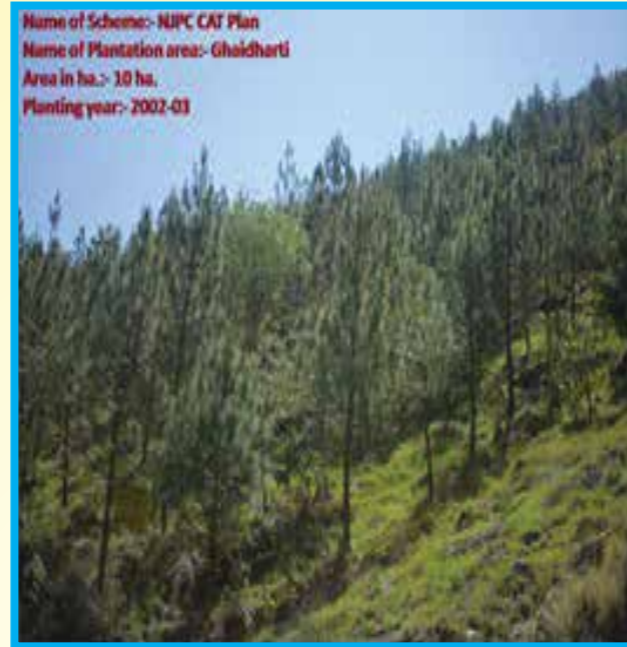
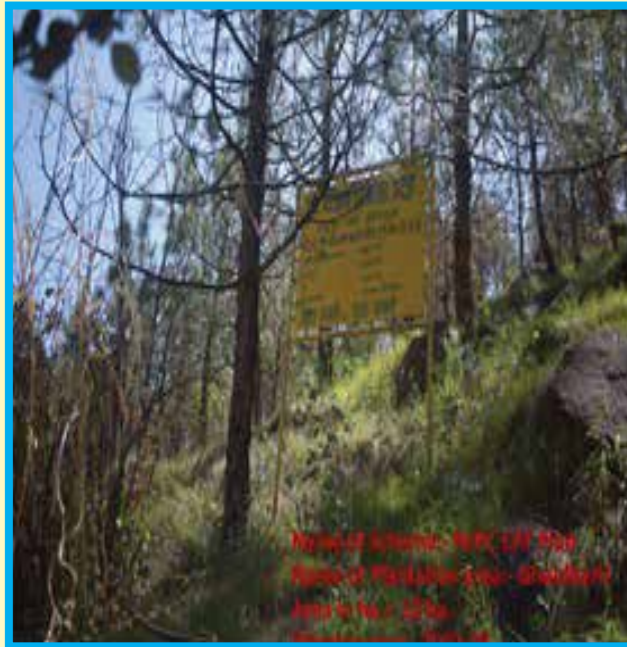
In order to compensate for the diversion of 187.1456 ha of forest land, a Compensatory Afforestation Plan was prepared as per prevalent provisions under Forest (Conservation) Act, 1980. This involved plantation works over 256.2956 ha of degraded forest undertaken by State Forest Department of Himachal Pradesh and funds amounting to INR 3.67 Crores was deposited by SJVN with Compensatory Afforestation Management and Planning Authority (CAMPA).

In addition to above, avenue plantation in and around the project area was also carried out through State Forest Department with funding from SJVN.

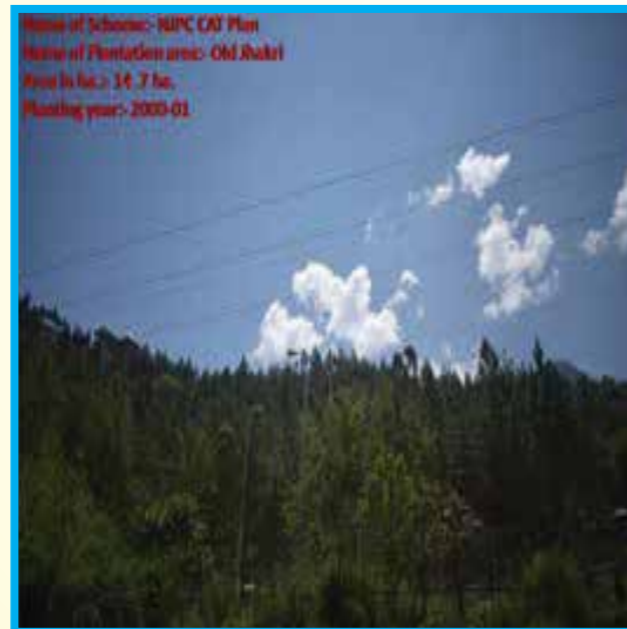
More than 20,000 plants of selected species like Hibiscus, Bottle brush, Alstonia, Tecoma, etc. were planted by SJVN at various locations in Jhakri, Kotla & Nathpa as well as project sites like outfall & pothead yard, etc.



Compensatory Afforestation at Bhadrash



CA Works at Ghaidharti, Planting Year 2002-03



CA Works at Old Jhakri, Plantation Year 2000-01

## CATCHMENT AREA TREATMENT (CAT) PLAN

The CAT Plan for the project was approved by Assistant Inspector General of Forests, Gol on January 09, 2003. It was formulated for a period of 10 years starting from 2002-03 to 2011-12 by taking into consideration various impacts of project activities and approach to be adopted for its mitigation. Total outlay for the CAT Plan was INR 29.57 Crores wherein INR 12.55 Crores was earmarked for Kinnaur Forest Division; INR 7.97 Crores for Rampur Forest Division and INR 9.05 Crores for Sarahan (Wildlife).

During the course on implementing CAT plan works, it was felt that the plan needs revision to factor in altered ground realities and new advancement in soil and water conservation techniques. Thus, the CAT Plan was got re-casted by HP State Forest Department with an objective to prioritize the most cost-effective vegetative measures and bio-engineering methodology rather than the conventional approach of using civil structures. In addition, target oriented plantation to encourage moisture retention, reduced soil erodibility and improved soil and water conservation measures were also addressed.



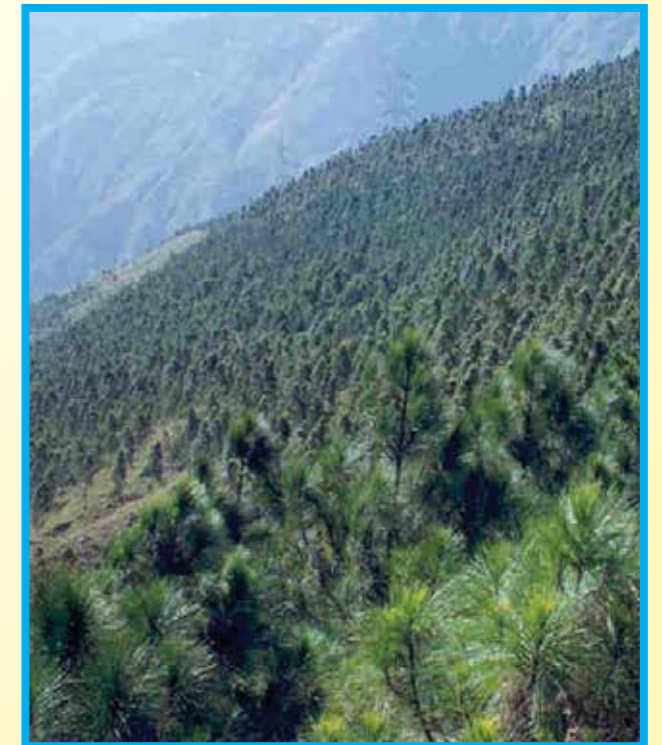
Village Path Development



Construction of Check Dam



Stabilization of Nigulsari Area



Afforestation

## FISHERIES MANAGEMENT

Under Fisheries Management of NJHPS, SJVN has funded INR 1.6 crore to the State Fisheries Department for development of Fisheries. Various components under the plan are as under:

- To develop facilities to raise seed of Lake Trout (*Salvelinus namaycush*), Brown Trout (*Salmo trutta faria*) and Rainbow Trout (*Salmo gairdneri*) at Sangla.
- To develop facilities to raise seed of Snow Trout (*Schizothorax richardsonii*) at Alsu (Mandi) for stocking in reservoir and main Satluj River.
- Miscellaneous (Administrative expense for transportation of brooders, fish seed, etc.; farm and laboratory equipments; etc.).
- Implementation of collaborative research project with scientists of Indian Council of Agriculture Research (ICAR) on breeding of Snow Trout (*Schizothorax richardsonii*).



Reinvigoration of fish at Nathpa Dam.

## DISPOSAL OF MUCK AND RESTORATION OF DUMPING SITES

Tunnel construction activities (and all underground works) inevitably generate huge quantities of excavated material, which is usually referred to as 'Muck'. This muck if not dumped properly can run off and pollute the nearby water bodies by increasing the water turbidity which can have a detrimental impact on aquatic ecology. Moreover, muck pills, if not treated properly, can increase dust emissions in the area. It is thus imperative that muck generated during the excavation of various underground works are handled properly in a scientific manner. In case of NJHPS, the total muck generated was about 6.80 million m<sup>3</sup>, out of this about 0.99 million m<sup>3</sup> was reutilized (in backfilling, construction material, etc.) and about 5.8 million m<sup>3</sup> was disposed of at eight disposal sites.

The details on muck generation is as under:

## MUCK MANAGEMENT

S. N.	Name of Dumping Site	Capacity of Dumping Site (m <sup>3</sup> )	Total Muck Generated (m <sup>3</sup> )	Muck Reutilized (m <sup>3</sup> )	Cumulative Dumping of Muck at Dumping Area (m <sup>2</sup> )
1	Nathpa	2015000	1594460	162535	1431925
2	Sholding	592000	564698	0	564698
3	Nigulsari	578000	598750	21100	577650
4	Wadhal	720000	738286	18500	719786

S. N.	Name of Dumping Site	Capacity of Dumping Site (m <sup>3</sup> )	Total Muck Generated (m <sup>3</sup> )	Muck Reutilized (m <sup>3</sup> )	Cumulative Dumping of Muck at Dumping Area (m <sup>2</sup> )
5	Manglad (Left)	410000	628260	287831	340429
6	Manglad (Right)	250000	466580	216700	249880
7	Jhakri-1	1221000	1374283	171866	1202417
8	Jhakri-2	720000	839262	119320	719942
<b>TOTAL</b>		<b>6506000</b>	<b>6804579</b>	<b>997852</b>	<b>5806727</b>

