

環境社会配慮レポート

PART E 220 kV 送電線初期環境評価

Part E: 220kV送電線初期環境評価

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第1章 序論

1.1 目的

アッパーセティ水力発電所は開閉所位置から Bharatpur のサブステーションまでの区間に建設される 220 kV 送電線を通じて、国家グリッドシステムと接続される。本送電線計画案は現在、異なる実行可能な案を評価するためにフィージビリティレベルでの検討を行っている。

この初期環境影響評価（IEE）の目的は、詳細検討および、設計に先立ち最適な代替ルート案を選択するために、生物環境、自然環境および、社会環境に対する影響を評価することである。

1.2 送電線ルートと影響範囲

選定された 220 kV 送電線は Tanahu 郡の Kahun Shivapur、Pokhari Bhanjyang、Keshavtar、Dharamapani および、Devghat の 5 つの VDC、Citawan 郡の Kabilas VDC と Bharatpur 行政市を横切る。

上記の Tanahu 郡と Chitwan 郡の VDC および行政市において、60 m 幅の送電線用地内の生物、自然環境、社会資源は直接影響を受けるもの、用地外の資源を間接的に影響を受けるものと分類される。計画された送電線の緒元を以下に示す。

電圧	:220 kV
回線数	:2 回線
送電線延長	:38.42 km
スパン	:300 m
鉄塔数	:約 130 基
送電線用地幅	:60 m
鉄塔基礎用地	:5.2 ha（農業用地：1.76ha、森林 3.44 ha）
送電線用地として制限を受ける面積	:193.02 ha

第2章 送電線ルート代替案比較検討

2.1 送電線ルート代替案

送電線ルートは以下の判断基準を考慮して選定される。

- 送電線用地の環境影響最小化
- 電力システムの信頼性改善
- 廉価な電力供給による電力市場での競争力の増加

NEAは上記基準に基づき、アップパーセティ水力発電所からBharatpurのサブステーションまでの3種類の送電線ルート代替案を選択した（NEA, 2006年5月）。送電線ルート代替案の線形をFigure 2.1-1に示す。

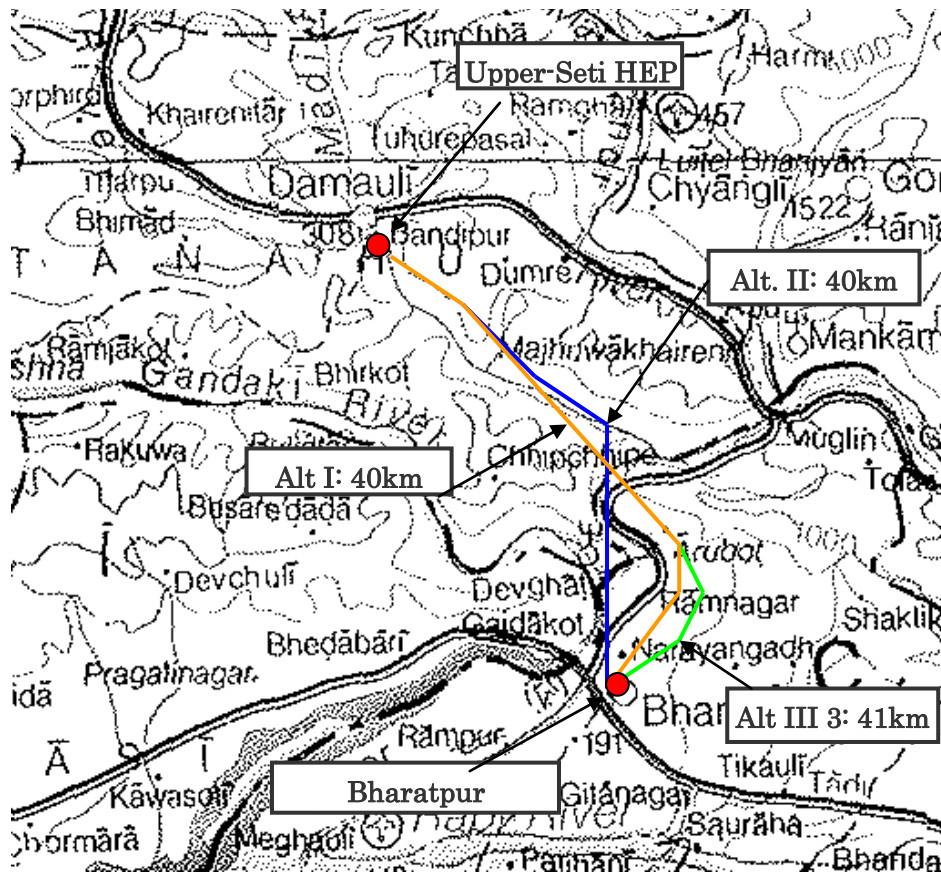


Figure 2.1-1 Alternative Route of Transmission Line

2.2 代替案比較検討

Table 2.2-1からTable 2.2-2に3種類の送電線ルート土地利用状況と共に、送電線用地において必要とされる土地収用および土地利用制限域の面積を示す。

各代替案ルート用地の土地利用状況は以下のとおり。

- 代替案ⅠとⅡは代替案Ⅲに比較して主に農地と放牧地を通る。
- 代替案Ⅰは代替案Ⅱ、Ⅲに比較して用地内の森林が最小となる。
- 代替案Ⅰ、ⅡおよびⅢにおいて影響を受ける建物の数はほぼ同じである。その数は代替案Ⅲの17に対し代替案Ⅱ、Ⅲはそれぞれ19と24となる。
- 代替案Ⅲは代替案Ⅰ、Ⅱに比較して送電線延長が長くなる。代替案ⅠとⅡの長さはほぼ同じである。

影響を最小にするという環境面から考えた場合、以下の理由により代替案Ⅰが最も望ましいと考えられる。

- 送電線用地の伐採によって失われる森林の面積が、Narayani 保護林を通過する他の2案比べて小さい。
- 代替案Ⅰは約11 kmの区間において既存送電線の用地と重なるため、必要な用地を最小にできる。また、伐採される森林面積も減らすことできる。
- 送電線用地に沿った農地は建設後も利用可能なために、地域社会経済への影響は最小限に抑えられる。

