

CATCHMENT AREA TREATMENT PLAN (DRAFT)

**Vijaynagar PSP (2x65 MW)
Tehsil Sandur, District Bellary
Karnataka**

Project Proponent

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1. Catchment Area Treatment Plan

1.1. Introduction

The proposed Vijayanagar Pumped Storage Project is a self-identified, green field project by the JSW Renewable Energy (Vijayanagar) Ltd for captive use in JSW Steel. The project, conceived as an off-stream closed loop project of installed capacity 130 MW/780 MWH pumped storage component with 6 hours storage capacity for peak power, shall be located in Vidya Nagar area of JSW Steel Plant, Taluka Sandur, District Bellary, Karnataka.

The project will encompass an upper reservoir to be located close to JSW boundary on hillock adjacent to the existing Raw Water Reservoir-1, constructed to meet the water demand of JSW Steel and Power Plant, serving as lower reservoir. The upper reservoir with gross and live storage of 2.48 MCM and 2.42 MCM, is proposed to be created by constructing 1500m long gravity dam with its top at El 665m and FRL at El 662m and maximum height of 25m from NSL. The existing Raw Water Reservoir- 1 with normal pond level at El 520m shall be used as lower reservoir. However, the fluctuation of level in the reservoir is assumed to be up to RL 518m. The water conductor system comprising of two nos. of 5.0 m diameter steel penstocks of length 718 m each shall take off from intake/outlet structure at the upper reservoir and aligned along the hill slope up to the surface powerhouse (45m L x 18m B x 48m H) designed to house two Francis Vertical Shaft Reversible Pump Turbine of 65 MW each. RCC box type 8m (w) x4m (d) 800m long Tailrace Channel shall lead water to lower reservoir. The submergence area of project for upper reservoir about is 19.5 ha. Since project involves submergence and diversion of forest land is required, Catchment Area Treatment Plan is a mandatory requirement.

1.2. Need for Catchment Area Treatment Plan

The CAT Plan targets towards overall improvement in the environmental conditions of the region. All the activities are aimed at treating the degraded and potential areas with severe soil erosion. The plan provides benefits due to biological and engineering measures and its utility in maintaining the ecosystem health. The plan with objectives addresses issues such as prevention of gully erosion, enhancing the forest cover for increasing soil holding capacity; and arresting total sediment flow in the reservoir and flowing waters.

1.3. Catchment Area

The total catchment area of local nalas draining up to the existing lower reservoir is 10.45 sq.km of which intercepted catchment is nil. Since the catchment is not intercepted by any other water resource project on upstream, the Catchment Area Treatment Plan shall be formulated for the entire catchment. The catchment area, marked on Toposheet, is shown in **Figure 1.1.**

1.4. Basin Characteristic of Catchment Area

The project area and its catchment entirely lie in Tungabhadra basin. The basin area is highly undulating with isolated hills and plains. The ground slopes from south to north and west to east. The catchment area has undulated topography. In the catchment area the ground elevation ranges between El. 663 m to El. 517 m. The drainage pattern of the catchment is dendritic.