## PHOTOGRAPHS OF MUCK UTILISATION SITES:



Ground at DPS Jhakri



Plantation site along Power House Road



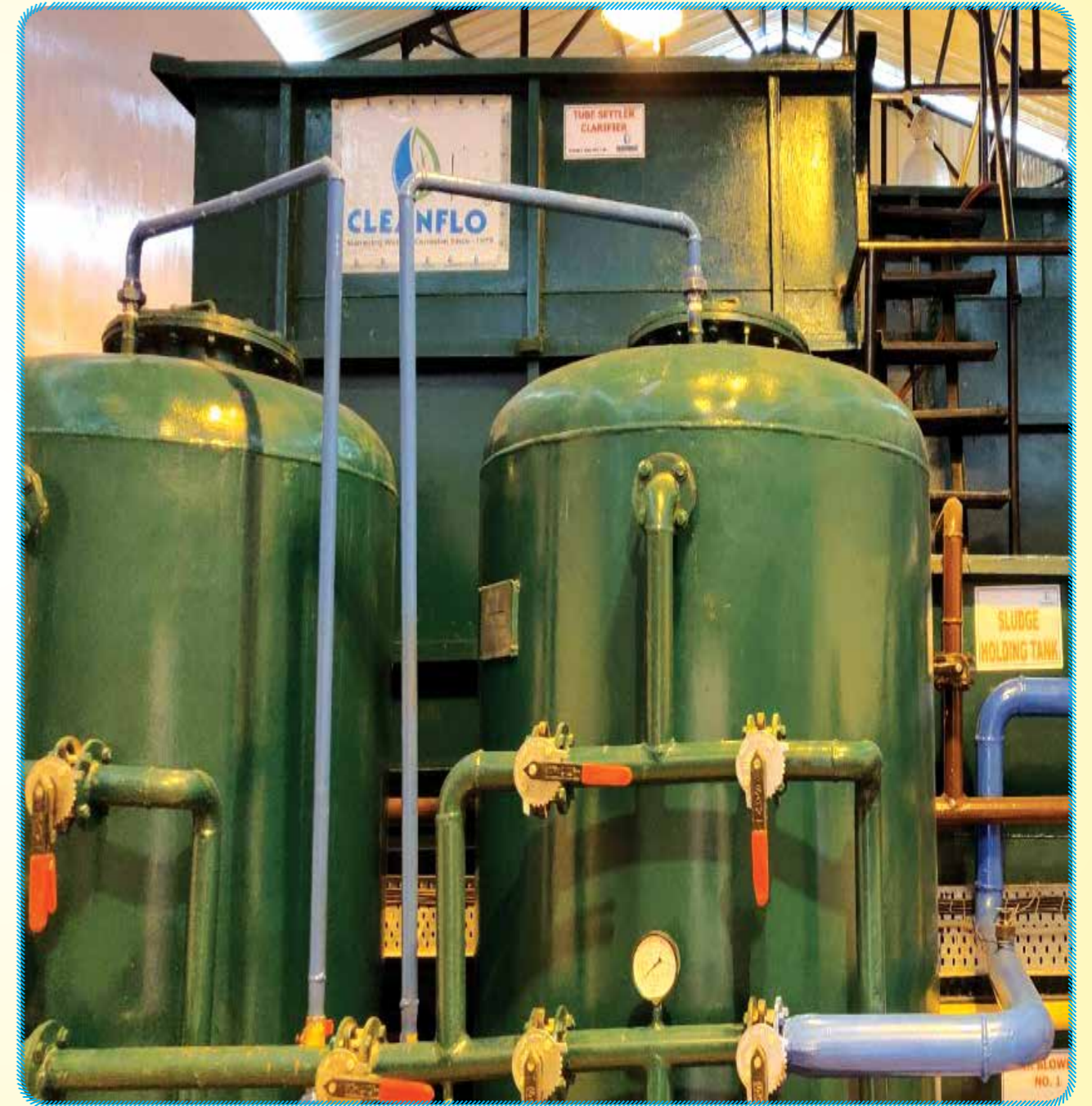
Manglad (Right)



Gulab Vatika

## OTHER MITIGATORY MEASURES

SJVN commissioned a One MLD capacity Sewage Treatment Plant (STP) to cater to local population of Jhakri, Shantinagar and R&R landless colony. In addition to this, two STP of 250 kLD capacity each for NJHPS township at Jhakri and two STP of 25 kLD and 75 kLD for Main Administrative Building and NJHPS-Jeori colony respectively was also commissioned.



Sewerage Treatment Facility for SJVN Township at Jhakri



Sewerage Treatment Facility for SJVN Township at Jhakri



Sewerage Treatment Plant to cater to Village Jhakri

Solid Waste Management facilities at NJHPS townships and the project area have been developed as per prevailing Ministry of Environment, Forest & Climate Change (MoEF&CC) and Central Pollution Control Board (CPCB) guidelines. Bins for segregation have been distributed in townships. A bio-methanation unit has been provided near the office canteen. An incinerator has also been installed and vermicomposting pits have also been erected. In addition, there is an exclusive availability of sweeping and garbage collection staff.



Biogas Plant for Office Canteen, Jhakri

- Installation of Biogas Plant in Office Canteen, Jhakri.
- Vermicompost pits for biodegradable waste in NJHPS colony.



Incinerator Plant at NJHPS



Installation of Bilingual Danger Sign Boards at various locations along Satluj River from Nathpa Dam to TRT Outfall as a measure of Advance Warning System.



### Installation of Advance Warning cum Alert System

comprises a total of 11 Siren locations (4 Sirens mounted on 13 Meter GI pole at each location) and two control stations for alerting the general public before release of water from Nathpa Dam. Sirens have been installed by the project from Nathpa Dam up to Averi store of SJVN (before Bayal).



310 KW DC Solar Plant at Surge Shaft

### SOLAR POWER INITIATIVES

- Grid Connected Solar Power Plant 310 kW (DC) has been commissioned at Surge Shaft area of the project.
- Grid-connected Solar Power Plant of 01 MW at Wadhal.
- Off-grid Solar Power Plant of 12 kW in Project Office premises.
- Off-grid Solar Power Plant of 6 kW in Monal Bhawan.
- Off-grid Solar Power Plant of 6 kW in O&M store.
- Off-grid Solar Power Plant of 6 kW in CISF Fire Office.
- A 12 kW (6+6) Solar Power Plant at Dam site of Nathpa.
- Two Grid-connected Solar Power Plant at Monal Bhawan and NJHPS Officers Club of 6 kW each.
- One 300 LPD Solar Heater installed at Main Administrative building of NJHPS.
- Two 300 LPD each Solar Heaters installed at Monal Bhawan.
- One 500 LPD Solar Heater installed at Mayur Bhawan.



*Solar Panels on Office Roof Tops*



*Solar Water heaters at Mayur Bhawan Guest House*



*Solar Water Heater Plant at Main Administrative Building*

- Energy conservation measures such as installation of Occupancy Sensors in the Office Building, Intelligent Lighting System and Alternate Phase Switching System has been installed at Power House Complex of the project.
- Independent Solar LED Light at various locations at Jhakri and Nathpa.
- Distribution of Solar lights in the Project Affected Area.



*Independent Solar LED Light at Jhakri*

- Electric Vehicle Charger has been installed at NJHPS Office Complex to charge electric vehicles of project, both private and hired.



Electrical Charger for Charging of Electrical Vehicles

- Energy efficient hot blowers have been provided in each room of the office complex in place of conventional type of heaters to save energy.



Energy efficient hot blowers inside office rooms

- **Use of Recycled materials:** NJHPS is utilizing its waste papers and kitchen waste for creative uses. Paper waste is being used for manufacturing of pencils and office files, while kitchen waste is being used for generating cooking gas for office canteen and to produce manure (used at the project's nursery).



In-house Pencil-making machine (from waste paper)



In-house pencil making machine and oven (from waste paper)



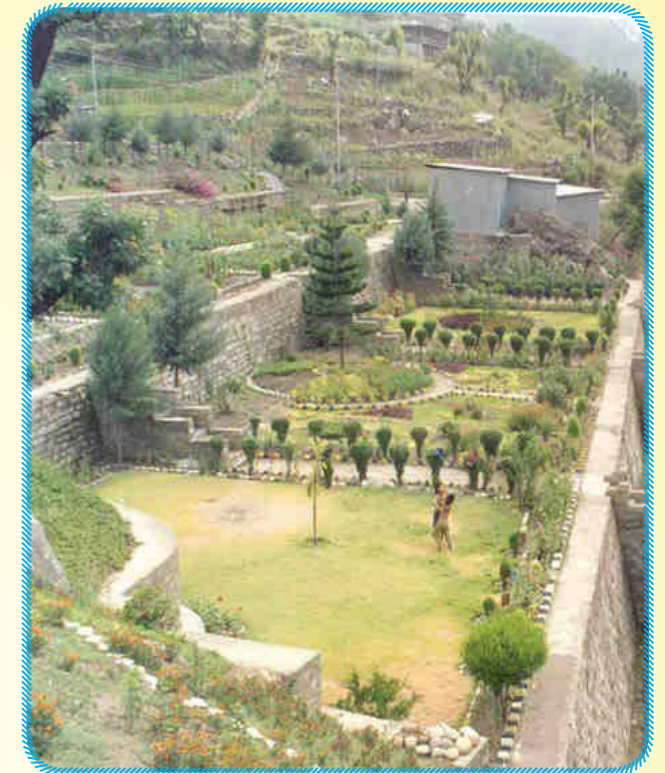
Pencils & File Cover prepared From Waste Paper

- Water bodies in the project vicinity have been rehabilitated. Besides this, SJVN also executes drives for afforestation/plantation in & around the project area for conservation of ecology.
- Plantation of various ornamental and medicinal plants in main office lawns and corridors.

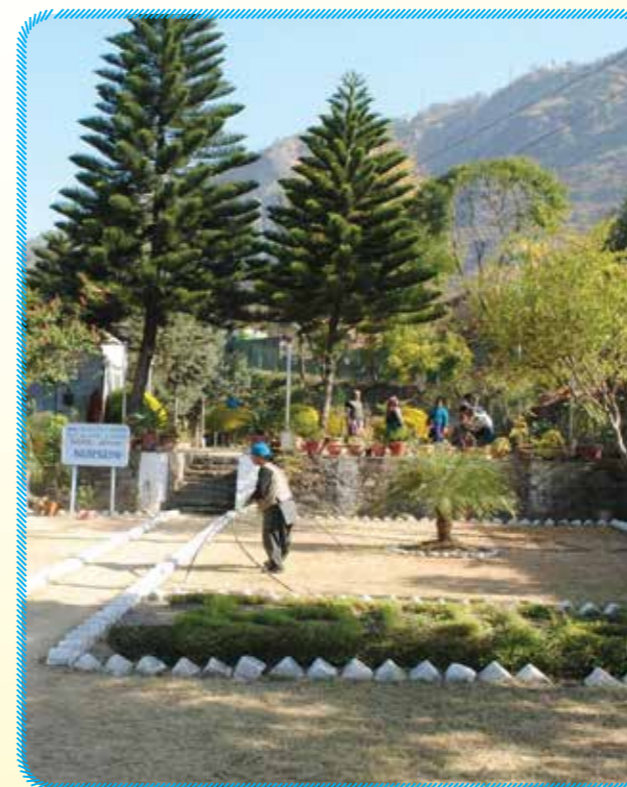
## DEVELOPMENT OF NURSERY



Nursery (Near Monal Guest House) while being developed in 1999



Nursery in SJVN Town Ship, Jhakri



Nursery (Near Monal Guest House) while being developed

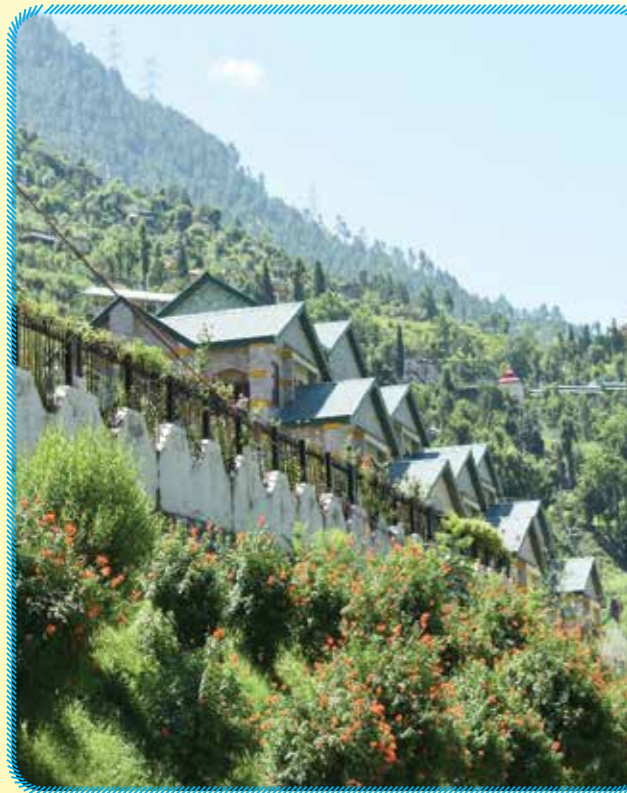


Nursery (Near Monal Guest House) while being developed in 1999

## DEVELOPMENT OF NURSERY



Nursery at Jhakri



Plantation near office building at Jhakri



View of Mayur Bhawan Guest House

## CELEBRATION OF WORLD ENVIRONMENT DAY

Includes mass plantation drives in and around the project area and organizing various competitions amongst employees, schools to increase awareness.



Awareness Rally on World Environment Day



Pledge - World Environment Day

The project has built over 315 toilets in schools under 'Swachh Bharat Mission' and additional grant for construction of 53 toilets is also being provided. In addition to this, the project is also presently providing Rs. 5000.00 as annual grant to each school for maintenance of built toilets and also observing following activities under Swachh Bharat Mission.



Handing over of Public toilets by Hon'ble CMD, SJVN to Gram Panchayat Jhakri.