Table 2.2-1 Land Use along Transmission Line Alternative Alignment I

District	VDC	Land Use								Total Length (m)	Total Area (ha)	Structures	Streams	Settlement / village
		Forest		Agriculture		River		Others						
		Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)					
Tanahu	Kahun Shivapur	675	40,500	675	40,500	125	7,500	0	0	1,475	8.85	0	Seti	Banchare
	Pokhari Bhanjyang	50	3,000	4,500	270,000	15	900	0	0	4,565	27.39	7	Khirkhadi Khola	Simalswara, Chhaphanda, Arkhale Pani
	Keshavtar	2000	120,000	3,725	223,500	15	900	0	0	5,740	34.44	3	Dhad Khola (2)	Guwandanda, Marauto
	Dharampani	4850	291,000	1,775	106,500	125	7,500	0	0	6,750	40.5	1	Bagar Khola, Seti	Huslan, Bagarkhola, Setigaon
	Devghat	0	0	2,270	136,200	125	7,500	2,575	154,500	4,970	29.82	4	Bar Khola, seti	Bargaon, Chaughare, Duighare
Chitwan	Kabilas	9200	552,000	3,675	220,500	0	0	1,375	82,500	14,250	85.5	4	Das Khola	Duighare, Upper syalni, Tandran, Devitar
	Bharatpur	0	0	2,125	127,500	0	0	0	0	2,125	12.75	0		
Total		1,6775	1006,500	18,745	1124,700	405	24,300	3,950	197,500	39,875	239.25	19	8	16

Source: Based on the measurements in 1:25000 Topographic Maps of the Area, Transmission Line ROW = 60m

Table 2.2-2 Land Use along Transmission Line Alternative Alignment II

District	VDC	Land Use								Total Length (m)	Total Area (ha)	Structures	Streams	Settlement/village
		Forest		Agriculture		River		Others						
		Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)					
Tanahu	Kahun Shivapur	675	40,500	675	40,500	125	7,500	0	0	1,475	8.85	0	Seti	Banchare
	Pokhari Bhanjyang	50	3,000	4,500	270,000	15	900	0	0	4,565	27.39	7	Khirkhadi Khola	Simalswara, Chhapdanda, Arkhale Pani
	Keshavtar	2,000	120,000	3,725	223,500	15	900	0	0	5,740	34.44	3	Dhad Khola (2)	Guwandanda, Marauto
	Dharampani	4,850	291,000	1,775	106,500	125	7,500	0	0	6,750	40.5	1	Bagar Khola, Seti	Huslan, Bagarkhola, Setigaon
	Devghat	0	0	2,270	136,200	125	7,500	2,575	154,500	4,970	29.82	4	Bar Khola, Seti	Bargaon, Chaughare, Duighare
Chitwan	Kabilas	8,375	502,500	4,000	240,000	875	52,500	1,375	82,500	14,625	87.75	6	Das Khola, Narayani	Duighare, Upper syalni, Tandran, Devitar, Jugedi Bazaar
	Bharatpur	0	0	1,625	97,500	0	0	0	0	1,625	9.75	3		Ganeshsthan, Barmelichouk, Baseni
Total		15,950	957,000	18,570	1,114,200	1,280	76,800	3,950	237,000	39,750	238.5	24	9	20

Source: Based on the measurements in 1:25000 Topographic Maps of the Area, Transmission Line ROW = 50m

Table 2.2-3 Land Use along Transmission Line Alternative Alignment III

District	VDC	Land Use								Total Length (km)	Total Area (ha)	Structures	Streams	Settlement /village
		Forest		Agriculture		River		Others						
		Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)					
Tanahu	Kahun Shivapur	1,250	75,000	0	0	125	7,500	0	0	1.375	8.25	0	Seti	Banchare
	Pokhari Bhanjyang	4,750	285,000	0	0	15	900	0	0	4.765	28.59	0	Khirkhad i Khola	Simalswara Chhaphdanda, Arkhale Pani
	Keshavtar	4,325	259,500	1,175	70,500	20	1,200	0	0	5.52	33.12	0	Dhad Khola (2)	Guwandanda, Marauto
	Dharampani	10,800	648,000	575	34,500	90	5,400	0	0	11.465	68.79	5	Bagar Khola, Seti	Huslan, Bagarkhola, Setigaon
	Devghat	5,075	304,500	2,450	147,000	340	20,400	3,500	210,000	11.365	68.19	9	Bar Khola, Narayani	Bargaon, Chaughare, Duighare
Chitwan	Kabilas	4,875	292,500	250	15,000	10	600	0	0	5.135	30.81	0	Das Khola	Duighare, Upper syalni, Tandran, Devitar
	Bharatpur	0	0	1,500	90,000	0	0	0	0	1.5	9	3		Ganeshsthan, Barmelichouk, Baseni
		31,075	1864,500	5,950	357,000	600	36,000	3,500	210,000	41.125	246.75	17	8	19

Source: Based on the measurements in 1:25000 Topographic Maps of the Area, Transmission Line ROW = 60m

第3章 ベースラインデータ

3.1 物理環境影響

送電線の詳細な現地調査により、全長は約 40 km となることが確認された。1.7 km が河川、沢、小川および道路を通過する。森林、放牧地、耕作地を通過する延長はそれぞれ約 21.6 km、2.1 km、12.9 km である。220 kV 送電線に対し、用地幅を 60 m とした場合、計画された送電線ルートに対し必要な用地は 230.5 ha となる。河川、沢、小川、道路は土地収用の必要がないため、必要な用地は 220.3 ha と想定される。

始点から 29,210 m 離れた地点から、Bharatpur の Substation まで提案された送電線ルートの用地は、既存の 132kV 送電線と共有するため、新規に必要とされる土地収用、土地利用制限地域の面積は 197.4 ha となる。その内訳は、73.7 ha が農地、12.8 ha が放牧地、そして 110.9 ha が森林である。

3.2 生物環境影響

(1) 森林と植生

生物地理図 (NARMSAP, 2002) において、送電線ルートは *Schima-Castanopsis* 森林ゾーン、Hill Sal 森林ゾーン、Lower Tropical Sal 森林ゾーンからなる中央ネパール地域を横切る。

送電線ルート上で上記森林ゾーンの明確な区分はないが、標高 1,000 m から 2,000 m の間は通常 *Schima - castanopsis* ゾーンに位置する。1,000 m 以下の *Schima wallichii* は *Shorea robusta* と落葉性の Hill Sal 森林等が混在している。送電線ルートは Tanahu 郡の Dharampani, と Keshavatr VDC の位置でこのゾーンに沿って建設される。Hill Sal (*Shorea robusta*) は通常、標高 300 m から 1,000 m の間で存在する。蘭はこの地域の豊かな峡谷部で見られる。

一方、*Cycas pectinanta*, *Gnetum montanum*, *Cyathea spinulosa* のような絶滅危惧種が、*Shorea robusta* と共にこの地域で見ついている。*Acacia Catechu* や *Bombax cieba*, のようなネパール国 Forest Regulation, 1995 によって保護種に指定されている樹木もこの地域で見ついている。

