ANNEXURE 5

Justification for locating the dam in Forest / Wildlife

TABLE 1: Summary of Gargai Dam Site Alternatives				
Sl. no	**Attribute**	**Alternative-1**	**Alternative-2**	**Alternative-3**
1	Location of dam	Near Suryamal	Downstream of Parali	Near Ogade
2	Catchment area (sqkm)	54.6	147.1	110.0
3	Annual river yield (MCM)			
	50% Dependability	126.8	341.6	255.4
	75% Dependability	98.9	266.4	199.2
	95% Dependability	82.0	221.0	165.3
4	Riverbed level (m)	280.0	89.0	114.0
5	Full reservoir level, FRL (m)	340.0	120.0	175.0
6	Submergence area at FRL (sqkm)	4.23	8.04	7.77
6.1	Villages getting affected	None	Chimnipada, Parali, Sagdohapada, Palchapada, Varsale, Patelpada & Varasale	Khodade, Tilmil, Ogade and parts of Pachghar,Fanasgaon, Amale
	Number of villages getting affected	0	7	5
6.2	Road length under submergence (km)	1.09	9.08	6.69
7	Height of dam (m)	60	31	67
8	Length of dam (m)	390	2311	775.5
9	Storage capacity (MCM)	99.6	95.9	172.6
10	Sediment Load (MCM) @ 1,790 cum/sqkm/year	9.77	26.34	19.69
11	Probable evaporation losses (MCM)	6.8	12.9	12.4
12	Live storage (MCM)	89.8	69.6	137.4
13	Peak design flood (cumecs)	1156	3114	2328
14	Spillway location	Gorge	Gorge	Right Flank
15	Type of dam	RCC	Earth/Rockfill dam	RCC
16	Compatibility with Modak Sagar Conveyance System	Compatible: Transfer of water from Gargai dam to Modak Sagar by gravity possible	Not compatible due to lower control levels	Compatible: Transfer of water from Gargai dam to Modak Sagar by gravity possible
17	Water Supply Rate (Tentative) (MLD)	228	155	440
18	Cost of the Project (Tentative) (Rs Crores)	1,170	1,055	1,498
19	Cost per Unit Storage of Water (Rs Million/Mm^3)	117.5	109.9	86.8
20	Cost per Unit Supply of Water (Rs Million/MLD)	52.0	68.1	34.0

Ref: Gargai DPR by Mott MacDonald, July 2012.

1. Selection of Dam Site. In line with the norms for choosing a dam site on Gargai river, three alternative locations were studied for technical and environmental considerations. Apart from the general principles of selecting a dam site mentioned above, constraints that are specific to the project, if any, must also be considered. One such constraint in the present study is the possibility of utilising existing as well as proposed infrastructure at the existing Modal Sagar reservoir on Vaitarna River, for conveying water from the Gargai reservoir to Mumbai. Meeting this requirement needs the control levels of Gargai reservoir, such as full reservoir level and minimum drawdown level, to conform to the hydraulics of such conveyance. In line with the norms stated above in choosing the dam site over Gargai, three alternative locations have been studied comparative study of these alternatives in terms of their physical parameters, merits and demerits are discussed in the following paragraphs. The technical specifications and location of each alternative is as in the table below.

2.Alternative-1

a) Technical considerations. A potential dam site is across a well-defined straight reach of Gargai River downstream of village Gomghar. The coordinates of the alternative site are (19^{0}44'26"N, 73^{0}22'02"E). Good foundation grade rock is anticipated at shallow depth at this location. Typical contours on the left side at this site run a little closer in comparison to those on right flank, covering an altitude of about 500 m. The riverbed level at the proposed location is 280m, based on contour survey. The planned storage at this location up to the full reservoir level (FRL) of 340 m is 99.6 MCM. At this FRL, the storage reservoir created on the upstream spreads over an area of 4.13 sq.km. Maximum height of the dam works out to be about 60 m, with dam length of 390 m. At the proposed dam site, the river cross-section is narrow with steep slopes; since the dam height is 60 m an RCC dam is proposed. For approaching the dam site, laying new roads and communication systems is required. The control levels at this dam site allow water to be conveyed to Modak Sagar through gravity. The length of the water conveyance system from the proposed Gargai reservoir site to its outlet at Modak Sagar is about 10 km. The catchment area up to this location is 54.6 sq. km, which produces annual water yields of 98.9 million cubic metres (MCM) and 82.0 MCM at 75% and 95% dependability, respectively. Thus, the yield at this location does not satisfy the desired water supply (455 MLD= 166.08 MCM per annum) as recommended by the Chitale Committee.