- Mandatory Pledge Ceremony for employees of NJHPS.
- Cleanliness drive.
- Distribution of dustbins to all houses of NJHPS colony in Jhakri/Nathpa/Kotla/Jeori for segregation of waste.
- Conducting mass awareness programmes about the adverse effects of open defecation for students of various government/private schools in Project Affected Area.
- Displaying of slogan banners at prominent places in Jhakri.
- Slogan writing competition among employees of NJHPS at Jhakri & Nathpa (Swachhta campaign).
- Tree plantation in and around project area.
- Painting, slogan-writing and essay writing competition among children of NJHPS employees.
- Swachhta Competition among various departments about cleanliness.
- Awareness about Swachhta and publicity of Swachhta Pakhwada in print media.
- Cleanliness drive of River Satluj upstream of Nathpa Dam.



Display of Slogans in Prominent Places

## ADOPTION OF ENVIRONMENT MANAGEMENT SYSTEM

NJHPS is exclusively certified for Environmental Management Systems by Bureau of Indian Standards (BIS) and is integrated with Quality and Safety Management Systems.



NJHPS Residential Colony

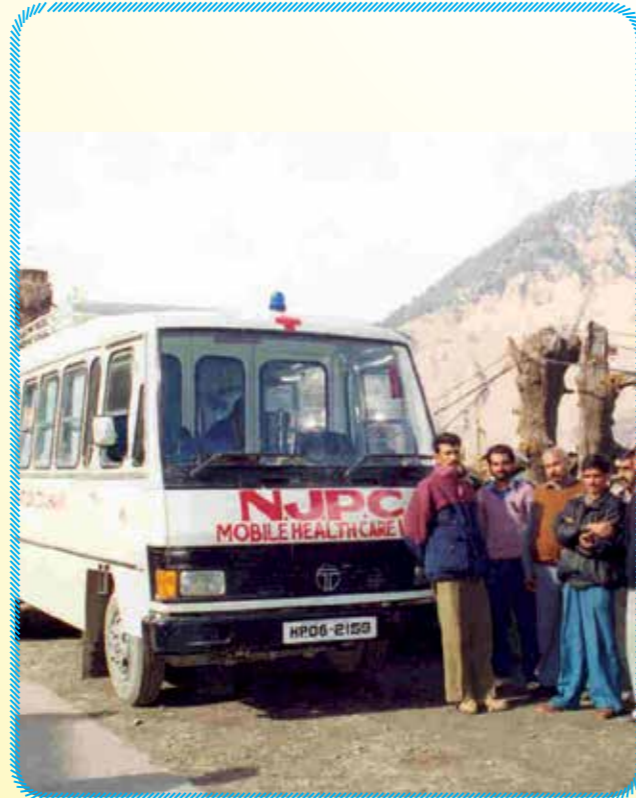
GLIMPSES FROM THE PAST



Soil Stabilisation Near Surge Shaft

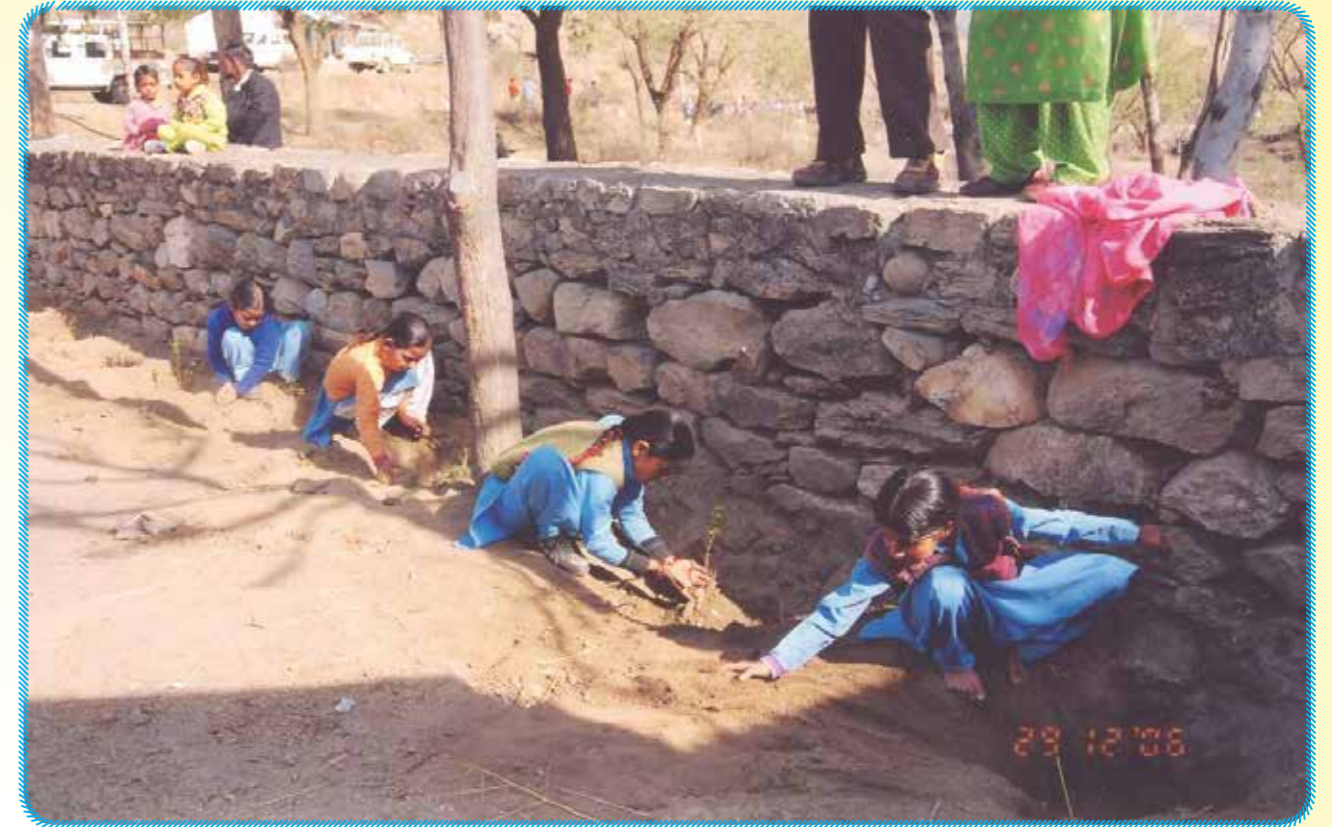


Environment Awareness Van



Mobile Healthcare Van

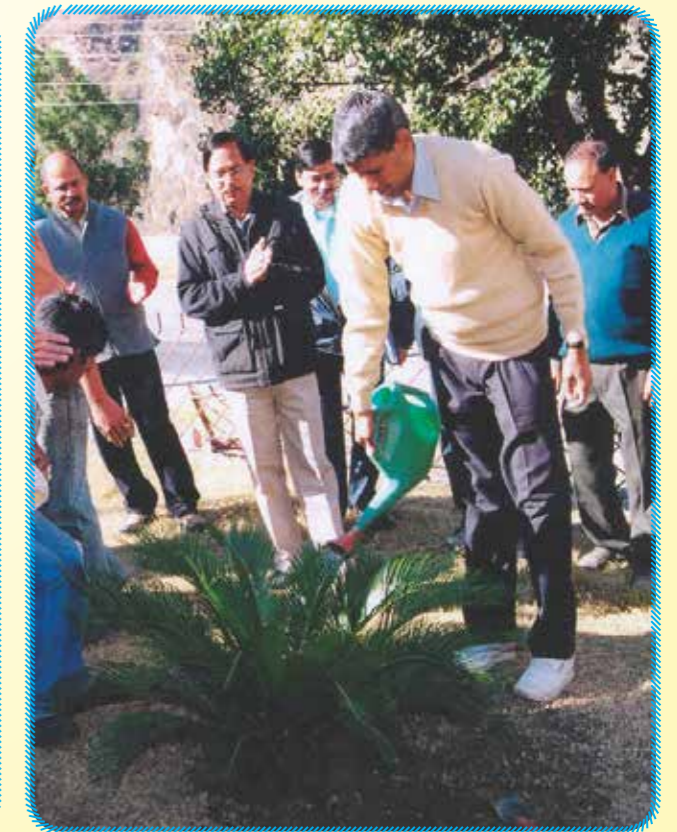
GLIMPSES FROM THE PAST



Plantation By School Children In Schools



Plantation by SJVN Employees



Plantation by Dignitaries at Project Site

**GLIMPSES FROM THE PAST**



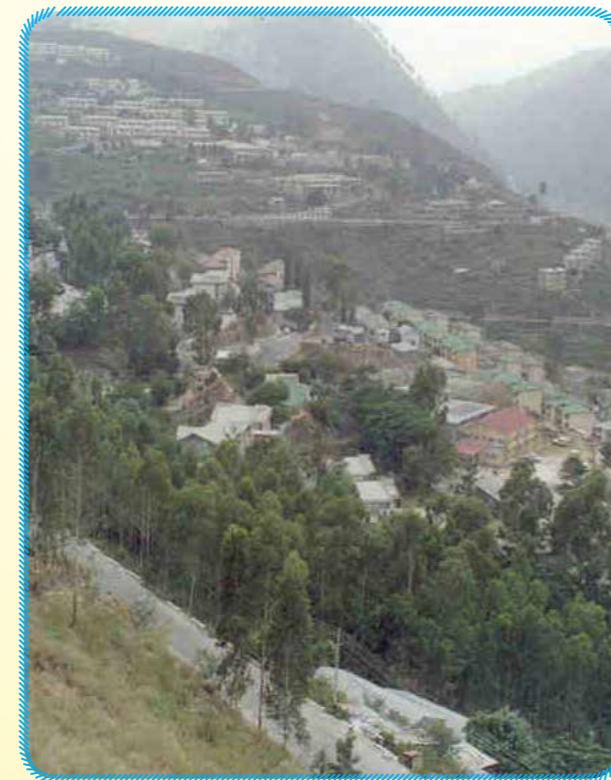
*Training Camp on Sustainable Agricultural Practices*