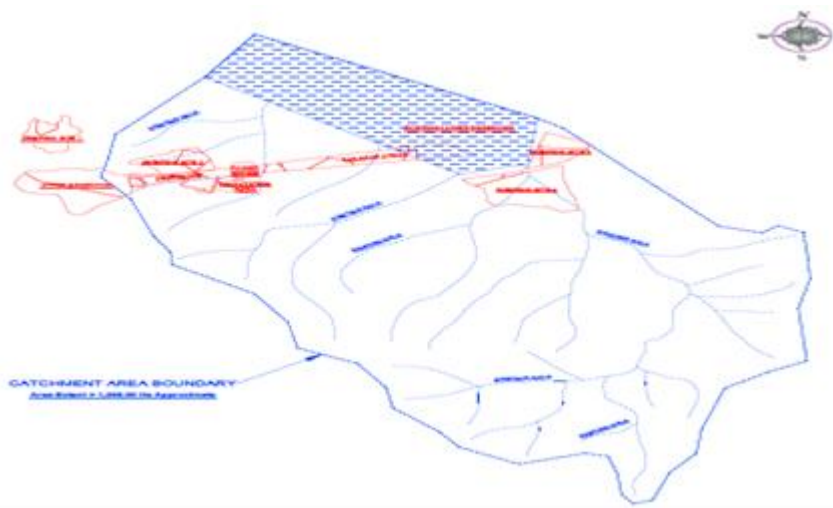


Figure 1.1 : Map of Catchment Area

1.5. Treatment of Catchment

Areas falling under very severe and severe erosion would be taken up for conservation treatment measures such as biological and engineering measures under CAT Plan. In the present case, an area of 40 ha has been proposed to be treated under the CAT plan. This area includes 30 ha area of catchment which shall be treated by biological / engineering measures and 10 ha area under non-forest land treatment within the catchment. The following activities will be undertaken.

1.6. Activities to be Undertaken

In critically degraded areas, plantation of locally useful diverse and indigenous plant species such as timber plantation species, fodder species, fuel wood species, grasses, shrubs and legumes, medicinal and aromatic plants would be undertaken. The forestation will include rising of multi-tier mixed vegetation of suitable local species in the steep and sensitive catchment areas of rivers/streams with the objective of keeping such areas under permanent vegetative cover. Furthermore, degraded areas would also be brought under vegetation cover. Suitable trees of economic value to local people shall be raised in the degraded forest areas near to villages with the objective of supplementing income of the villagers.

Effective fencing would also be provided for protection of saplings. Before any new area is taken up, eradication of weeds and unpalatable grass species is important. There are a few locations within forest in the catchment area where the crown density is poor and plantation

can be done to increase the patch density of crop. In such areas, plantation of 1000 seedlings per hectare is likely to create dense forest.

Civil Structures

➤ **Gully Control-Check Dams**

Gullies are mainly formed because physiographic, soil type, and heavy biotic interference in an area. Different types of check dams would be required for different conditions comprising of different materials depending upon the site conditions and the easy availability of material (stones) at local level and transport accessibility. Generally, brush wood check dams are recommended to control the erosion in the first order basin/streams in upper reaches and dry random stone masonry check dam shall be provided in the lower reaches where discharge is higher. In such stream where discharge and velocity of flow are still higher gabion structure shall be provided. Lower down the sub-watershed, i.e., in the third order drainage silt retention dams in the form of gabion structure shall be provided.

➤ **Stream bank Protection**

Stream bank erosion is caused by variety of reasons such as destruction of vegetative cover, mass movement on unstable bank slopes, undermining of top portion of lower bank by turbulent flow and sliding of slopes when saturated with water. The Stream Bank Protection would include wire crate boulder spurs in two to three tiers depending upon the high flood level of the streams.

1.7. Normal Afforestation

Out of the total stock to be planted under afforestation, 20% species shall be tree species having medicinal values and 10% of fruit bearing wild species useful to wildlife shall also be planted. The cost analysis per hectare of afforestation with 1000 plants/ha, with four strands barbed wire fencing stretched across stone fence posts inclusive of maintenance for ten years has been worked out as Rs. 7.52 lakh/ ha as shown in **Table 1.1**. The rate analysis is as per CSSR sanctioned by PCCF Karnataka for 2021-22 dated 9.3.2021, with 10% compounding annual enhancement. Cost of barbed wire fencing per ha has been worked out in **Table 1.2**.

Plantation under normal afforestation component shall be carried out in catchment area. Plantations will be maintained for ten years. The cost of works under normal afforestation component for 15 ha area@ Rs 7.52lakh/ha has been assessed as **Rs. 112.80 lakh**.