b) Ecological Considerations. The sub-mergence at this location would be lesser at 4.23 sq. kms. However, the entire sub-mergence area is in a pristine valley with very dense natural tropical semi-green forest of canopy density higher than 0.6 to 0.7. This location does not contain any human interference as there are no inhabitations and villages. It therefore does not offer any opportunity for betterment of tribal villagers. Ecologically this site has maximum disadvantage. **Consequently, this is a much better habitat for wildlife and, therefore, should not be disturbed.** This part of Tansa Wildlife Sanctuary in the Gargai valley has reported siting of forest owlet. Flying squirrel of the Western Ghats and the Oriental dwarf Kingfisher is also sited, though rarely in this area. This alternative will cause greater ecological damage and may adversely affect niche areas of the WildLife Sanctuary and must be avoided.

3. Alternative-2

a) Technical considerations: The second alternative dam site that has been studied is 4 km downstream of the only gauge-discharge station on Gargai River, located at village Parali, and upstream of the confluence of Gargai with Pinjal. The coordinates of the site are (19º43'40"N, 73º14'10"E). At the proposed location, the Gargai River wide-opens, and its drainage density decreases. However, there will be more water available at this location, compared to other alternatives considered, due to larger drainage area (147.14 sqkm) contributing to yield. The 75% and 95% dependable annual yields at this location are 266.4 MCM and 221.0 MCM, respectively. The seat of the dam is at about 89 m, in the gorge, and the general ground profile is at 120 m. Therefore, it is difficult to plan a deep storage reservoir to hold the desired capacity, which is corresponding to a release of 455 MLD, by increasing the height of the dam due to lower riverbank levels. Additionally, as the dam location and the corresponding submergence area lie in a relatively flat region, cost of the dam per unit increase in dam height would be more, due to the need for more land acquisition, rehabilitation and relocation. Moreover, as the riverbanks are wide open, the foundation of the dam should be anchored deep into the grade rock. Due to shallow depth of river regime and widely spaced riverbanks at the proposed location, length of the proposed dam between abutments exceeds 2.3 km at a dam height of about 31 m. Thus, an earth dam or a rock-fill dam is suitable at this location. Based on contour studies, the reservoir storage capacity for FRL of 120 m is 35.9 MCM, which is only a fraction of 95% dependable yield.

b) Ecological Considerations: This location is on relatively flat terrain and, therefore, has a very large area of sub-mergence with consequent larger submergence of biodiversity of the area. The tail-end of the reservoir does not submerge the villages mentioned in Alternative I. It also does not submerge the additional village of Khodade. The villages affected by this alternative are outside the sanctuary and hence no villages can be removed and relocated from the sanctuary. Thus, no benefit can accrue to the Tansa Wildlife and all the present villages will continue to remain inside the sanctuary. The total sub-mergence is also higher at 8.04 sq. kms. The seat of the dam is at about 89 m, in the gorge, and the general ground profile is at 120 m. Therefore, it is difficult to plan a deep storage reservoir to hold the desired capacity, which is corresponding to a release of 455 MLD. This alternative will cause a very large alteration to topography without correnponding benefits for the project. This alternative affects the villages of Parali, Sagdahapada, Varsale, Kaelebepada and Patelpada. The parali and varsale are already main stream villages and have education, transportation and health facilities.the project will not benefit tribal population.