*Environment Awareness Camp*

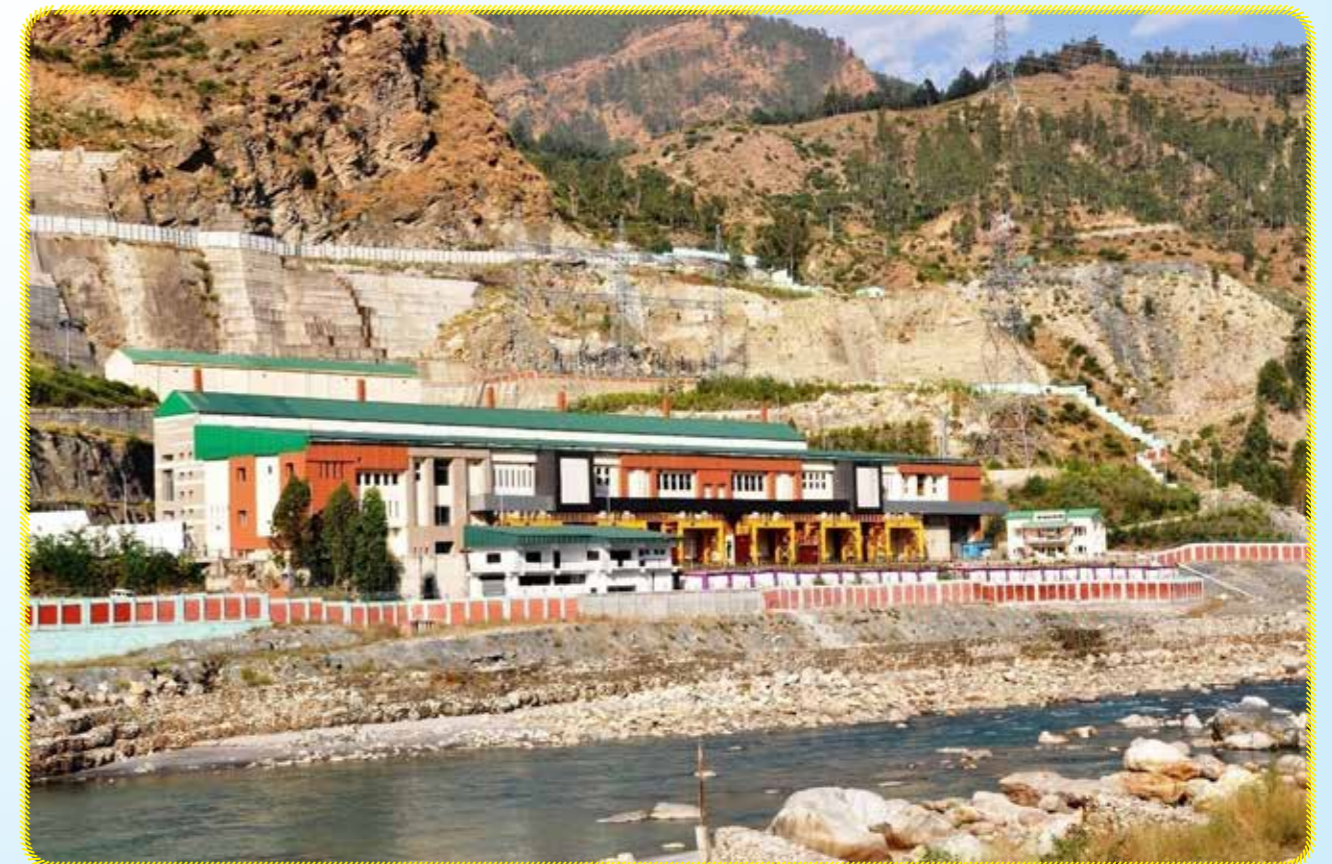


*Avenue Plantation Near Office Complex, Jhakri*



*Avenue Plantation in SJVN Township, Jhakri*

**412 MW RAMPUR HYDRO POWER STATION (RHPS)**





## MESSAGE

It is a matter of great pleasure to know that SJVN is conceptualizing souvenir on Environment. SJVN is known for environment friendly Organisation and its strategy invariably have high priority towards Environment and sustainability. While executing Rampur Hydro Power Station, SJVN has taken all measures to mitigate or minimize the impact on Environment during the construction and locals were adequately compensated for damage to crops, property etc.

RHPS has its well defined Catchment Area Treatment Plan (CAT Plan) outlaying of Rs. 23.38 crores for Forest Conservation, Pasture development, Rain Water Harvesting, Wild life improvement, Agriculture, Horticulture, Husbandry etc. RHPS has also developed Environment Monitoring Plan for 40 years from date of its commissioning. Noise, Air, Water and Waste water quality will be measured and in case of deterioration corrective measures will be taken. On the aforesaid Rs. 8.36 crores will be spent.

United Nation Kyoto Protocol has mandated to reduce emission of green house gas. To achieve this target, the protocol introduced Clean Development Mechanism (CDM). RHPS was registered as a CDM Project on September 29, 2011. RHPS has reduced 1,407,658 metric tonnes CO<sub>2</sub> equivalent per year and realize the revenue of Rs. 64.5 crores.

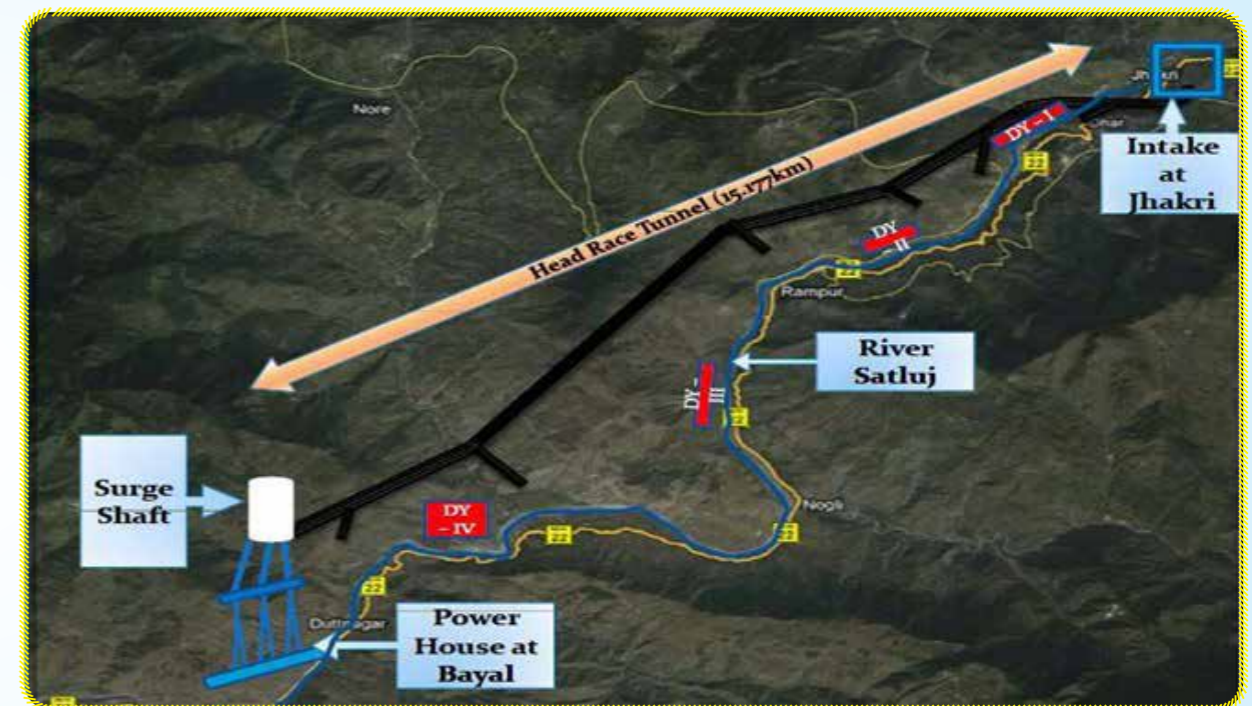
RHPS has also developed 60 kW Solar Power for auxiliary power consumption and more Solar Power will be added in future. Mass plantation, awareness through painting competition, wild life photography etc being organized periodically.

4-11

(Manoj Kumar)  
Head of Project (RHPS)

## INTRODUCTION

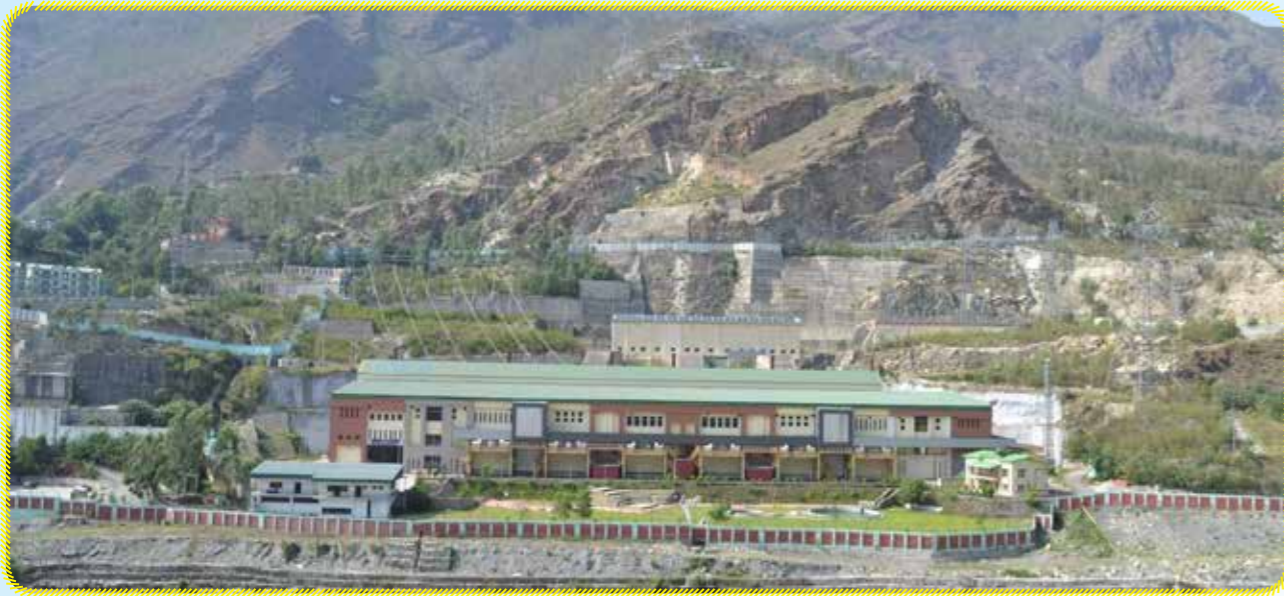
Rampur Hydro Power Station (RHPS) of 412 MW installed capacity is located on River Satluj in Shimla and Kullu districts of Himachal Pradesh and is a tandem development to Nathpa Jhakri Hydro Power Station. The project utilises the desilted water of NJHPS, which is again diverted into the intake structure of RHPS at Jhakri. A 15.77 km long concrete-lined, underground headrace tunnel, located at the right bank of River Satluj in Jhakri (Dist. Shimla), carries the water downstream to the six turbines installed in the surface powerhouse, located near village Bayal, in district Kullu, opposite Duttanagar near Rampur. As the project uses desilted water from NJHPS, it did not involve the construction of a dam or desiltation chamber. Also, there is no inundation due to formation of reservoir in the project. RHPS is thus designed to work as a cascading project to work in tandem with upstream NJHPS.



Project Layout map of RHPS



Intake Structure on Left Bank



Power House

A Memorandum of Understanding for the execution of Rampur Project was signed between Government of India and Government of Himachal Pradesh in October, 2004. Major works project began in February 2007, and after completion of HRT, Surge Shaft, Valve House, Power House, TRT and other associated works, water filling of Water Conductor System was completed in March, 2014 successfully without any leakage. The project was commissioned progressively from March, 2014 to December, 2014. Important salient features of the project include:

- Concrete-lined Head Race Tunnel of 15.177 km. length with 10.50-meter diameter.
- Open to the sky Surge Shaft of 165-meter height and 38-meter diameter.
- Surface type Valve House.
- Surface Power House having 6 vertical axis Francis Turbines of 68.67 MW each to utilize a design head of 119.10 meters.
- Concrete-lined horse-shoe type Tail Race Tunnel of 67.15-meter length and 10.50-meter diameter opening to an open channel that ends in the river.

RHPS is designed to generate 1878 million units of electricity each year. Power generated from Rampur HPS is distributed to Northern Regional states i.e. Himachal Pradesh, Haryana, J&K, Punjab, Rajasthan, Uttar Pradesh and Uttarakhand as per their percentage allocation by the Ministry of Power.

## ENVIRONMENTAL CONTEXT AND PROJECT LOCATION

The project area and the project's influence area are located in the lower Himalayas and are characterized by rugged topography with steep hills (altitude varying from 850m to 2000m). The area experiences subtropical to sub-Himalayan climate and is sparsely vegetated. The immediate vicinity of the project supports patches of dense forests, but has a long history of deforestation. The hill slopes are steep and are generally covered with sparse vegetation, overburden and outwash material. Most of the human population in the project's influence area is concentrated in the villages along the highway and the connecting district roads.

The location and design of the project were finalized with an aim to minimize adverse impacts on people and environment due to land acquisition. The project required about 99.51 ha. of land, out of which 29.21 ha. was private land and the rest 70.30 ha. was forest land (of which 20.41 ha. area was notional forest land for underground structures).

## STATUTORY CLEARANCES

The project was subjected to detailed scrutiny by the various statutory bodies at the State and the Centre. The prominent environmental regulations/guidelines attracted by project were Forest (Conservation) Act 1980, Environment (Protection) Act 1986, Environmental Impact Assessment Notification, 1994 (superseded in 2006), and SJVN Environment Policy, approved by the Board of Directors during its 156th meeting held on November 17, 2006.

Environment Clearance for the project was granted on March 31, 2006 and Forest Clearance on April 7, 2006 for diversion of 69.3762 ha, which was further revised to 70.3036 ha vide MoEF&CC's letter dated May 28, 2009.

The project was evaluated for all the anticipated environmental impacts during its construction and operation phases and suitable mitigation measures were prepared as a part of the Environment Impact Assessment Study (EIA) report prepared by M/s WAPCOS Ltd.