(2) 野生生物

送電線のルートは、北の Mid Hill 地域から南の Dun 峡谷 (Siwalik や Terai を構成する) まで広がっている。この地域は Lowland 地域から Mid Hill 地域への遷移域であり、生息する動物相は多様である。生態学的に、送電線ルートの森林は Lower Tropical Sal、Hill Sal、*Schima castanopsis* が支配的であり、中央ネパールの熱帯・亜熱帯の生態種からなる。いくつかの野生生物、鳥類が IUCN、CITES、ネパール国保護規定に含まれている。これらの種で、送電線プロジェクトの実施によって、その生息状態が脅かされる可能性は低い。

3.3 社会経済・文化面での影響

(1) 影響を受ける VDCs

入手可能な 2 次情報データを基に、Tanahu 郡とChitwan郡の影響を受けるであろうVDCs に関する現況を述べる。アッパーセティ発電所とNEAの送電システムを結ぶ 220 kV送電線ルートが通る両郡の人口統計的特性を、Table 3.3-1に示す。人口密度は、1 km²平方あたり約 210 人、平均世帯規模は 5 人、男性人口に比べ女性人口の方が圧倒的に多い。

Table 3.3-1 Demographic Characteristics of the Affected Districts

District	Chitawan	Tanahu
Total Population	472,048.00	315,237.00
Male	235,084.00	146,788.00
Female	236,964.00	168,449.00
Number of Households	92,863.00	62,898.00
Average Household Size	5.08	5.01
Area in km ² .	2,218.00	1,546.00
Population Density Person/km ² .	213.0	204.00

Source: CBS, 2001

影響VDCsと市に関する人口統計的特性をTable 3.3-2に示す。平均世帯規模は、Bharatpur 市に比べ丘陵地のVDCs のほうがやや大きいことが明らかである。

Table 3.3-2 Population Distribution in the Affected VDCs and Municipality

Village Development Committee / Municipality	Total Population	Total Household	HH size	Male	%	Female	%	M:F
Kahun Shivapur (T)	8,066	1,087	7.4	4,031	50.0	4035	50.0	1 : 1
Pokhari Bhanjang (T)	4,082	832	4.9	1,902	46.6	2180	53.4	0.87 : 1
Kesavtar (T)	5,423	1,054	5.1	2,513	46.3	2910	53.7	0.86 : 1
Dharmapani (T)	3,914	709	5.5	1,780	45.5	2134	54.5	0.83 : 1
Devghat (T)	7,620	1,666	4.6	3,691	48.4	3929	51.6	0.94 : 1
Kabilas (C)	5,513	985	5.6	2,765	50.2	2748	49.8	1.008 : 1
Bharatpur NP (C)	89,323	19,922	4.5	45,858	51.3	43465	48.7	1.05 : 1
Total Affected Population	123,941	26,255	4.7	62,540	50.5	61,401	49.5	1.02 : 1

Note (T) = Tanahu; (C) = Chitawan

Source: CBS, 2001

影響 VDC と Bharatpur 市の主な民族カーストの構成は、最も多いのが Magar、続いて丘陵地方の地方部は Gurung、都市部である Bharatpur 市は他のグループより Brahmins と Chettris が多い。Kami や Damai、Sarki (KDS)など、いわゆる社会的不利な立場にある民族も数は多

くないが、各影響 VDC に分布している。彼らは、Chitwan 郡に比べ 丘陵地帯の Tanahu 郡に比較的多く住んでいる。

(2) 影響を受ける人々と資産

プロジェクトによって影響を受ける人々の詳細な情報は入手できておらず、今後詳細な調査を行う必要がある。しかしながら、潜在的に影響を受ける土地と構造物については、詳細調査の入手可能なデータベースからおよその概要が把握されている (Masina Continental Associates et.al, July 2006)。

送電線ルート沿いには合計 32 の構造物があり、うち 18 が居住家屋、14 は牛舎や収穫期に使用される小屋などである (Table 3.3-3を参照)。影響を受ける農地は 77.5 haと見積もられ、送電線鉄塔の設置に必要な土地はわずか 1.76 ha、75.73 haの農地は植林や構造物の建設などある程度は土地利用が制限されることになる。

恒常的な土地収用に必要、あるいは土地利用の制限を受ける農地区画は、補足 EIA に示すが、20 の地籍図上の合計 447 土地区画が影響を受けると特定されている。これらの土地所有者の特定や彼らの社会経済的な現況の詳細については、NEA の環境部が行う EIA で質問票を使って行われる予定である。これら地籍図で確認できる土地とは別に、農地として使われているが法的な登記手続きがなされていない土地もあり、こうした土地と所有者は詳細な現地調査で特定する必要がある。

Table 3.3-3 Houses & Other Structures and Features along 220 kV Transmission Line Right-Of-Way

Drawing Number	Approx. Distance m	Village	No of Houses	No of Sheds	Total Structures	Feature	Along RoW C/L	Within T/L RoW	Outside T/L RoW	RoW Width -m	Comments
2	230	Dharape ni	1	-	1	-	-	-	1R	60	
2	785	Banchare	1	2	3	-	-	1L	2L	60	
2	935	Banchare	1	1	2	-	-	-	2L	60	
2	1365	-	-	-	-	Seti River	-	-	-	-	40m wide
3	1425	-	-	-	-	Road to Belbas	-	-	-	60	
3	1545	-	-	3	3	-	2	1R	-	60	
3	1710	Majhkot	1	1	2	-	-	2R	-	60	
4	3800	-	-	-	-	Gagate Khola	-	-	-	60	20m wide
4	4127	-	-	-	-	Kirandi Khola	-	-	-	60	40m wide
5	4555	-	-	-	-	Chisopani Khola	-	-	-	60	5m wide
5	5126	Kukurdh unge Gudi	1	1	2	-	1	1L	-	60	
5	5445	-	1	2	3	-	1	2L	-	60	
6	6027	-	-	-	-	Khirekhadi Khola	-	-	-	60	
7	7051	-	-	1	1	Road to Kesabata	1	-	-	60	
7	7693	Guwanda nda	1	1	2	-	-	2R	-	60	
7	8195	-	-	-	-	Road to Kesbata	-	-	-	60	
8	8605-8901	-	-	-	-	Sukaura Khola	-	-	-	60	300m along valley
9	9854	No Name	1	-	1	-	-	1L	-	60	