4. Alternative-3

a) Technical considerations. Another alternative dam site, proposed at coordinates (19º42'45"N, 73º17'15"E), is at a distance of about 8 km upstream of Alternative-2, along the river Gargai. In this Alternative, the storage dam is proposed so as to accommodate the planned water potential. Good, stable banks exist along the river at this location with a well-defined channel. The river valley at this dam site is narrow resulting in minimal dam length. The dam site is open to large drainage area (110.0 sqkm) for tapping the inflows to fulfil the desirable storage needs. Apart from a saddle which can be used to install the overflow section, located away from the main gorge of

the river the rim of the proposed storage appears to be watertight and stable. Alignment of the dam is along a meandering stretch of the river and is inclined compared to the direction of the river's natural course. However, the possibility of locating the spillway in the swaddle location and availability of strong banks in the main gorge and its downstream allow consideration of this site. Good foundation grade rock is available at the shallow depth below the dam seat of 114.0 m. Existence of a saddle allows locating the spillway aloof from the main section of the of the dam, which also reduces the cost by eliminating the need for elaborate energy-dissipation arrangements. Total catchment area up to the proposed dam site is 110 sq km, which produces annual yields of 199.2 MCM and 165.3 MCM, at 75% and 95% dependability, re3spectively. Based on contour studies, a reservoir capacity of 165.5 MCM at this location, for FRL of 174.1m, has a water spread area of 7.77 sq km. It is possible to transfer water, through gravity, from this storage site to Modak Sagar via a 2 km long tunnel, dug across the hillock in between the two reservoirs.

b) Ecological Considerations The length of the Dam is 775.5 meters and the height of Dam is 67 meters. The total submergence at this site at FRL 175 would come to 772 ha. The total number of trees affected in this alternative would be very high. The canopy density would be about 0.2. However, after reducing the Islanded territories and niche areas protected by a proposed gabion, the number of trees is reduced to 466214. In this alternative, a large portion of the State Highway passing through the sanctuary is also sub-merged. Alternate alignment proposed from village Satronde to Suryamal is completely outside the sanctuary. Thus, the human interference due to traffic will be entirely removed. Two villages, viz. Ogada and Khodade are completely sub-merged and hence need to be rehabilitated. However, four other villages namely; Amle, Tilmal, Panchghar and Fanasgaon will remain in the sanctuary. The anthropogenic stress on the sanctuary needs to be removed to make it free of human interference and grazing pressures. The area around the submergence of the project in the Gargai river valley comprises of semi evergreen tropical forests. The area has good potential to harbour wildlife. However, the examination of wildlife siting logs and management plans reveal very few incidences of wildlife siting. **This project offers an opportunity to relocate and resettle all 4 tribal villages even if they are not affected by the project.** In this case removal of human interference from the sanctuary should be the best option from ecological considerations.

5. Rating the Alternative Dam Sites. In order to select the dam site objectively from among the alternative locations mentioned in the preceding section, an objective rating methodology has been developed.

6. Procedure for Rating. A set of criteria reflecting positive or negative impacts on technical feasibility are given **Table 2**. A weightage is given to each criterion based on its importance. All three alternative sites are rated according to pre-set conditions, which depend on the nature of impact of a criterion. For instance, the positive impact of the project is water supply, which has social and economic impacts. Therefore, alternatives with larger values for this criterion get more points. Similarly, submergence by the reservoir and length of conveyance system from the dam have been minimised i.e. alternatives with lesser values for these criteria get more points. The criteria that have been selected, the corresponding conditions constraining them and weightage are given in **Table 3**. More specifically, for a given criterion, alternative sites are rated such that the site that satisfies the pre-set condition upon that criterion is given full points in **Table 3**. Other

alternative sites are rated in proportion to the ratios of their respective criterion values to that of the alternative getting maximum points for the chosen criterion. The comparison of relative impacts on social and ecological aspects are given in **Table 4.** This is repeated for all criteria, over which the ratings for each alternative site are summed. The alternative site that scores maximum points is chosen as the site for proposing a dam over Gargai River. Rating of all three alternatives, as per the procedure described above, is presented below:

Table 2: Impacts Weightage Points

Sr.no.	Criterion	Impact (+ve/- ve)	Points	Percentage
1	Area under Submergence	Negative	5.0	33.3
2	Number of Affected Villages	Negative	2.5	30
3	Road Length Under Submergence	Negative	2.5	20
4	Major Roads (Two Lane)	Negative	1.875	75
5	Minor Roads	Negative	0.375	15
6	Cart Track	Negative	0.250	10
7	Possible water Supply from reservoir	Positive	5.0	33.3
8	Conveyance Length to Modak Sagar	Negative	5.0	33.3
		Total	**15.0**	**100**

Table3: Rating of alternatives sites Technical Considerations

Sr.no	Criteria	Value	Alterative-I		Alternative–II		Alternative-3	
		Units	Value	Rating	Value	Rating	Value	Rating
1	Area under Submergence	Sq.Km	4.23	--	8.04	--	7.72	--
1.1	Number of Villages affected	-	0.00	2.50	7.00	1.04	5	1.46
1.2	Road Length submerged	Km	1.09	--	9.08	--	6.69	--
1.3.1	Major Roads (Two Lane)	Km	0.00	1.88	3.18	1.06	4.16	0.81
1.3.2	Minor Roads	Km	1.09	0.38	1.53	0.26	2.53	0.19
1.3.3	Cart Track	Km	0.00	0.25	4.37	0.00	0.00	0.25
2	Possible Water Supply from the reservoir	MLD MCM/y	22.8 83.1	2.59	155 56.7	1.77	440 160.6	5.00
3	Conveyance Length to Modak Sagar	Km	5.50	1.33	3.8 (GravittyNot Possible)	0.00	2.0	5.00
Overall Points			**8.92**	**4.13**		**12.71**		
Overall Percentage (%)		**59.46**		**27.56**		**84.74**		

Source: Draft DPR, MottMacdonald, July,2012

Table 4: -Impacts on Environmental and Sociological of all alternatives sites

[L: Longterm, S: Shotterm, I: Irreversible, R: Reversible]

Sl. No	Criteria	Category	Alternative I				Alternative II				Alternative III			
			Impacts				Impacts				Impacts			
			+/-	L/S	R/I	Sum	+/-	R/I	L/S	Sum	+/-	R/I	L/S	Sum
1	Environment	Water	+	L	I	1	+	L	I	1	+	L	I	1
		Air	0	0	R	0	+	0	R	1	+	0	R	1
		Land	0	L	I	0	-	L	I	0	-	L	I	0
		Noise	-	S	R	0	-	S	R	0	-	S	R	0
		Flora	-	L	I	0	-	L	I	0	-	L	I	0
		Fauna	-	L	I	0	-	L	I	0	+	L	I	1
		Avifauna	+	L	I	1	+	L	I	1	+	L	I	1
		Aquatic Fauna	+	L	I	1	+	L	I	1	+	L	I	1
3	Wildlife Habitats	Change in species composition	-	L	I	0	+	L	I	1	+	L	I	1
		Increased aquatic life	+	L	I	1	0	L	I	1	+	L	I	1
		Migratory birds	+	L	I	1	+	L	I	1	+	L	I	1
		Afforestation, green belt	+	L	I	1	0	L	I	0	+	L	I	1
		Water holes	-	L	I	0	0	L	I	0	+	L	I	1
4	Sociological	Employment	0	S	I	0	+	L	I	1	+	L	I	1
		Infrastructure development	+	L	I	1	+	L	I	1	+	L	I	1
		Displacement	+	L	I	1	-	L	I	0	-	L	I	0
		Loss of homestead/heritage sites/monuments	0	L	I	1	-	L	I	0	-	L	I	0
		Tourism	+	L	R	1	-	L	R	0	+	L	R	1
		Water supply	+	L	I	1	+	L	I	1	+	L	I	1
		Ground water recharge	+	L	I	1	+	L	I	1	+	L	I	1
		Increased/improved crop production	0	L	I	0	-	L	I	0	+	L	I	1
	Total		**12**				**11**				**16**			