Since the project was funded by the World Bank, it also attracted the Bank's own Screening procedure for environmental impacts. As per World Bank process, the project was classified as Category A and it triggered 6 of the 10 World Bank Safeguard Policies for a comprehensive environmental assessment study:

- Environmental Assessment
- Forests
- Cultural Property
- Involuntary Resettlement
- Safety of Dams
- Projects on International Waterways

Subsequently, the following studies were carried out through independent consultants to meet the World Bank's due diligence for funding of the project:

- Study of the Managed River Flow in the project stretch of the river Satluj prepared by DHI India Water & Environment Pvt. Ltd
- Assessment of the Terrestrial Biodiversity Impacts from the project prepared by Consulting Engineering Services India Ltd.
- Analyses of Induced Impacts of the RHPS & Cumulative Impacts of Hydro Power Development in the Satluj Basin in India prepared by DHI-India Pvt. Ltd.
- Safety Assurance Plan for the project prepared by National Safety Council of India
- Archaeological Study Report prepared by Archaeological Survey of India, Shimla Office
- Catchment Area Treatment Plan for the project prepared by the Himachal State Forest Department.

The project had also prepared an Emergency Preparedness Plan (EPP) in-house, summary recommendations from which were incorporated in the Environment Management Plan (EMP).

A consolidated Environmental Assessment and Environment Management Plan report incorporating all the findings of the above said reports/study was prepared by M/s DHI India Water & Environment Pvt. Ltd.

Based on project parameters and the baseline environmental condition, potential impacts, as a result of construction and operation of the project were identified. These included impacts on various environmental parameters caused by different activities during construction as well as operation phases of the project. A multi-pronged approach was adopted to mitigate the anticipated environmental impacts that occur due to construction of the hydro project.

The major sources of construction-related impacts on water quality were identified from erosion of disturbed areas required for the construction activities (such as construction sites, concrete batch plants, material storage areas, vehicle maintenance areas, disposal areas, etc.), wastewater discharge from labour camps, contamination of surface water (with oil grease, petrochemicals, cement, chemicals, etc. resulting from various construction activities), sewage from project colony during operation stage and other effluents. Impacts of the project were also identified on aquatic habitats and fishes downstream of construction areas (due to sediment and muck). The identified impacts on air quality were mainly from vehicular emissions, stationary equipment at the construction site, quarry site activities (including operation of crushers), concrete batching plants, construction work, fugitive emissions due to movement of vehicles along unpaved roads. Various sources of noise that could have potentially affected the labour, residents as well as wildlife in the nearby areas were identified. These included vehicles and equipment for excavation, stationary equipment including batching plant, blasting operations, drilling machines, quarrying and crushing activities. Due to the influx of labour force, expected setting up of small businesses and ancillary developments and associated immigration of people in the area, additional pressure on land and natural resources, and generation of solid and liquid wastes were also anticipated.

A reduction in flow for a stretch between the tailrace outfall of existing NJHPS and the tailrace outfall of RHPS was also anticipated on water quality, aquatic and terrestrial ecology as a result of the diversion of water for the project.

However, SJVN, in lieu of its Environment Policy and experiences gained from NJHPS, was able to effectively mitigate the identified impacts, and even managed to improve the environment in the project vicinity.

## ENVIRONMENTAL MITIGATION MEASURES

In order to mitigate the above impacts, various mitigation measures were suggested in the Environment Management Plan report. RHPS went beyond with what was required as per MoEF&CC's conditions laid out for Environment Clearance and Forest Clearance in efforts to best conserve the environment. These environment mitigatory measures include:

- Compensatory Afforestation (CA)
- Catchment Area Treatment (CAT) Plan

- Fisheries Management/Enhancement Plan
- Muck Management Plan
- Restoration and Landscaping of project sites
- Control of pollution from labour camps/construction areas
- Environment Management in road construction
- Wildlife Conservation
- Public Health Delivery System
- Control of air pollution
- Noise control measures
- Disaster Management Plan
- Setting up of Environmental Laboratory

## COMPENSATORY AFFORESTATION

In order to compensate for the diversion of 70.30 ha. of forest land, a compensatory afforestation plan was prepared as per provisions under Forest (Conservation) Act, 1980. This involved plantation works over 141 ha. of degraded forest which were implemented by State Forest Deptt. of Himachal Pradesh with an expenditure of Rs. 88.29 lakhs.

## CATCHMENT AREA TREATMENT (CAT) PLAN

CAT Plans are developed for bio-engineering interventions for conserving the water-sheds. Compensatory afforestation and green-belt development programmes are implemented in the periphery of the project to improve the forest cover and land use of the project area. Protecting the health and safety of the local populace from the impact of the influx of skilled and unskilled manpower is undertaken by creating awareness and extending medical facilities to the local population. For the protection of fauna, wildlife conservation plans are undertaken in the catchment area of the project to safeguard their ecological corridors.

The CAT Plan for RHPS was prepared in July 2005 and amended in November 2005 by the Divisional Forest Officer (DFO) and his team from the CAT Plan Division, Nichar, Forest Department, Govt. of Himachal Pradesh and was finally approved during April 2007.

It was formulated for a period of 10 years starting from 2006-07 to 2015 -16 by taking into consideration various impacts of project activities and approaches to be adopted for its mitigation. Total outlay for the CAT Plan envisaged was Rs 23.37 crores wherein Rs. 10 crores was earmarked for Rampur Forest Division and Rs. 13.37 crores for Ani Forest Division.

Due to altered ground realities and new advancement in soil and water conservation techniques, the said CAT plan was recasted by the Forest Department, Govt. of Himachal Pradesh. The main objective was to prioritize the most cost-effective vegetative measures and bio-engineering methodology rather than the conventional approach of using civil structures. In addition, target-oriented plantation to encourage moisture retention, reduced soil erosion and improved soil and water conservation measures were also addressed.

The whole work was spread over ten years from 2012 onwards with a detailed Annual Plan of Operations (APOs).

From the year 2012 onwards, HP Forest Department has been implementing the CAT Plan based on the recasted Plan involving afforestation measures, development of pastures, nurseries, payments for environmental services including study and its implementation, soil and water conservation measures, research, capacity build-up, publicity, funds for monitoring and evaluation, wildlife-related interventions, infrastructure build-up, etc., and every year the utilization certificates for funds released were given based on this revised plan.



Forest Nursery in Anni Division



Infrastructure in Forest



Check Dams



An integrated approach has been adopted under CAT Plan involving various biological, engineering, and bio-engineering measures:

- Biological measures: Plantation, Turfing, Pasture development etc.
- Engineering measures: Check Dams, Contour bunding, Catchwater drain, Retaining walls/dry masonry wall, etc.
- Bio-engineering measures: Check Dams, Bally benching, Jute matting etc.

Various nurseries have been established at both the forest divisions. Saplings of Reetha, Dodonea, Robinia, Agave, Daru, Kainth, etc. have been raised. Vermicompost pits have been made. Further, under the recasted CAT Plan, measures for afforestation and soil and water conservation were given more importance and have been taken up by the State Forest Department.

## FISHERIES MANAGEMENT

Under Fisheries Management of the project, SJVN has funded Rs. one crore to the State Fisheries Department for development of a fish hatchery at Macchial, near Jogindernagar in Mandi District. The construction of the hatchery has been completed. Initially, there was no proven technology for breeding Golden Mahseer (*Tor putitora*) in captivity. The Mahseer is a migratory fish and it migrates several miles against the water current in search of food and breeding grounds. In absence of suitable breeding grounds, it doesn't lay its eggs. However, this work has been accomplished by the Directorate of Fisheries, Himachal Pradesh, for the first time. More than 20000 hatchlings have been recovered from the eggs at this hatchery. The mahseer fish breeding programme has given a new push to over 6,000 river fish farmers and anglers who hunt for the golden mahseer in the region.

We are facing limitations in the breeding of snow trout (*Schizothorax richardsonii*) species in captivity. Since this species is also an important fish for livelihood and angling, therefore efforts are being made to try to build a broodstock of snow trout in captivity and breeding the same in the fish hatchery at Macchial.

Further, 20 affected fishermen were provided carts to facilitate them in setting up their roadside ready to eat fish stalls. Financial support was given to 5 fishermen to develop their fish pond. Fishing nets were provided among 20 fishermen who were actively involved in fishing.

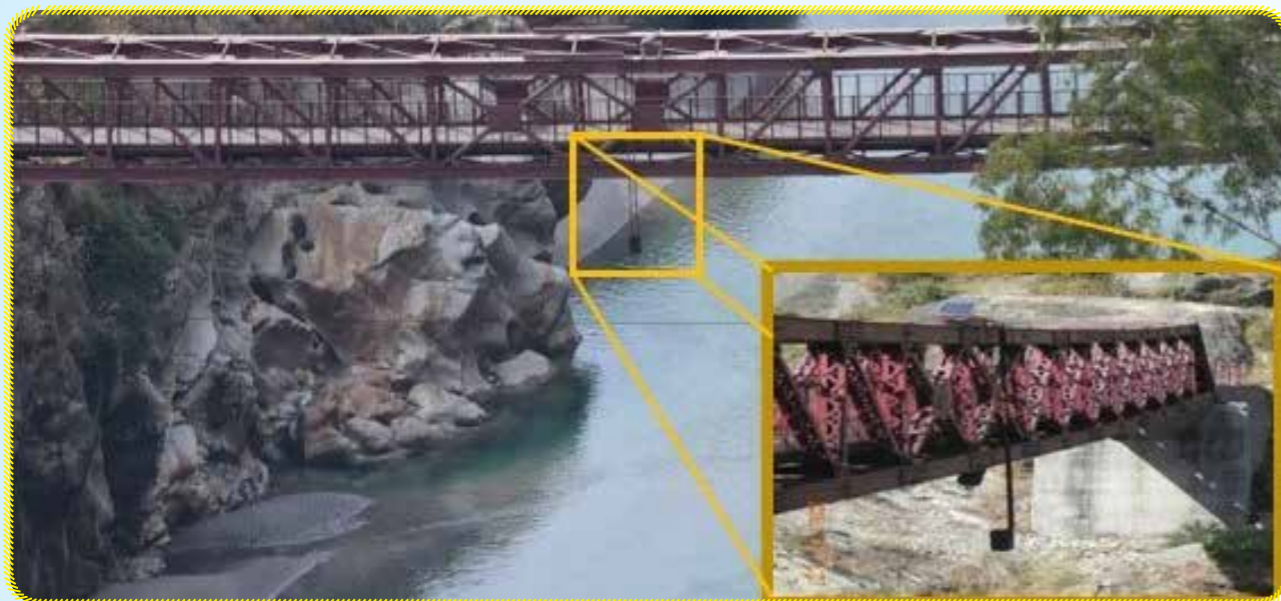


Fish Farm at Macchial Near Joginder Nagar (Mandi, HP)

## MINIMUM DOWNSTREAM RELEASE

RHPS does not have any dam and is designed to operate in tandem with Nathpa Jhakri Hydro Power Station (NJHPS). The desilted waters of NJHPS are directly taken to the surface powerhouse of the project through an HRT without any interference with Satluj River at any point. Thus Rampur HPS does not have its own Dam and is fed by the dam of NJHPS located at Nathpa after power generation there.

Accordingly, there are no specific recommendations for the release of environmental flows from RHPS. Thus, MoEF&CC has stipulated that “PP shall install an online monitoring facility to record the discharge of Satluj river at the downstream of Jhakri on a regular basis to generate a time-series data round the year.” This is being complied through the installation of an online continuous flow measurement device at the downstream of Rampur HPS intake/NJHPS outfall.



*Real Time Online Continuous Flow Measurement and Data Logging Device Installed at Foot Bridge Near RHPS Intake Structure*

## MUCK MANAGEMENT PLAN

Excavated material that is generated while digging up HRT, diversion tunnels, desilting chambers, excavations for surface/underground power houses, and other cavity structures, etc. is termed as muck. This material, if disposed off into nearby rivers or nallahs will increase their silt load thereby causing adverse effect on the aquatic flora & fauna as well as causing hindrance in operation of downstream hydropower projects. Moreover, if left at the site of excavation, the material will cause hindrance to work, environment, aesthetic degradation and air pollution while also running the risk of adding silt into the river during rains.

Thus it becomes imperative that the material is disposed off at properly marked pre-identified sites after their proper protection & treatment and later on after the closure of works these dumping sites are restored back to their original state while also enhancing their aesthetic beauty and merging them into the surroundings by applying various bio-engineering protection works for their retention and subsequent maintenance.