Drawing Number	Approx. Distance m	Village	No of Houses	No of Sheds	Total Structures	Feature	Along RoW C/L	Within T/L RoW	Outside T/L RoW	RoW Width -m	Comments
9	10380					Danda Kho;a	-	-	-	60	
9	10685	No Name	1	-	1	-	-	1R	-	60	
9	10835	No Name	1	-	1	-	-	1R	-	60	Track to Sukaura
10	11781	-	-	-	-	Dhada Khola	-	-	-	60	30m wide
11	14915	-	-	-	-	Bakse Khola	-	-	-	60	15m wide
14	17935	Kesartar	1	-	1	Bagar Khola	-	1L	-	60	110m wide
15	18285	Kesartar	1	-	1	-	-	1L	-	60	
15	18578	-	-	-	-	Seti River	-	-	-	-	120m wide
15	19010-19245	Serenghat	2	-	2	Boad Khola	-	2R	-	60	235m wide
16	20045	-	-	-	-	Daduwa Khola	-	-	-	60	30m wide
18	23460-23620	-	-	-	-	Narayani River	-	-	-	-	160m wide
18	23697	-	-	-	-	XXHighway	-	-	-	60	Mugling-Bharatpur
19	23940	No Name	1	-	1	-	-	1R	-	60	
19	24360	-	-	-	-	Parallel 132kV T/L	-	-	-	60	
19	24600	-	-	-	-	Bench Mark 788	-	-	-	45	132kv T/L adjacent to East
21	27450	-	-	-	-	Das Khola	-	-	-	45	25m wide
21	27880	No Name	1	1	2	Tandrang Kholsi	2	-	-	45	80m wide junction
22	28915	-	-	-	-	Khahare Khola	-	-	-	45	52m wide
22	29210	No Name	2	1	3	-	1	2R	-	45	Crossing 132kV T/L
23	29617	-	-	-	-	Bharlang Khola	-	-	-	30	For 160m follows Bharlang valley
23	29990	-	-	-	-	Jugedi	-	-	-	30	220m wide valley

Drawing Number	Approx. Distance m	Village	No of Houses	No of Sheds	Total Structures	Feature	Along RoW C/L	Within T/L RoW	Outside T/L RoW	RoW Width -m	Comments
						Khola					
23	30415	-	-	-	-	Crossing of 132 kV T/L	-	-	-	30	
24	30948	-	-	-	-	Bhateri Kholsi	-	-	-	30	30m wide + landslide
24	31789	-	-	-	-	Sal-National Forest	-	-	-	45	Bench Mark 827 & reserve boundary
26	34786	-	-	-	-	Ramnagar Khola	-	-	-	45	40m wide
27	36200	-	-	-	-	Jal Binayak Khola	-	-	-	45	20m wide
28	37858	Chihan	-	-	-	Temple Complex	1	-	-	45	80m long
29	38151	-	-	-	-	132kV T/L exits	-	-	-	60	-
29	38415	Ganeshsthan	-	-	-	Bench Mark 900	-	-	-	60	End of T/L _ Substation adjacent
TOTAL	38.42km	8 Villages	18	14	32		8 + 1	14	5 +5		

- NOTES:**
- 1) Approximately 1702 m of river, creek and road crossing
 - 2) Approximately 21614 m of Forest crossing;
 - 3) Approximately 2138 m of grazing and scattered tree area crossing
 - 4) Approximately 12916 m of cultivated land area crossing
 - 5) ROW area required for restriction on land use in the grazing and agricultural land = 86.484 ha
 - 6) ROW area required for forest clearance = 110.94 ha
 - 7) ROW area under rivers, streams, creeks and road not required for acquisition = 10.212 ha

第4章 初期環境評価

4.1 環境影響と軽減策

送電線ルートの設置は長距離だが、ある一定の限られた地域に影響を及ぼす事業である。道路などの事業とは異なり、その影響はルート沿いのわずかな地域に限られる。また建設や事業実施に関わる活動についても、道路事業のように膨大な掘削作業や砕石、排水路の変更など、大幅に現地の土地利用を変えるようなことはない。送電線事業により土地利用に及ぼす変化は、主に自然環境や社会経済面での影響であることが予想される。これらの影響は深刻なものとそうでないものに分けることができるが、ここでは**Table 4.1-1**に深刻な影響のみを提示する。

Table 4.1-1 Environmental Impact and Mitigation Measure Matrix for Significant Adverse Environmental Impacts of the 220 kV Transmission Line Project

SN	Environmental Issue	Environmental Impact	Stage of Project	Mitigation Measures
1. Physical Environment				
1.1	Soil erosion	Land degradation and landslides	Construction phase	<ul style="list-style-type: none"> • Ground clearance should not be carried out by uprooting of trees and ground vegetation • Tower foundation excavation should be minimized to required levels and spoil should be properly placed and compacted in designated areas
1.2	Land Use*	Change in land use	Construction & operation phases	<ul style="list-style-type: none"> • Reduction in ROW width
2. Biological Environment				
2.1	Terrestrial forests and vegetation*	Loss of forests and vegetation	Construction and operation phases	<ul style="list-style-type: none"> • Reduction in ROW width • Restriction on illegal felling of trees in areas other than required for ROW and T L itself
2.2	Wildlife and wildlife habitat*	Loss of wildlife habitat and wildlife	Construction phase	<ul style="list-style-type: none"> • Reduction in ROW width • Restriction on hunting of wildlife by the construction workforce
2.3	Avian Fauna*	Loss of avian fauna	Operation phase	
3. Socio-economic and Cultural Environment				
3.1	Telephone/electric lines and built structures*	Disruption of services and losses of built structures	Construction phase	<ul style="list-style-type: none"> • Adequate clearance height of the conductors above the telephone and electrical lines • Information to local people for the service disruption during construction • Adequate compensation to the owners of built structures without deduction of depreciation costs • Resettlement and rehabilitation package to the affected structure owner
3.2	Public Health and safety*	Risks to public health and safety	Operation phase	<ul style="list-style-type: none"> • Bill boards and hoarding boards with information about the hazards • Public awareness programs on measures for public health and safety in the TL corridor
3.3	Agricultural production	Loss of Agriculture production due to disruption	Construction phase	<ul style="list-style-type: none"> • Adequate compensation of the loss of agricultural produce • Scheduling of the construction activity such that the agricultural fields are without crops during construction period.