(Ref. Sociological & ecological assessment studied by NERIL team)

7. Choice of Dam Location: The rating procedure followed to rank alternative sites considers both positive as well as negative impacts due to their location. Choosing Alterantive-3 means water availability for Mumbai. Even in terms of minimising the adverse impacts on social, environmental, economic and capital aspects due to the project, Alternative-3 fares better than the other alternative sites considered. Therefore, a dam over Gargai River is proposed to be located near Ogada village, at coordinates ($19^0$42'45"N, $73^0$17'15"E). Considering the ecological aspects of the three alternatives, the alternative no. 3 of locating the dam site near village Ogada is the best option for the wild-life sanctuary, particularly if while adopting this alternative, we also plan to remove the villages and human interference from the Sanctuary. It is further observed that removal of highway and creation of Islands will benefit uninterrupted habitat for the Wildlife in TWS. It will be of immense use for the sanctuary if along with this alternative, the villages are relocated outside the sanctuary and the Gargai valley is made completely free from any anthropogenic stress.

8. Maximising the Environmental Benefits of Gargai Project for Wildlife. A detail survey of the project affected people by the proposed Gargai Dam Project in the village of Ogada, Khodada, (both fully affected) and Tilmal (partially affected households) was carried out. The SIA team was tasked to carry out household survey of the rest of villages viz. Pachghar, Fanasgaon, Amle and the balance of Tilmal (area unaffected by Gargai Project). This was done in coordination with the Range Forest Officer Wildlife Range Parali. Regular onsite interaction with the RFO, Bos and the

Guards gave valuable insights in the problems faced by the local population and the reasons for such sparse wildlife in the valley.

9. This exercise confirmed the need to induce voluntary dislocation of these villages from within the Protected area to a location in the RF adjacent to it. On this subject several studies exist. We have referred to and quoted from a comprehensive study on the subject of "Displacement and Relocation of Protected Areas: A Synthesis and Analysis of Case Studies" carried out by Antoine Lasgorceix and Ashish Kothari; published in Economic & Political Weekly, vol. xliv no 49 December 2009.

10. The man-animal conflict. The benefits of removing human population from the wildlife areas are well known and need no further elaboration. It is well experienced that the human habitation and uses of natural resources for their needs, are prohibited or restricted within PAs and rightly so. It must be noted with concern that only 5% of India's land mass is under the Protected Areas. The animal world does not have freedom to survive in 95 % of our lands. Even within this 5% areas there are three to four million people living inside the PAs besides a few million more in its close vicinity, whose livelihoods depend on natural resources from these PAs (Kothari et al 1995).In the interest of animals it is only right that the development facilities such as transport, health, education facilities, land development and so on should not be allowed to reach these villages inside the PAs to ensure that the last bit of land left for wildlife is not lost. Survival needs of communities inside PAs need access to natural resources, which though legitimate, is a competing demand against the needs of the wildlife. Consequently, the communities inside the PAs have to live in a state of deprivation, poverty and perpetually in conflict with the department of wildlife. Conflict with wildlife through crop or livestock damage is also inevitable. This causes injuries and death to the humans on the one hand, and retaliatory killings of animals on the other. We can summarise our opinion as follows and proceed to elaborate upon the same thereafter:

"The wildlife is entitled to their share of land which must increase, the tribal inhabitants are equal citizens and hence cannot be deprived of development. Voluntary displacement that ensures equity of livelihood options and maintenance of the social ethos of the tribal population is therefore inevitable and should be ensured whenever an opportunity to do so exists. Gargai Dam project of MCGM offers an opportunity to voluntarily displace the tribal population of Tansa wildlife sanctuary living in the villages of Ogada and Khodada which are affected by the project and the villages Amale, Pachghar, Fanasgaon and Tilmal which are either partially affected or not affected by the project."