A part of this muck was proposed to be reused and remaining to be dumped at pre-identified muck dumping sites. These dumping sites were identified close to the four adits, so as to minimize the risk involved in terms of affecting human settlements.

The selection criteria used for identifying these dumping sites at the project was meticulously based on the following environmental as well as economic point of view:

- The dumping sites were located nearest possible to the component likely to generate huge quantity of muck so as to avoid long-distance transportation.
- Sites with active landslides and the possibility of toe erosion related slope failure were avoided.
- Dumping sites away from any water bodies like nallahs, streams, etc. were preferred with base levels adequately higher than the Maximum Flood Level (MFL).
- To avoid any accidental spillage of materials during heavy rains and floods, proper protection structures were built along the edges of dumping sites wherever necessary.
- The natural slopes of the identified dumping sites were such that it accommodates maximum material on minimum land.
- Site located on the concave side of meander belts were preferred.
- All the identified sites were selected keeping in mind the conservation of Terrestrial and Aquatic Ecosystem.
- The sites were selected so as to avoid areas of archaeological, historical, spiritual or cultural importance.
- Landuse classification of the project area was also helpful in deciding the location of dumping sites and preference was given to open/barren lands causing minimum environmental hindrance.

Initially, it was estimated in the EMP that about 3.06 million m<sup>3</sup> of muck would be generated from tunnelling and excavation activities, out of which 0.3 million m<sup>3</sup> of muck was to be reused in various construction works and the remaining quantum of 2.7 million m<sup>3</sup> of muck to be disposed at four designated dumping sites, with the total capacity of 2.81 million m<sup>3</sup>, as described, which would be restored through appropriate biological and engineering measures.

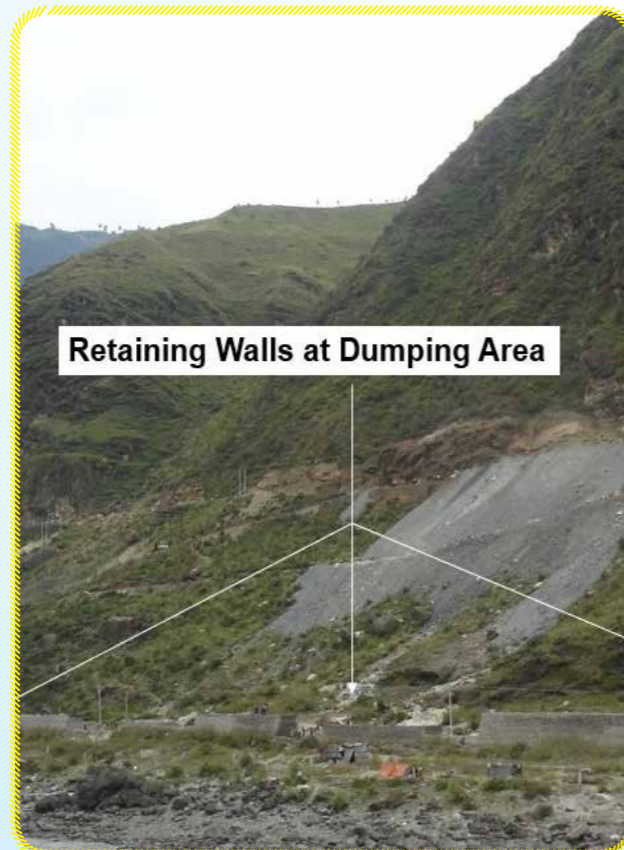
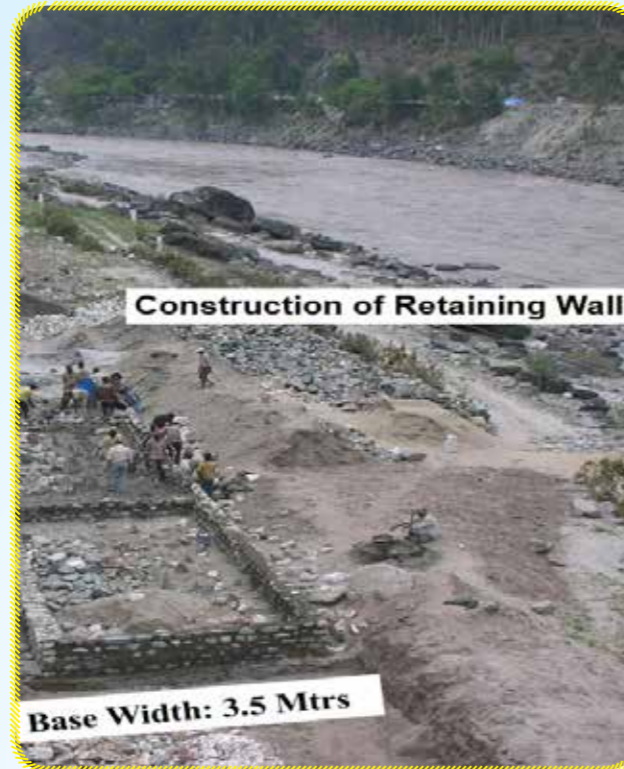
However, during the execution of the project, additional muck was generated due to in-depth excavations at powerhouse area, execution of additional adit (Kasholi), and encountering of geological surprises.

In the end, the total quantity of muck generated was 4.3 million m<sup>3</sup>, which was more than the estimated quantity. Hence meticulous planning had to be done to accommodate the additional muck within the project area without compromising on the environmental parameters.

Maximum muck was reutilised as an aggregate material in various infrastructure works and at various locations (such as at the Army area, SJVN's residential colony area and land belonging to private landowners on their request) for landscaping purposes. This way about 42% of total generated muck i.e. 1.7 million m<sup>3</sup> muck was successfully re-utilized without the acquisition of any further forest or private land of prime importance.

The remaining 2.5 million m<sup>3</sup> of muck was dumped scientifically at pre-designated dumping sites according to due procedures and following all MoEF&CC rules and guidelines prevalent at the time. The protection structures at these dumping areas were provided in stone masonry with plum concrete having appropriate base width and height.

## CONSTRUCTION OF RETAINING WALLS



The details of the muck dumping sites are as follows:

S.No.	Name of the Dumping Site	Capacity (m <sup>3</sup> )
1	Dumping Site I (Opposite Khaneri Hospital)	1052780
2	Dumping Site II (HRTC Workshop, Rampur Bushahr)	65841
3	Dumping Site III (D/s Nirmand Bridge)	381958
4	Dumping Site IV (Averi)	1318192
	Total	2818771

## PHOTOGRAPHS OF RESTORED MUCK DUMPING SITES

### DUMPING SITE I (Opposite Khaneri Hospital)



Plantation Atop DS-I

## DUMPING SITE II (OPPOSITE RAMPUR BUS STAND)



Dumping Site II with Restoration Works

## DUMPING SITE III (NEAR NIRMAND BRIDGE)



Dumping Site -III on the Right Bank with Restoration Works

## DUMPING SITE IV (AVERI)



Dumping Site IV on the Right Bank with Restoration Works

## THE GEO-GREEN SOLUTION

In SJVN, it is always our endeavour to find better and more efficient solutions, while learning from our past experiences. Restoration of dumping sites using conventional methods were not found very effective. These dumping sites gave a very shabby look to the area due to presence of rocky boulders which are generally dry and unfertile. This aspect therefore required attention as it had an impact on the aesthetics of the area as well as public perception about the project. Due to the sterile nature of the earth excavated from underground works, the survival rate of plant species was also observed to be very poor until weathering occurred over a long period of time.

SJVN, out of its concern for the environment, undertook three pilot projects as innovative measures for assessing the effectiveness of using environmentally degradable material for reinstatement of muck dumping areas.

Details of Pilot Projects are as given below:

Pilot Project-01	Restoration of Muck Dumping Yard-02, for an area of 2225 m <sup>2</sup> has been completed at the cost of INR8,80,278/- by Coir-Geo Textile application. Completed on November 19, 2009.
Pilot Project-02	Restoration of Muck Dumping Yard-01, for an area of 1416.50 m <sup>2</sup> has been completed at the cost of INR7,63,895/- by Coir-Geo Textile application. Completed on September 15, 2011.
Pilot Project-03	Restoration of Muck Dumping Yard-01, for an area of 1567.5 m <sup>2</sup> has been completed at the cost of INR4,14,923/- by Jute-Geo Textile application. Completed on March 15, 2012.

## What is the Geo-Green System?

Geo-textiles are permeable fabrics which, when used in association with soil, have the ability to separate, filter, reinforce, protect & drain. Fibres, such as coir/jute, have found a new usage highly effective in addressing a number of soil-related problems in civil engineering like soil erosion control, stabilization of steepened slopes, stabilization of exposed highly erodible sub-soil, and disturbed or badly compacted ground as is the case with dumping sites.

There are generally three types of geo-textiles used: open mesh, woven and non-woven. Open mesh types have found applicability in the protection of slopes along roads and railway embankments, bridge approaches, terraces in hilly terrains, stabilization of sand dunes, mine spoils, PFA dumps in thermal power plants, etc. Woven and non-woven types are more effective in protection of river bank, strengthening of the road when used as an intervening layer between sub-grade and sub-base, filtration by retaining soil particles on the one hand and ensuring permeability of water through and along it. Open mesh types generally do not last for more than two seasons, whereas woven & non woven types can last up to 4 years, however, they are of lesser strength and have poor water holding capacity as compared to open mesh types.

Geo-textiles can be used concurrently with bio-engineering structures for slope stabilization of dumping sites for which two components should be calculated:

- Required stresses for equilibrium, and
- Suitable geo-textile reinforcement layout

Geo-textiles made of coconut or jute are biodegradable, and hence they promote fast growth of vegetation by providing nutrients and creating a micro-climate and by preventing loss of soil in shallow and steep slopes. They can absorb five times their own weight of water by firstly attenuating the run-off into the drainage system and then releasing it gradually to soak into the adjacent soil for the nourishment of plants.

Geo-green erosion control system involves laying of a blanket made out of geo-textiles, such as 100% coir fibre and High Density Poly Ethylene Monofilament (Brown) UV stabilized stitching thread, with functional longevity of 36 months. The blankets augment the moisture retention capacity of the surface thereby contributing to the longevity of survival of the plant species. The slopes of the dumping areas are first levelled before a layer of fertile top soil is laid over it.

### How was the Geo-Green System laid?

Thus the system of Geo-green Erosion Control Blanket was introduced in RHPS. This Geo-green Erosion Control Blanket product is made from biodegradable coconut fibres, reinforced with high-density poly-ethylene for enhancing strength to withstand steep slope and changing climate conditions. These blankets not only retain water



for longer periods but over a time period gradually biodegrades naturally to fully blend with the soil conditions. It, therefore, enables vegetation to take early hold in gripping the deep excavated soil together, thereby aiding in restoration of muck dumping sites. This technique was further extended to areas where the muck was utilized for job facilities and levelling of undulations. It also provided protection to all the edges of dumping sites to prevent the muck from entering into river.

The dumped muck was excavated up to a depth of 30 cm. and all undulations of the dump yard slopes were levelled before a layer of fertile topsoil was laid over it. To prepare a rich top soil, good earth was transported and mixed with existing earth up to a depth of 20 cm. in a 60:40 ratio. Manure and soil conditioner were mixed with the good earth up to a depth of 10 cm. above the previous layer of existing earth and good earth (30% manure, 70% good earth and 1 kg per sq.m soil conditioner) to obtain a healthy and plant nutritious soil layer. Seeds of locally prevalent plants were mixed into the top layer before a Geo-green Erosion Control Blanket was laid out on the slope. The erosion control blanket was laid above the top layer and anchored suitably at the top.

Besides the seeds planted, cuttings and plant samplings of species such as Hopseed (Mehndi) - *Dodonaea viscosa*, Silver Oak- *Grevillea robusta*, Bougainvillea and Subabul- *Leucaena leucocephala* were planted onto the treated slopes. After regular watering for six months, traces of the existing muck dump yard faded away as the slope turns green and blends into the landscape.