SN	Environmental Issue	Environmental Impact	Stage of Project	Mitigation Measures
3.4	Loss of Land and Property*	Livelihood and future opportunity	Construction & Operation phase	<ul style="list-style-type: none"> • Reduction in ROW width • Adequate compensation to the affected land and property owners with permanent occupation of areas affected • Adequate compensation for the affected land under ROW for restriction considering the future opportunity of the agricultural land • Resettlement and rehabilitation package to the affected population
3.5	Tourism and Aesthetics	Loss of tourism and aesthetic value	Construction and operation phases	<ul style="list-style-type: none"> • Restriction on haphazard storage, camp managements, and disposal of spoils • Design the tower structures that complements to the natural background
3.6	Occupational Health	Risks to the health of construction and operation workforce	Construction and operation phases	<ul style="list-style-type: none"> • Provision of appropriate protective equipment and gear to the construction and operational workforce • Trainings on the possible occupation hazards to the construction and operation workers

Note: * Irreversible impacts

4.2 環境モニタリングプログラム

NEA は、ネパールの他の組織と異なり、環境調査や環境モニタリングを行う部署、環境部がある。しかし事業に必要な環境モニタリングを効果的に行えるだけの熟練の職員数が不足しており、モニタリング実施に必要な能力向上の観点から環境部の強化が必要である。とりわけ送電線ルート設置の建設時の自然環境および社会的側面のモニタリングはきわめて重要である。

4.3 初期環境影響評価の結果と結論

本 IEE では、提案されている 220 kV 送電線ルートによる主要な環境面での影響を特定してきた。自然環境では、一部侵食など地盤の弱い問題以外は大きな影響はないと考えられる。しかし保護林を伐採しなければならない懸念がある点については、EIA の中で一層その影響を明らかにしていく必要がある。また送電線鉄塔設置のための掘削や土捨場の管理については注視が必要である。不可逆な影響を及ぼすと思われるのは森林地帯の生物環境である一方、21.6 km 沿いに広がる森林地域の野生生物の生態にはほとんど影響がないと思われる。1.76 ha ほどの農地は送電線鉄塔設置のために収用せざるをえないと予測され、またルート沿いでは一部の土地利用が制限される可能性が高い。合計 18 の居住家屋と 14 の付帯施設が土地収用のため影響を

受けると考えられる。

森林や農地、資産の損失による影響の度合いは、まだ十分に評価していない。さらに地域ごとに必要な軽減策や自然や社会基盤の損失を回復するための方策を計画することが不可欠である。事業の中で特別な軽減策を含めたプログラムとモニタリングプログラムを作成していく必要があり、また環境管理計画も含めるべきである。

本 IEE は、提案されている 220 kV 送電ルートが他の送電線ルートよりも適している点を説明できしており、今後詳細設計調査にむけて必要な手続きを進められることが望まれる。また調査の中では予測できる負の環境影響を挙げており、これらの点については詳細な EIA で十分分析されることが期待される。最後に、選択した送電線ルートは、ネパール政府の Environmental Protection Rule (1997) と JICA ガイドライン (2004) の規定に照らし合わせて適切と判断できる。

環境社会配慮レポート

PART F 環境管理計画の枠組み

Part F: 環境管理計画の枠組み

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第1章 環境管理計画の枠組み

1.1 背景

環境管理に必要な事項を特定し、補足環境影響調査で提案している環境影響軽減策やモニタリングが、プロジェクト実施時期中に確実に行われるよう、必要な枠組みを確保するため、本プロジェクトの環境管理計画を作成する。本環境管理計画は、過去の類似水力発電プロジェクトの経験や既存EIAの結果をはじめ、社会アクション計画や住民移転計画、そのほかの環境管理計画、水力発電プロジェクトに対するネパール政府の法令や規則、ガイドラインをレビューし、それらをもとに作成された。

1.2 環境管理計画の概要

影響緩和策・改善策と実施スケジュール、必要なインプット、各組織の任務等を含む環境管理計画の概要をTable 1.2-1に示す。ここに示される費用はあくまで概算であり、詳細設計作成段階で精査する必要がある。

Table 1.2-1 Summary of Environmental Impacts and their Corresponding Mitigation/Enhancement Measures and EMP

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
1. Pre-Construction/ Construction Period						
<i>A. Physical Environment</i>						
(1) Land Use and Topography						
<ul style="list-style-type: none"> ▪ Inundation of the land for reservoir 	Loss of current land use opportunity for villagers, and loss of habitat for wildlife and vegetation	S, P (negative)	<ul style="list-style-type: none"> ▪ Unavoidable impact, but selection of lower reservoir Full Supply Level could minimize existing land use changes drastically. 	n/a	NEA	n/a
<ul style="list-style-type: none"> ▪ Construction activities of various types in the dam site and project facility sites involving excavations, drilling, blasting and material removals 	Land instabilities	NS, T (negative)	<ul style="list-style-type: none"> ▪ Locating the access road route under the Vyas-Shivapur footbridge rather than through the village, with associated benefits of traffic separation; ▪ Shifting the spoil bank to the river side to reduce the affected area; ▪ Locating the permanent NEA camp at the southern end of the flat area and close to the power station; ▪ Shifting the main access road to uphill from the present road so that project-related traffic is separated from schools and shops along the existing road in Beni Patan. 	Bio-engineering of the cut batter slopes of the access roads (lump sum): 2.0 million NRs	Contractor, NEA	Part of contractor's contract
<ul style="list-style-type: none"> ▪ Spoil bank to be constructed along with the right bank of the Seti River 	Soil erosion	NS, P (negative)	<ul style="list-style-type: none"> ▪ Construction of a dry stone gabion structure at the toe of the spoil bank; ▪ Construction of a water collection system for the spoil bank to avoid free flow of the run off from the mountain slope over the spoil material; ▪ Proper grading of the spoil surface with adequate drainage provisions after the closure of spoil disposal at the site; ▪ Afforestation and bioengineering of the spoil area after proper grading and drainage management. 	<ul style="list-style-type: none"> ▪ Dry gabion wall approximately 1,300 m (1.5m high and 1m wide): 5.0 million NRs ▪ Run off catch drainage of mountain slope (approx. 900m): 3.2 million NRs 	Contractor, NEA	Part of contractor's contract

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
(2) Air Quality						
<ul style="list-style-type: none"> Dust generated from excavation, filling, stockpiling and construction vehicle movements associated with the construction of the various surface and sub-surface structures and transportation of the spoil materials to the spoil bank. 	<p>Increase in particulates and gaseous emissions</p>	MS, T (negative)	<ul style="list-style-type: none"> On-site vehicle speed restrictions and vehicle washing before leaving the site; Frequent watering of the road in the dry season ensuring that the road surface does not generate dust. Frequent watering of the dusty barren areas or spoil disposal areas. 	<ul style="list-style-type: none"> Water sprinkling: 4.9 million NRs (2 tankers /day/245 days a year/5 year) Dust masks to workers: 0.7 million NRs (twice a year (lump sum)/5 year) 	Contractor, NEA	Part of contractor's contract
(3) Noise/Vibration Level						
<ul style="list-style-type: none"> Noise generated from cut-and-cover activities, excavation, back filling and construction of above ground structures and transportation of the construction vehicle. Vibration generated from and drill & blast activities in the dam, tunnel and powerhouse. 	<p>Increase in noise and vibration levels</p> <p>It is not expected to effect communities living away from source. However, impacts to wildlife are expected.</p>	MS, T (negative)	<ul style="list-style-type: none"> Care in the placement and orientation of noisy plants away from sensitive receivers; Use and correct fitting of silencers, mufflers and acoustic shields; Regular maintenance of plant and equipment; Awareness programs and information sharing with the communities on the noise related issues 	Part of construction cost	Contractor, NEA	Part of contractor's contract
(4) Water Quality						
<ul style="list-style-type: none"> Poor sanitation facilities to construction workforce at the construction camps and construction areas may promote the use of the adjacent river bed areas for open defecation dislodging of solid waste and other sanitation uses. 	<p>Changes in river water quality</p> <p>Such uses of the river area, especially in the dry season, may substantially degrade the water quality in the Seti River due to discharges of organic load.</p>	MS, T (negative)	<ul style="list-style-type: none"> Establishment of good water supply and sanitation facilities in the construction work camps, at actual construction sites; Establishment of effective solid waste collection facilities in the construction work camps; Public awareness program to the construction workforce and the construction on good health and sanitation practices 	<ul style="list-style-type: none"> Sanitation (toilet provisions) at all work and campsites 4.5 million NRs (lump sum, about 100 toilets) Camp solid waste collection management system and disposal facilities: 2.8 million NRs 	Contractor, NEA	Part of contractor's contract