Table 1.1 : Cost Norms for Normal Plantation Works (per ha)

S.N.	Particulars	Advance work Year	Raising Yr	I-Yr	II-Yr	III-Yr	IV-Yr	V-Yr	VI-Yr	VII-Yr	VIII-Yr	IX-Yr	X-Yr	Grand Total
A	Advance Work													
1	Advance work i/c raising of Pbs 8"x12" size	139200	-	-	-	-	-	-	-	-	-	-	-	139200
B	Raising of plantation													
1	Raising plantation in advance worked area	-	78000	-	-	-	-	-	-	-	-	-	-	78000
2	Maintenance of seedling before planting (Pbs 8"x12" size Pbs 1200 Pbs @7.18 each)	-	8592	-	-	-	-	-	-	-	-	-	-	8592
3	Raising nursery for replacement of casualties next year 10% (8"x12" size Pbs 100 Pbs @24.36 each)	-	2436	-	-	-	-	-	-	-	-	-	-	24636
C	Maintenance of plantation (with casualty replacement, cultural operation)													
1	Maintenance of plantation during 1st year	-	-	41200	-	-	-	-	-	-	-	-	-	41200
2	Maintenance of seedlings raised for casualty replacement ((8"x12" size Pbs 100 Pbs @7.16 each)	-	-	716	-	-	-	-	-	-	-	-	-	716
D	Maintenance of plantation (with cultural operation and manuring)													
1	Maintenance of plantation	-	-	-	34300	-	-	-	-	-	-	-	-	34300

	during 2nd year													
E	Maintenance of plantation (with cultural operation but without manuring)													
1	3rd year	-	-	-	-	-	-	-	-	-	-	-	-	28300
2	4th year	-	-	-	-	-	28300	-	-	-	-	-	-	28300
3	5th year	-	-	-	-	-	-	28300	-	-	-	-	-	28300
F	Maintenance of plantation (without cultural operation)													
1	6th year	-	-	-	-	-	-	-	8400	-	-	-	-	8400
2	7th year	-	-	-	-	-	-	-	-	8400	-	-	-	8400
3	8th year	-	-	-	-	-	-	-	-	-	8400	-	-	8400
4	9th year	-	-	-	-	-	-	-	-	-	-	8400		8400
5	10th year	-	-	-	-	-	-	-	-	-	-	-	8400	8400
	Total (A to F)	139200	89028	41916	34300	28300	28300	28300	8400	8400	8400	8400	8400	431344
I	Total (A to F) amount after taking escalation cost for each year @10% compounding factor	153120	107724	55790	50219	45577	50135	55148	18006	19806	21786	23932	26363	627606
II	Resurveying, re-demarcation and other works for section 4 of Notification (LS)	11169	-	-	-	-	-	-	-	-	-	-	-	11169
III	Barbed Wire 4 strands fencing on stone pillars (considering 200m average periphery)	100000	-	-	-	-	-	-	-	-	-	-	-	100000
IV	Total Advance work year to 10th year of maintenance (I+II+III+IV)	264289	107724	55790	50219	45577	50135	55148	18006	19806	21786	23932	26363	738775
V	Administration & Supervision charges @5% of above	13215												13215
Grand Total														751990
Say														7,52,000

Table 1.2 Cost of Barbed wire fencing (4 strands) with stone pillars for 200m periphery/ha

S.N.	SSR item No.	Particulars	Qty	Unit	Rate	Total
1		Procurement of stone pillars of size 6'x6"x4" i/c transportation at site (pillars @3m spacing)	67	each	1060	71020
2	87(a)	Excavation of pit (0.3mx0.3mx0.5m) to accommodate pillars	67	each	9.63	645.21
3	87(b)	Carrying stone pillars from unloading point to the pits and placing them upright in the pit	67	each	60.48	4052.16
4	87(c)	Collection of available stones filling the soil and stones ramming with crow bar and fixing	67	each	48.40	3242.80
5		Cost of barbed wire of 12x14 gauge, weighing 1kg /7m. Total length (4x200+10% extra for looping around alternate pillars, i.e., 880m x1/7=126kg	126	kg	120	15120
6	87(d)	Unrolling the barbed wire, drawing the barbed wire looping around the alternate pillars, fastening binding wire to the remaining pillars and fixing the barbed wire i/c binding wire cost	67	each	21.14	1416.38
7		Miscellaneous and administration charges i/c area weightage and transportation of barbed wire	1	Job	LS	4500
Total (1 to 7)						99996.55
Say						100000.00