### GEO-GREEN EROSION CONTROL BLANKET TECHNIQUE



**Laying of Geotextile Blanket above Top Layer and Anchoring with U- Hook**



Watering of Plants up to Six Months after Completion of Job



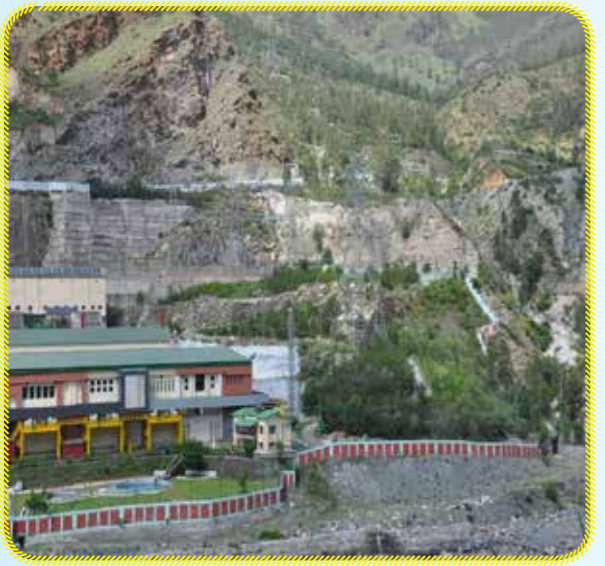
Restored Area After Geo-Green Erosion Control Blanket Technique



The details of muck utilization sites treated with geo-green erosion control blankets and landscaping works are as under:

Type-D, Jhakri	Restoration of muck utilization area near Type D quarters at Jhakri was carried out on an area of 5798 m <sup>2</sup> . The work was completed on 6th March 2013 at the cost of Rs. 26.19 lacs (per m <sup>2</sup> @ Rs. 452/-).
Duttnagar Area	About 4970 m <sup>2</sup> area in the project colony of RHPS at Duttnagar and the area near left abutment of steel bridge was developed and restored through coir geo-green erosion control blanket. The work was completed on 31st March 2013 at the cost of Rs. 22.78 lacs (per m <sup>2</sup> @ Rs. 458/-).
Bayal Area	In the Bayal area, the power house slope, located opposite to Duttnagar, on the right bank of River Satluj, was restored through coir geo green blanket on 3637 m <sup>2</sup> area at the cost of Rs. 16.67 lacs (per m <sup>2</sup> @ Rs. 458/-).
Auditorium, Jhakri	Restoration of muck disposal area near the Auditorium area at Jhakri was done on an area 2868.08 m <sup>2</sup> at an estimated cost of Rs. 22.28 lacs (per m <sup>2</sup> @ Rs. 777/-).
Left Bank Work	About 1992,92 m <sup>2</sup> area, near the left bank diversion works, was restored through coir geo-green blanket at the cost of Rs. 9.13 lacs (per m <sup>2</sup> @ Rs. 458/-).
Surge Shaft	About 2427.30 m <sup>2</sup> area near the surge shaft was restored through coir geo green blanket at the cost of Rs. 9.9 lacs (per m <sup>2</sup> @ Rs. 407.86/-).
Power House	Restoration of power house slope was done on an area of 14525 m <sup>2</sup> . The work was completed on 10th September 2014 at the cost of Rs. 67 lacs (per m <sup>2</sup> @ Rs. 460/-).

**MUCK UTILIZATION SITES**

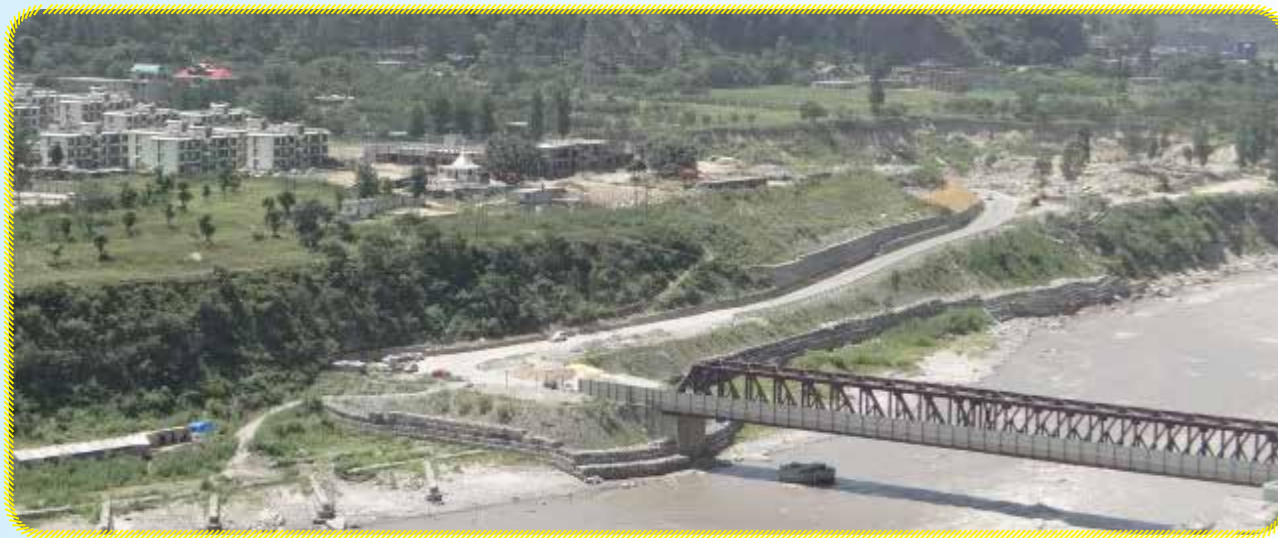


**MUCK UTILIZATION SITES**





**SOIL STABILISATION MEASURES**



*Slope Statbilization Near Spill Tunnel – Jhakri*

**SOIL STABILISATION MEASURES**



**OTHER MITIGATORY MEASURES**

Several Environmental Management measures were taken to ensure that the environment was not damaged. Sanitation facilities and settling tanks were constructed and solid waste management measures were implemented through the contractors for control of pollution from labour camps. Portable toilets were installed in the Power House site. In order to reduce the potential impacts to surface water within the vicinity of the construction areas, all construction camps and project colonies were equipped with wastewater treatment facilities such as community latrines and sewerage system



*STP of 400 KLD at RHPS*

from labour camps to treatment site and disposal sites. All project colonies have been connected to a sewerage treatment plant for managing wastewater. Additionally, sedimentation pits were also provided at all locations where construction water was generated such as at batching plants, adit portals, etc.

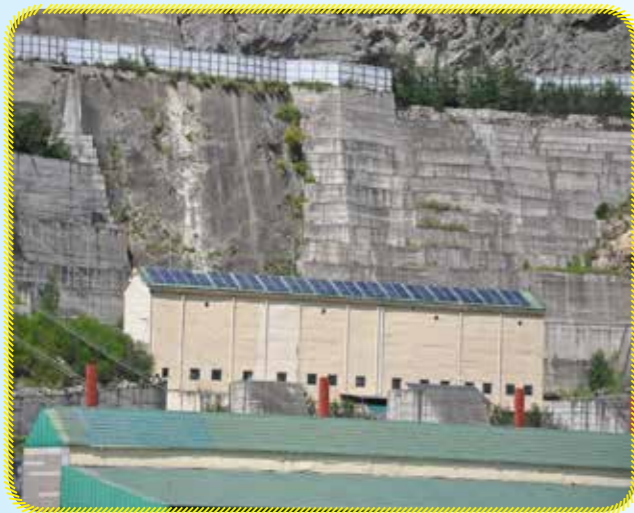
As far as Public Health Delivery is concerned, adequate medical facilities are being provided to personnel working at the project. First Aid facility was available at the site and a medical health facility has been created at Bayal. An ambulance service facility was available round the clock. Moreover, during construction, it was ensured that all labourers engaged for construction works were thoroughly examined by health personnel and adequately treated before issuing them work permits. The labourers engaged were medically examined to prevent spreading of any communicable diseases in the area.

Adequate free fuel arrangement for heating purposes was made during the construction phase of RHPS for the labour force to avoid indiscriminate felling of trees. Moreover, the concept of community kitchen was also encouraged and LPG connections were provided by the contractor.

There was a likelihood of generation of fugitive emissions from project access roads and construction sites. In order to keep air quality within the permissible limits, sprinkling of water on these areas was made mandatory by SJVN. However, keeping in view the importance of creating public goodwill, the respective Panchayats had been given the job of sprinkling water on unpaved roads within their jurisdiction. This served as an excellent example of environmental benefit through participatory management.

The project has also installed a 60 kW (AC) solar PV Power plant on the inclined RCC rooftop of the Butterfly valve house. The working of solar

60 kW PV Power Plant is to control 220-volt DC supply & 220-volt UPS AC supply to cater to the load requirement for operation, control and illumination at Butterfly valve house.



## ENVIRONMENT LABORATORY

An Environment Laboratory was established by Rampur HPS at Jhakri for regular monitoring of various environmental parameters. The laboratory is the cornerstone of SJVN pollution abatement and control efforts as it provides qualitative and quantitative data for decision making and monitoring permissible limits of various parameters. This laboratory is following the testing standards/protocols of the State Pollution Control Board, Central Pollution Control Board and the MoEF&CC for air, water and noise monitoring. It is the first laboratory in the region and has been equipped for performing various chemical and bacteriological analysis of environmental samples of drinking water, surface water, wastewater, air quality, noise sampling, etc. This laboratory is being used to carry out sampling and testing for all SJVN projects in the region.





GAS ANALYZER



AIR MONITORING AT CRUSHER SITE



AIR MONITORING IN PROJECT AFFECTED AREAS



NOISE SAMPLER

SJVN also undertook internal monitoring of various EMP activities implemented by the contractors through a project monitoring committee. Any shortcomings were brought to the notice of the concerned EIC for rectification. For other EMP activities such as Fisheries Management Plan and Catchment Area Treatment Plan being implemented by the State Government, funds were released by SJVN after utilization certificates were received. Wherever required, monitoring of works was done jointly with the State Government.

Also, in compliance to the stipulatory conditions laid down by MoEF&CC, a Multi-Disciplinary Committee was constituted to oversee the implementation of suggested safeguard measures. The Committee visited the project on numerous occasions for monitoring, review and inspection.

Regulatory monitoring was also being carried out by the State Pollution Control Board who undertakes Air and Noise quality monitoring for the project. Towards this end, SJVN has provided all the necessary monitoring equipment to SPCB.



Works of water sprinkling to control dust pollution awarded by Project to the Panchayats

## DISASTER MANAGEMENT PLAN

Disaster Management Plan was formulated in the EMP for various kinds of anticipated disasters like floods, earthquakes, breaching of headrace tunnel, sabotage, etc. Various measures such as the installation of communication systems, warning signs, V-Sat, Disaster Management Committee, etc. were proposed in the Disaster Management Plan. Accordingly, V-Sat system has been installed at Bayal. Warning boards have been provided from Jhakri to Luhri as a cautionary measure.

RHPS has also installed an advanced warning-cum-alert system. Before releasing water from the outfall, it is mandatory to inform the local authorities and surrounding people. Earlier, when water was released from the outfall of the project, the hooters were operated to alert and safeguard the local population. This hooter system was of mechanical type. Now, the project has installed control electronic siren/hooter system, i.e. Advance Warning cum alert System.



Flood Warning System Stations

Each Station covers up to 2 km. aerial distance with programmable Audio-Visual Alarms.  
Salient Features of the stations includes:

1. Solar Power System for continuous 7 sunless days.
2. 15 km. River stretch covered along the road, down-stream of RHPS.
3. 5 Remote Terminal Units (Stations) with dual Sirens equipped with Self Diagnostic features.
4. 2 Nos. Radar Sensors for automatic initiation of High River water level Alarm.

RHPS also holds the distinction of being one of the few projects in the country, which had been certified as IS/ISO 14001:2004 compliant during the construction stage of the project. The project has been further certified for integrated management system ISO 18001:2007, IS/ISO 9001:2008 and IS/ISO 14001:2004 compliant. Surveillance audits are regularly carried out every 9 months and renewal of license is done after a period of three years.