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
<ul style="list-style-type: none"> Excavation works are expected to increase the turbidity and total suspended solids in the flowing water. Besides, accidental oil spills of the operating equipment will be released to the flowing water. And also, discharge of concrete plants, aggregate washing plants etc. provide huge amount of fine sediment to the receiving water bodies. 	Changes in river water quality	MS, T (negative)	<ul style="list-style-type: none"> Discharge of batching plant, aggregate washing plant, and tunnel seepage waters only after appropriate treatment (sedimentation facility) to the natural water bodies; Public awareness program to the construction workforce and the construction on good health and sanitation practices; Disposal of construction related spoils only into defined and well protected spoil disposal sites approved by concerned authorities. 	<ul style="list-style-type: none"> Sedimentation tank for batching discharges, tunnel discharges and aggregate crushing discharges and spoil disposal area: 10 million NRs 	<ul style="list-style-type: none"> Contractor, NEA 	<ul style="list-style-type: none"> Part of contractor's contract
B. Biological Environment						
(1) Terrestrial						
<ul style="list-style-type: none"> Forest and vegetation clearing, excavation and grading and other construction activities 	Loss, disturbance and damage to existing vegetation; Habitat degradation of dependent species	MS, P (negative)	<p><u>Forest and vegetation</u></p> <ul style="list-style-type: none"> For every tree cut, the compensatory plantation at 1:25 trees must be made Secure necessary permit for tree cutting Implement tree balling where practicable Immediate revegetation To provide alternatives of kerosene rather than fuel wood <p><u>Wildlife</u></p> <ul style="list-style-type: none"> Selecting the appropriate layout to minimize the cutting trees (especially from the dam site to the lower reservoir area) To restrict hunting and trapping To save endangered animals by a rescue operation using boats during the filling of the reservoir and relocating them to compatible ecosystem in nearby forests. 	<ul style="list-style-type: none"> Part of construction cost 	<ul style="list-style-type: none"> Contractor, NEA 	<ul style="list-style-type: none"> Part of contractor's contract

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
C. Socio-economic Environment						
<ul style="list-style-type: none"> Inundation by reservoir development 	Inundation of existing infrastructure facilities of the communities such as motorable roads, suspension bridges, foot trails, irrigation canals, and electricity distribution.	MS, T (negative)	<ul style="list-style-type: none"> Implementation of restoration of project impacted infrastructure program under social program of the project Implementation of rural electrification program under social program of the project 	<ul style="list-style-type: none"> Restoration of project impacted infrastructure program: 85.5 million NRs Rural electrification program: 19.6 million NRs 	Contractor, RSISU-PM O-NEA, local government	Social program of the project
	Inundation of existing community built structure (cremation, resting places etc.).	MS, T (negative)	<ul style="list-style-type: none"> Provision of compensation for affected community structures under the framework of Resettlement Plan Implementation of affected community's initiative support program under social program of the project 	<ul style="list-style-type: none"> Compensation for community structures : 0.39 million NRs Affected community's initiative support program: 52.1 million NRs 	Contractor, RSISU-PM O-NEA, local government	Social program of the project
	Inundation of land, loss of yield, involuntary resettlement, and impact on the livelihood of Affected Persons (APs)	MS, P (negative)	<ul style="list-style-type: none"> Land acquisition, and provision of compensation including the affected private land, the affected structures, loss of agricultural production equivalent to one year production, and other rehabilitation compensation fees for relocatee Implementation of separate package programs for restoration of livelihood and enhancement of quality of life. They include agricultural development program, skill enhancement and employment program, affected community's initiative support program, women development program, and community-based watershed management program. 	<ul style="list-style-type: none"> Compensation and relocation costs: 1,080 million NRs Agricultural development program: 27.51 million NRs Skill enhancement and employment program: 10.14 million NRs Women development program: 13.03 million NRs Watershed management program: 12.31 million NRs 	Contractor, RSISU-PM O-NEA, local government	<ul style="list-style-type: none"> Resettlement action plan Social program of the project
	Risk of shoreline erosion and land failure, where the people often utilize the edge of land for cultivation and other purposes	MS, P (negative)	<ul style="list-style-type: none"> Acquire land as risk zones by delineating a 10 m vertical height from the FSL with measures such as planting work Implementation of community-based watershed management program and community's initiative support program 	<ul style="list-style-type: none"> Included in the land acquisition cost and in the mitigation cost for forest and vegetation Included in community-based watershed management program, and community's initiative support program 	RSISU-PM O-NEA	Social program of the project

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
<ul style="list-style-type: none"> Influx of large number of workers 	Shortages of drinking water	NS, T (negative)	<ul style="list-style-type: none"> Provide water supply for construction workers by contractors Implementation of community/public health and education enhancement program under social program of the project including the support for water supply taps 	<ul style="list-style-type: none"> Part of construction cost Community/public health and education enhancement program: 15.9 million NRs 	<ul style="list-style-type: none"> Contractor, NEA Contractor, RSISU-PM O-NEA, local government 	<ul style="list-style-type: none"> Part of contractor's contract Social program of the project
	Deterioration of the existing sanitation conditions and break of the epidemics such as typhoid, cholera, and diarrhea and other communicable diseases like STD and HIV	MS, T (negative)	<ul style="list-style-type: none"> Implementation of community/public health and education enhancement program under social program of the project 	<ul style="list-style-type: none"> Included in community/public health and education enhancement program cost 	<ul style="list-style-type: none"> Contractor, RSISU-PM O-NEA, local government 	<ul style="list-style-type: none"> Social program of the project
<ul style="list-style-type: none"> Land clearing within project facility site; site grading, excavation, hauling/stockpiling of excavated and construction materials including land acquisition for project site 	Total or partial loss of land/farm area, properties and crops, involuntary resettlement, impacts on the livelihood of APs including loss of income due to land acquisition	S, P (negative)	<ul style="list-style-type: none"> Negotiate with PAFs/PAPs for an acceptable compromise on valuation and compensation Finalize the RAP incorporating therein the agreements reached during public consultations Land acquisition and provision of compensation as stated previously Implementation of several social programs for restoration of livelihood and enhancement of quality of life as stated previously 	<ul style="list-style-type: none"> Included in compensation and relocation costs Included in social action program costs 	<ul style="list-style-type: none"> RSISU-PM O-NEA 	<ul style="list-style-type: none"> Resettlement action plan Social program of the project