1.8. Engineering Works (Soil & Water Conservation Measures)

Hard (Engineering) structures are to be constructed as landslide control and stream bank stabilization over visually active slides and eroded banks of the main nala and its tributaries falling under "Severe" and "Very Severe" erosion intensity areas to control the sediment flow and further degradation of the catchment areas. Since these measures are to be carried out by construction of individual structure such as wire crate spurs, check dams, contour staggered trenches, catch water drains, retaining walls etc. on-site specific basis, the cost of each of such structure must be analyzed on the basis of dimensions adopted. The analysis of rates of such structures is presented in **Table 1.3.**

Table 1.3 : Cost Norms for Engineering Works

S. No.	Item	Quantity	Unit	Rate	Amount
1.	Dry Rubble Stone masonry (DRSM) Check Dam				0
(a)	Excavation in foundation in all kinds of soil i/c boulders in 5.60 m x 1.80 m x 0.50	5.04	Cum	116	584.64

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	m = 5.04 cubic meter				
(b)	Loading and unloading of rubble stone				
	I-Step 5 x 1.5 x 1.25 = 9.38				
	II – Step 7 x 1.0 x 0.75 = 5.25	23.52	Cum	297.38	6994.14
(c)	Wing Walls 2 x 3.75x 0.6 x 1.5 = 6.75 Total 21.38 x1.1= 23.52				
(d)	Carriage of boulder by road from quarry site to 30 km beyond initial lead up to 1 km (146.40+10.4x25) x1.3	23.52	cum	528.30	12425.62
(e)	Carriage of boulder by manually (head load) total lead up to 150 m @153.8x1.3	23.52	Cum	199.94	4702.59
(f)	Labour charges for dry stone masonry with outer face stone dressed i/c lead upto 1 km and all lifts @706x1.3/cum	23.52	Cum	917.80	21586.67
				Total	46293.66
Add 2% Contingencies					925.87
Grand Total Rs.					47219.53
Say Rs.					47000.00
2.	Wire Crate Check Dam				
(a)	Excavation in foundation in all kinds of soil i/c boulders in 6.60 m x 2.30 m x 0.50 m = 7.59 cubic meter	7.59	Cum	116	880.44
(b)	Loading and unloading of rubble stone				
	Foundation Step - 6.0 x 2.0 x 1.0 m = 12 cubic meters				
	I- Step - 6.0 m x 1.9m x 1.0m = 11.40 cubic meter	35.24	Cum	297.38	10479.67
	II- Step – 6.0 m x 1.8m x 0.8 m = 8.64 cubic meter				
	Total requirement of boulder = 32.04 x 1.1 = 35.24 cubic meter				
(c)	Carriage of boulder by road from quarry site to 30 km beyond initial lead up to 1 km (146.40+10.4x25) x1.3	35.24	Cum	528.30	18617.29
(d)	Carriage of boulder by manually (head load) total lead up to 150 m @153.8x1.3	35.24	Cum	199.94	7045.89
(e)	Weaving of wire netting of GI wire mesh size 15 cm x 15 cm				
	Foundation Step-2(6x2+6x1+2x1) = 40 m ²				
	I- Step-2(6x1.9+6x1+2x1) = 38.8 m ²	113.2	M ²	30	339.60
	II- Step- 2(6x1.8 + 6x0.8 + 2x0.8) = 34.4 m ²				
	Total = 113.2 m ²				
(f)	Filling of boulder and hand packing in wire crates	35.24	M ³	778.70	27441.39
(g)	Cost of GI wire	2.25	Qtl	10000	22500
(h)	Carriage of boulder by manually (head load) total lead up to 150 m	2.25	Qtl	120	450
Total Rs.					87754.28