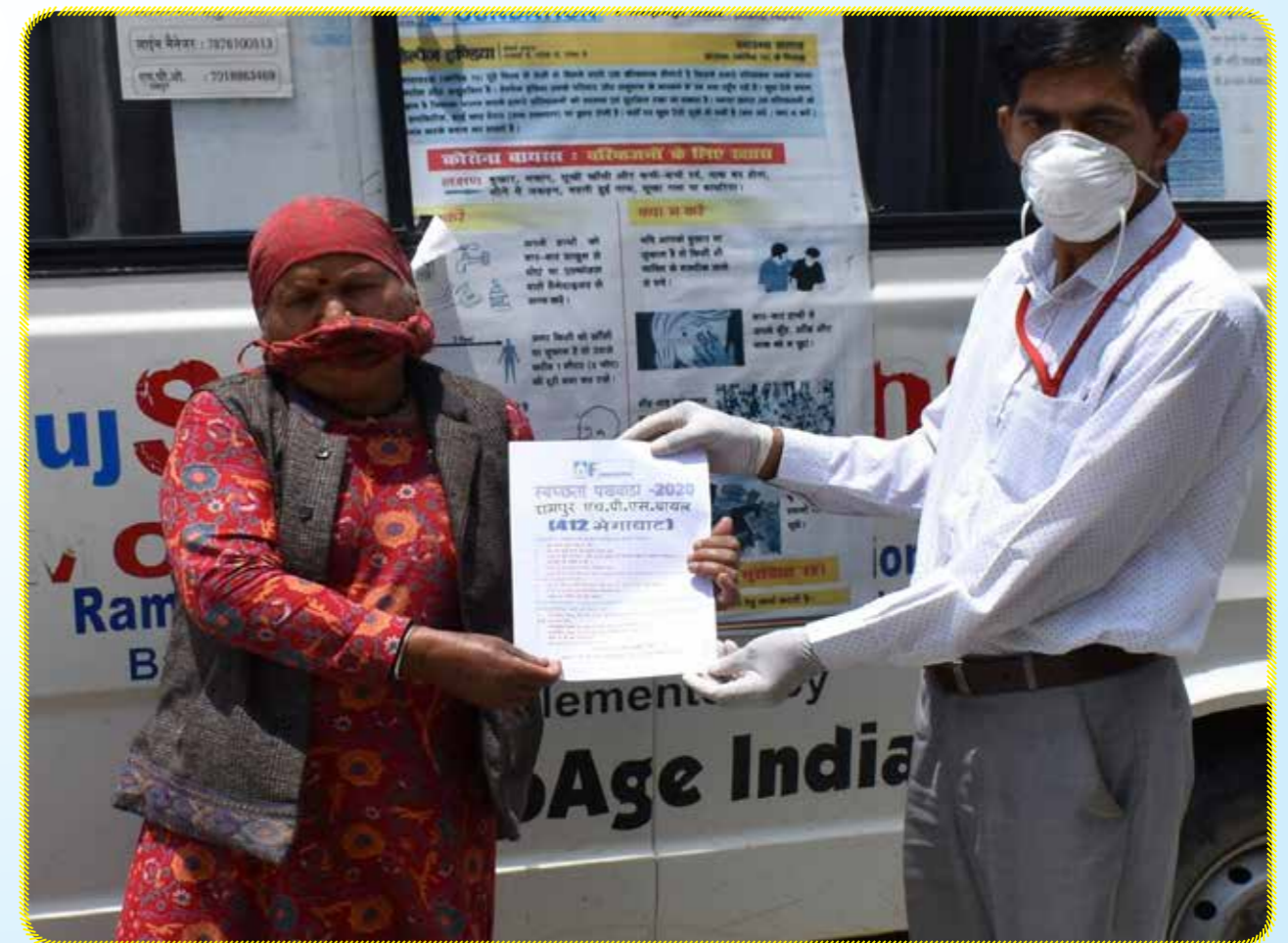
Sensitization of Public by Focusing on Three Groups Viz. Mahila Mandals, Panchayats and Schools.



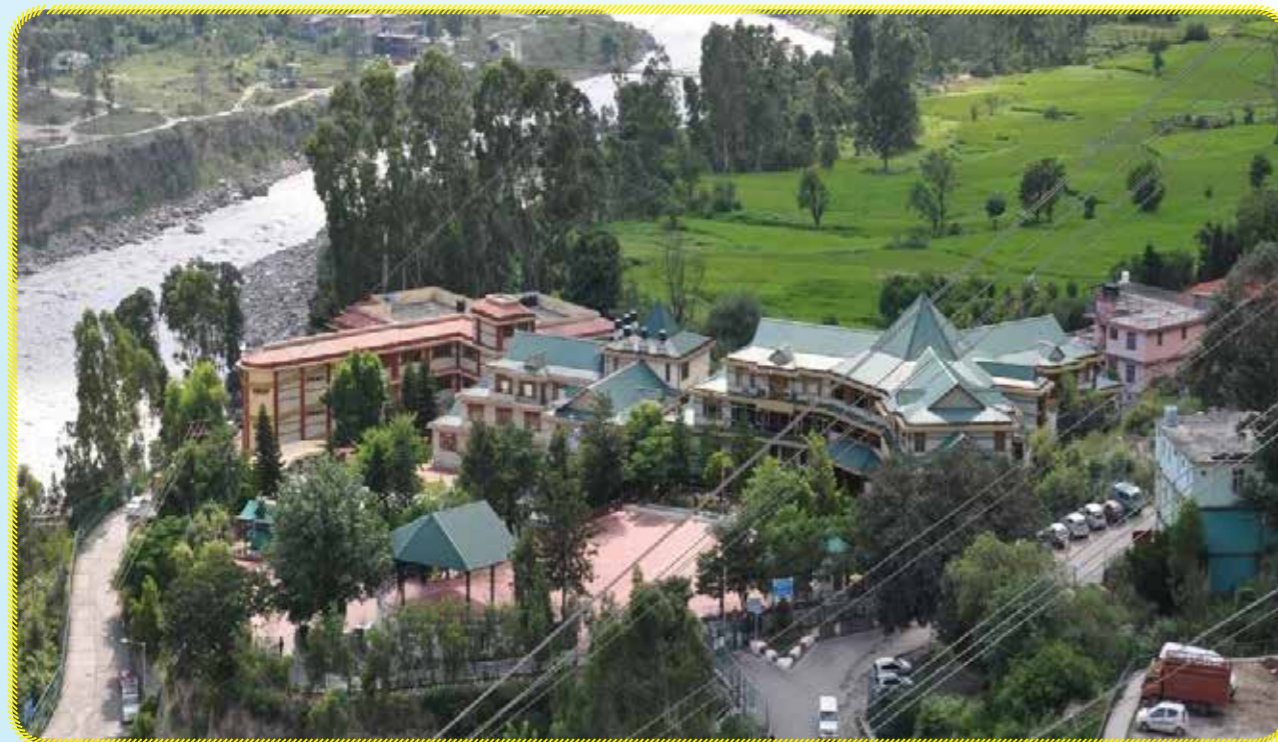
Various Programs Suiting The Intellectual Level of Groups Comprised Quizzes, Lectures, Discussions, Films, Drawing Competitions and Paragraph Writing.



Mobile Healthcare Unit Facility for Project Area.



## DEVELOPMENT OF PARKS AND NURSERY



## BIODIVERSITY FLOURISHING AT NJHPS AND RHPS

Being an environmentally responsible company and to control any adverse impacts due to human interference, wildlife conservation measures were taken by SJVN in NJHPS and RHPS. These projects have undertaken habitat enrichment, awareness programmes, strengthening anti-poaching/patrolling activities, etc. which has led to improvement in biodiversity within and around the projects.

One may spot many species of fauna, including avian species, like Himalayan griffon vulture, Oriental Magpie Robin, etc. The presence of such species is testament to the fact that conservation measures undertaken have largely been successful in providing vegetation and habitat for their survival.



Oriental Magpie Robin (*Copsychus saularis*)



Himalayan Bulbul (*Pycnonotus leucogenys*)



Rufous Treepie (*Dendrocitta Vagabunda*)



Himalayan Griffon Vulture (*Gyps Himalayensis*)



Himalayan Griffon Vulture (*Gyps Himalayensis*)



Garden Lizard (*Colotes Versicolor*)



Grey Treepie (*Dendrocitta Formosae*)



Common Hoopoe (*Upupa Epops*)



Spotted Dove (*Spilopelia Chinensis*)



Spotted Dove (*Streptopelia Chinensis*)



House Sparrow (*Passer Domesticus*)



House Swift (*Apus Affinis*)



Laughing Dove (*Streptopelia Senegalensis*)



Indian Paradise Flycatcher (*Terpsiphone Paradisi*)



White-Breasted Kingfisher (*Halcyon Smyrnensis*)



Green Bee-Eater (*Merops Orientalis*)



*Black Drongo (Dicurus Macrocerus)*



*Red-Vented Bulbul (Pycnonotus Cafer)*



*Common Snowtrout (Schizothorax Richardsonii)*

## SATLUJ ARADHANA – A UNIQUE INITIATIVE BY SJVN

Since ancient times in India, the purpose of worshipping water bodies is to offer respect to the rivers, reservoirs and water sources and to preserve them. SJVN considers the Satluj river as the backbone of the corporation. Taking inspiration from the worship of river Ganga on the ghats of Varanasi, SJVN, under the Dynamic leadership of the Chairman & Managing Director Sh. Nand Lal Sharma, organised “Satluj Aradhna” as a part of its 31st Raising Day celebrations in May, 2018.

Paying obeisance to the river is a way of thanks giving to the water source and to inculcate the idea of preserving it. Hence, “Satluj Aradhana” is not only a token of gratitude to the mighty Satluj river which is giving us so much power, income and maintains the climate of the state, but is also a unique initiative for creating awareness among the masses for preserving our rivers and keeping them clean. “Satluj Aradhana” has inculcated environmental sensitivity amongst the masses and has reconciled our ancient cultural and religious values with the modern thought and values of environmental conservation.

During the “Satluj Aradhna” in 2018, the Nathpa dam site on the banks of the Satluj, transcended into a place akin to the ghats of Varanasi. There was festivity in the air with lights and diyas amid chants of vedic mantras making it a historic occasion. During the ‘Deepdaan’, diyas were floated on the Satluj river which illuminated the place with the spirit of faith and reverence. Five pundits from Benaras performed Puja-Archana facing the river. Besides the SJVN family, hundreds of local natives of Nathpa village and surrounding places of Shimla district and Kinnaur were witness to the occasion.

On 7 October, 2019, SJVN, successfully conducted the Satluj Aradhana again on the banks of the Satluj river at Rampur HPS. The auspicious occasion was graced by the presence of the Hon’ble Chairman cum Managing Director Sh. Nand Lal Sharma, respected Director (Personnel) Smt. Geeta Kapoor, the respected Heads of Project of NJHPS, RHPS and Luhri projects.

The event was also attended by officials from the local administration, the press, local panchayat pradhans, members of the local community, and SJVN employees. The Hon’ble Chairman cum Managing Director while addressing the audience at large re-emphasized the importance of rivers and encouraged the local population to maintain clean local Panchayats, thereby promoting the “Swachh Bharat Abhiyan” (Clean India Mission).



**SATLUJ ARADHANA AT NJHPS, NATHPA**



**SATLUJ ARADHANA AT RHPS, DUTTNAGAR**



## AWARDS AND ACCOLADES

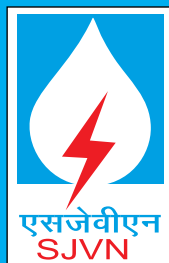
NJHPS and RHPS have been recognised for their achievements in the field of environment on many occasions, and over the years several awards have been conferred upon the projects for the same.



## CONCLUSION

It is clear that the World is gradually moving towards policies that lay emphasis on maximizing the use of renewable energy to meet future requirements. Hydropower can play a major role in this regard and act as a powerful catalyst for sustainable development. Its positive impacts on socio-economic upliftment, infrastructure and regional development are unparalleled in the power sector. SJVN's development objective was to improve the reliability of India's Northern Electricity Grid through the addition of renewable, low carbon energy from NJHPS and RHPS and to improve the effectiveness of SJVN with respect to the preparation and safe implementation of economically, environmentally, and socially sustainable hydropower projects.

SJVN has taken some very innovative measures in managing the specific environment and social impacts from its projects. The evaluation of the impacts and success of these measures have revealed that considerable development took place in the project region which created goodwill amongst the general public. Nonetheless, lessons learnt in implementing various programmes and plans will be used for improving the performances of our future projects.



एसजेवीएन लिमिटेड  
**SJVN Limited**