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
<ul style="list-style-type: none"> Construction activities for the project 	Work related injuries and accidents	MS, T (negative)	<ul style="list-style-type: none"> Project contractors will be responsible for the occupational health of workers. 	n/a	Contractor	<ul style="list-style-type: none"> Part of contractor's contract
	Girl trafficking, and sexual and labor exploitation, child labor	S, T (negative)	<ul style="list-style-type: none"> Implementation of women development program under social program of the project, including education on HIV/AIDS, STD, family planning, and girl trafficking. 	<ul style="list-style-type: none"> Women development program: 13.0 million NRs 	Contractor, RSISU-PM O-NEA, local government	<ul style="list-style-type: none"> Social program of the project
	Increase in employment opportunities	MS, T (positive)	<ul style="list-style-type: none"> Require contractors to source workforce from qualified locals Contractors to orient workers on desirable working relationship especially if there are non-resident workers Implementation of skill enhancement and employment program under social program of the project 	<ul style="list-style-type: none"> n/a Skill enhancement and employment program: 10.1 million NRs 	<ul style="list-style-type: none"> Contractor, RSISU-PM O-NEA Contractor, NEA, local government 	<ul style="list-style-type: none"> Part of contractor's contract Social program of the project
	Increase in livelihood and business opportunities	MS, T (positive)	<ul style="list-style-type: none"> Priority to be given to local subcontractors Priority to be given to local suppliers of construction materials and equipment Supply of food and catering to be preferentially awarded to local suppliers Implementation of skill enhancement and employment program, agricultural development program, and women development program including income generation and micro credit funds 	<ul style="list-style-type: none"> n/a Included in social action program costs 	Contractor, RSISU-PM O-NEA	<ul style="list-style-type: none"> Part of contractor's contract Social program of the project
	Potential health, sanitation and safety problems including accidental risks for local community people	NS, T (negative)	<ul style="list-style-type: none"> Contractor to provide construction camp as temporary housing facilities for workers equipped with adequate water and sanitation facilities Contractors to implement proper solid waste management in the work site, workers will be oriented to observe proper hygiene and sanitation practices and provided with appropriate protection gears while working Construction areas to be enclosed as necessary and provided with appropriate signage to avoid accidents 	Part of construction cost	Contractor, RSISU-PM O-NEA	<ul style="list-style-type: none"> Part of contractor's contract

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
2. Operations and Maintenance Period						
A. Physical Environment						
(1) Land Use and Topography						
<ul style="list-style-type: none"> Failure at the terrace breaks associated with the toe cutting by the stream, caving and overhanging 	Soil slides associated with the terrace materials in the upper reservoir area	S, P (negative)	<ul style="list-style-type: none"> Completion of protection embankment works with concrete blocks cover in the vicinity of Bhimad Bazaar Land acquisition program and stabilization of erosion prone in the risk zone area from Full Supply Level to 10m high above Selective planting of ground cover and trees at the base of areas susceptible to erosion in tributary stream leading into the Seti River Land acquisition program and stabilization of erosion prone areas with suitable tree species in the vicinity of the Wantang Khola, the Pedhi Khola and Tittuwa 	Part of construction cost	Contractor, NEA	Part of contractor's contract
<ul style="list-style-type: none"> Full supply level at 415m and flushing operation 	Backwater effects of the reservoir	NS, T (negative)	<ul style="list-style-type: none"> The annual flushing of the reservoir at FSL 415 m will effectively control any sedimentation. In the case that nominated Full Supply Level is 415 m, the sedimentation will not happen around the Bhimad Bazaar. The backwater effect after the sedimentation is minor. 	n/a	NEA	n/a
<ul style="list-style-type: none"> Diverted water flowing out from tailrace outlet and immediate increase of downstream water level by dam operation 	Impact to agricultural land in the downstream of the dam	NS, P (negative)	<ul style="list-style-type: none"> The agricultural land on the left bank appears to be high enough that it would not be affected. The agricultural land on the right bank will be acquired for the construction. The permanent river protection work will not be required in this section. Monitoring of sedimentation patterns should be undertaken in this zone for at least 10 km below the outlet. 	Land acquisition cost for agricultural land on the right bank	NEA	n/a
(2) Water Quality						
<ul style="list-style-type: none"> Environmental flow 	Changes in river water quality and flow volume	S, P (negative)	<ul style="list-style-type: none"> The mitigating effects of joining the Madi River downstream which has a flow regime equivalent to 75% of the Seti River flows. Impacts on the river's aquatic ecology and fish resources are unavoidable in the section of the Seti River immediately downstream of the dam and must be mitigated to the fullest extent possible. 	n/a	NEA	n/a
<ul style="list-style-type: none"> Eutrophication of the reservoir 	Changes in river water quality	S, P (negative)	<ul style="list-style-type: none"> Installation of Fraction Fence system in the reservoir Development of sewerage system in the upstream urban area to prevent waste water with nutrient salt flowing into the river 	<ul style="list-style-type: none"> n/a To be estimated, but not be covered by the project 	<ul style="list-style-type: none"> NEA Local government 	<ul style="list-style-type: none"> Part of contractor's contract n/a