Add 3% Contingencies					2632.63
Grand Total Rs.					90386.92
Say Rs.					90400
3	Contour Bunding	1	ha	10000	6000.00

The Break-up of works in respect of civil structures for land slide and stream bank stabilization and moisture retention operations with their costs is shown in **Table 1.4**.

Table 1.4 : Cost of Engineering Measures

DRSM check dam @ Rs. 0.47 lakh each		Wire Crate Check Dam @ Rs. 0.904lakh each		Total Cost (Rs. lakh)
No.	Cost	No.	Cost	
40	18.80	15	13.56	32.36
40	18.80	15	13.56	32.36

1.9. Treatment of Private Land

The silt contribution of private land holding is very significant because it interrupts the natural drainage and contributes to heavy soil erosion as compared to the other land use categories like dense forest/open forest. Therefore, better land management shall help in reducing the sediment flow besides increasing the land productivity by way of proposed soil cover to increase soil moisture content. Therefore, it is proposed to carry out terracing and bunding in 10 ha area along with some engineering measures to control erosion/sliding witnessed in the agricultural land is also proposed. The cost of works proposed under this head work out to **Rs. 1.00 lakh**.

1.10. Cost of Other Component of CAT Plan

Apart from the forestry works and drainage line treatment in the catchment area there are other aspects of the CAT Plan to be addressed and their cost included in the overall cost estimate of the plan. Provision for micro planning and documentation are some of the integral ingredients, which have to be considered and included while formulating the CAT plans.

Provision for Micro Plans

Based on the ground truth reality in each of the village forest department committee or society under different sub-watersheds, comprehensive micro plan for execution of the work has to be prepared as per norms. The micro plan for each beat shall be with due regards to the environmental functions and productive potential of the forests and their carrying capacity. For this purpose, a provision of **Rs. 0.50 lakh** is being made.

Provision for Proper Documentation

Emphasis should be laid on the publicity of the work proposed under the plan and work carried out on annual basis so that transparency is maintained and proper documentation of the work is also carried out for future reference and testing the efficacy of the work in due course of time. On this count a provision of **Rs. 0.50 lakh** is proposed. The documentation would inter alia include implementation report, progress reports, photography, videography etc.

Provision for Forest Protection

The need for rigorous watch and ward of the forest covered under the catchment area becomes more imperative in view of proposed new plantation under the CAT plan and due to increased human activity in the form of labour, who shall be engaged for forestry works. Thus, fire protection measures including construction and maintenance of fire lines shall be carried out. For these a provision of **Rs. 3.00 lakh** is being earmarked.

1.11. Summary of Cost of Works

The cost of all works proposed in the CAT plan is enumerated in **Table 1.5**.

Table 1.5 : Cost of Engineering Measures

S. No.	Particulars	Amount (Rs. In Lakh)
1.	Habitat treatment works under free draining catchment	
(a)	Normal afforestation (15 ha @ Rs. 752000/ ha)	112.80
	Sub- total (1)	112.80
2.	Soil and water conservation measures	
(a)	DSRM check dam (40 no. @Rs 47000/ha each)	18.80
(b)	Wire crate check dam (15 no. @ Rs 90400/each)	13.56
	Sub- total (2)	32.36
3.	Private land treatment	
(a)	Bench terracing (10 ha @ R10000/ha)	1.00
	Sub- total (3)	1.00
4	Other Components of CAT Plan	
(a)	Provision for Micro Plan	0.50
(b)	Documentation	0.50
(c)	Forest Protection	3.00
	Sub- total (4)	4.00
Grand Total.		150.16
Say		150.00