11. The objectives in respect of the wildlife areas in this proposal are as follows:

- To free the Gargai valley area of Tansa Wildlife Sanctuary of all human interference
- To bring about a voluntary displacement of all six tribal villages in the Gargai valley
- To create pastures, water holes and other habitat improvements schemes to complete the food chain to ensure that this forest is used by wildlife to its natural carrying capacity.
- To resettle the local communities, provide them assured livelihood opportunities, health, hygiene and education while maintaining their tribal culture and social fabric.
- The resettlement plan is to ensures that the resettlement is done adjacent to their original habitat in similar microclimatic conditions, identical ground, vegetation and social interaction and identity of the tribal villages.

12. The precedents of displacement of villages in PAs: - Few cases of precedence in this regard are quoted for ready reference.

Relocation Cases in NP/ Sanctuary	Year
Madhav National Park, MP	1958
Bandhavgarh National Park, Madhya Pradesh (MP)**:**	1972
Panna National Park and TR, MP	1980
Nagarjunsagar-Srisailam Sanctuary and Tiger Reserve, Andhra Pradesh	1982
Gir National Park, Gujarat	1983
Pench Wildlife Sanctuary, National Park, and TR (MP and Maharashtra)	1983
Pakhui-Nameri Sanctuary/National Park and Tiger Reserve, Arunachal Pradesh – Assam	1985
Bandipur National Park and Tiger Reserve, Karnataka	1985
Rajiv Gandhi National Park	1990
Bori-Satpura-Pachmarhi Sanctuary, Satpura National Park and Satpura TR, MP	1990
Asola Sanctuary in Delhi	1992
Corbett National Park and TR, Uttarakhand	2001
Bhadra Sanctuary and Tiger Reserve, Karnataka	2002
Kuno Wildlife Sanctuary, MP	2002
Rajaji National Park, Uttarakhand	2003
Buxa National Park and TR in West Bengal	2003
Phawngpui (Blue Mountain) National Park, Mizoram	2005
Chandaka- Dampara Wildlife Sanctuary in Orissa	2005
Chandaka-Dampara Wildlife Sanctuary in Orissa	2005
Phawngpui (Blue Mountain) National Park, Mizoram	2005
Dampa Sanctuary and TR, Mizoram	2006
Dudhwa National Park and TR in Uttar Pradesh	2006
Dampa Sanctuary and TR, Mizoram:	2006
Kudremukh National Park, Karnataka	2007

13. Environmental Impacts of relocation. The main expected environmental impact of relocation at the old site is the decrease of human pressures and disturbance. "***After relocation of 411 families from Corbett TR in Uttarakhand, the tiger population has increased by 52% over the period 1984-2002; and 273 ha of land were restored back to prime tiger habitat (MoEF 2006b),*** *though it is not clear if there may have been a number of other factors involved in these changes such as improved management and increasing resources for the TR.* ***Similarly, it is reported that the hard-ground subspecies of the Swamp deer or barasingha (Cervus duvaucelii), once down to only 66 in the 1970s, increased to over 400 after relocation of villages from the Kanha National Park*** *(Panwar 1978). Karanth (2006) reports the recovery of prey and predator populations in areas that have been freed of human presence.* The other reported impacts at the old site are the decrease of forest fires and human-wildlife conflict, leading to a better conservation. On the other hand, local people and scholars also point out that relocation sometimes leads to reclamation of grasslands and grassy blanks by the forest, reducing the space for herbivores and grassland birds, and indirectly impacting predators (Rangarajan and Shahabuddin 2006).

14 Benefits to TWS. ***Going by these precedents, we expect that the benefits accrued to the WL habitat in Gargai valley of TWS will result in substantial growth of pray and predator species due to complete removal human interference and domestic animals grazing pressure caused by 618 households, 2318 people, 1638 domestic bovines, 1136 sheep / goats, removal of 19 Km of the state highway and traffic passing through the PA, conversion and availability of 256.297 Ha private lands in to pastures for ungulates (thus improving the food chain and habitat), reduced risk of forest fires and increasing the overall area within the sanctuary (The legal status of the water body created by the dam continues to be that of WL Sanctuary)***