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
<ul style="list-style-type: none"> Sediment flush operation 	Changes in river water quality	S, P (negative)	<ul style="list-style-type: none"> Optimum operation to minimize environmental impact based on experiences of operation in Japan 	n/a	NEA	n/a
B. Biological Environment						
(1) Freshwater						
<ul style="list-style-type: none"> Change of flow regime due to dam 	Local aquatic habitat alteration and permanent/temporary displacement of species	MS, P (negative)	<ul style="list-style-type: none"> Fish hatchery backed with open water stocking of suitable fish species, as is being done at NEA's Kali Gandaki A HEP. 	<ul style="list-style-type: none"> Financial and Technical Assistance to Kali Gandaki A hatchery for added production & facility development and research for Upstream & Downstream Stocking in Seti River system: 73.6 million NRs NEA Extension program for fisheries and mitigation to local fishermen: 1.0 million NRs 	NEA	n/a
C. Socio-economic Environment						
Downstream safety						
<ul style="list-style-type: none"> Immediate increase of water level in power generation and just after the sediment flushing operation 	Danger in downstream communities and river users	S, P (negative)	<ul style="list-style-type: none"> Installation of siren system Public awareness on safety for downstream communities 	<ul style="list-style-type: none"> Siren network along the Seti in the downstream of dam (lump sum): 3.5 million NRs Awareness training on the safety measures to downstream areas (lump sum): 0.3 million NRs 	Contractor, NEA	Part of contractor's contract for installation
White water rafting in the downstream of the dam						
<ul style="list-style-type: none"> Decrease of flow volume in non-power generation period, and immediate increase of water level in power generation and just after the sediment flushing operation 	Danger of the rafting activity in the river and camp site at the riverside for the rafting participants	S or MS, P (negative)	<ul style="list-style-type: none"> Scheduled rafting activity to avoid immediate increase of water level Public awareness on safety for both rafting operators and participants Select safe location of the camp site for the rafting participants 	n/a	NEA	n/a

Note: S - Significant impact, MS - Moderately significant impact, NS - Not significant impact
 T - Temporary impact, P - Permanent impact
 (negative) - negative impact, (positive) - positive impact

RSISU - Resettlement Plan and Social Action Plan Implementation Sub-unit under Environmental and Social Monitoring Unit of PMO, NEA

1.3 環境管理計画における関係者・関係機関

プロジェクトの環境管理計画では、既存の法令や規則に従い、プロジェクトの様々な関係者が建設・運用期間にそれぞれどのようにプロジェクトの環境管理に関わる必要があるかを提示する。プロジェクトの総合的な環境管理の責任の所在は、プロジェクト、つまり NEA のプロジェクト環境管理事務所にあるが、プロジェクトの環境・社会管理には多くの関係者・関係機関が関与することが予想される。下の表に、主な関係機関とそれぞれの主な責任と役割を示す。

Table 1.3-1 Environmental Management Roles and Responsibilities

Organizations	Roles and Responsibilities	Timings
MOEST	<ul style="list-style-type: none"> ▪ Ensure that the environmental measures and cost are included in the project documents and tender clauses ▪ Monitoring of the overall project ▪ Auditing of project performance 	<ul style="list-style-type: none"> ▪ Prior to Final Project approval ▪ At least once a year during construction ▪ After two years of project completion - operation phase
MOWR/ DOED	<ul style="list-style-type: none"> ▪ Ensure that the environmental measures and cost are included in the project documents and tender clauses ▪ Monitoring of the overall project 	<ul style="list-style-type: none"> ▪ Prior to Final Project approval ▪ At least twice a year during construction and once during operation
NEA Board/NEA/NEA-ESSD/USSH EP - PMO	<ul style="list-style-type: none"> ▪ Ensure that the EIA and EMP measures are incorporated in the final project design and costs. ▪ Acquire necessary permits and approval for project construction and operation. ▪ Ensure that the project construction activities are in accordance with legislative requirements. ▪ Implementation of repair and maintenance of project components including environmental safeguards as recommended by EMP, MOWR, DOED and MOEST ▪ Monitoring and record keeping regarding environmental measures and impacts as per EMP ▪ Ensure public participation and involvement in all phases of project implementation 	<ul style="list-style-type: none"> ▪ Prior to contract award ▪ Before construction ▪ During construction continuously ▪ During operation continuously ▪ During operation continuously ▪ Project period continuously
Panel of Experts (POE)	<ul style="list-style-type: none"> ▪ Review and recommend the final design of the project and ensure that the EMP measures are included in the design and Tender ▪ Review monitoring and auditing reports of the supervising consultants and Project- Environmental Monitoring Sub-unit (ESMU) and recommend corrective measures to meet the objectives of EMP 	<ul style="list-style-type: none"> ▪ Prior to contract tendering in Detail Design Phase ▪ During construction phase every six month
Detail Design Consultants	<ul style="list-style-type: none"> ▪ Incorporate environmental mitigation measures as per POE recommendation in the design, project cost and tender documents ▪ Include EIA recommendations in the design, project cost and tender documents 	During Detail Design Phase

Organizations	Roles and Responsibilities	Timings
EIA Consultant	<ul style="list-style-type: none"> ▪ Verify and improve upon the earlier EIA reports and EMP and recommend environmental measures to Detail Design Consultants ▪ Verify and prepare detailed programs for Affected Persons/Affected Families and communities and recommend final RP costs to Detail Design engineers ▪ Verify and complete RP and recommend final RP measures and costs to Detail Design Consultants 	During Detail Design Phase
Supervising Engineers	<ul style="list-style-type: none"> ▪ Approval to civil construction as per design ▪ Monitoring of civil construction as per detail design ▪ Ensure that the EMP provisions are implemented and recorded ▪ Ensure that the Project corrective actions are duly implemented. 	Continuously in Construction phase
USSHEP -ESMU	<p>RSISU:</p> <ul style="list-style-type: none"> ▪ Implementation, and supervision of land acquisition, compensation and resettlement as per RP and record keeping of these ▪ Implementation, and supervision of SAP as per SAPF ▪ Liaison with other Nepalese authorities for EMP/RP/SAPF items ▪ Information Dissemination through Public Information Center and other media and collection of feed back through regular consultation with the various stakeholders ▪ Distribution of the Project's bimonthly monitoring reports of EMSU to different central and local level stakeholders ▪ Project grievance and complaint handling <p>EMSU:</p> <ul style="list-style-type: none"> ▪ Monitoring of natural environmental, RP and SAP mitigation measures as per EMP/RP/SAPF by EMSU and recommend concerned engineers and sections for corrective actions and bi-monthly report preparation ▪ Environmental impact and compliance monitoring of construction works as per EMP by EMSU and recommend corrective actions to supervising engineers and bi-monthly report preparation. 	Pre-construction and construction phase, continuously
Construction Contractor	<ul style="list-style-type: none"> ▪ Implement civil construction as approved by supervising engineers ▪ Implement mitigation measures as specified in EMP and recommended by Supervising engineers ▪ Front line Monitoring and record keeping of environmental mitigation measures as per EMP through a special monitoring unit ▪ Maintain good public relationship with the project area people 	Construction phase continuously
NGOs, CBOs, VDCs, Municipality and DDCs and other stakeholders	<ul style="list-style-type: none"> ▪ Monitor that the environmental and social mitigation measures are implemented in all stages of the project as per EMP, RAP, SPAF ▪ Ensure that the public participation and involvement in the project implementation is maximized by the project owner, consultants and contractors. 	Project period

プロジェクトの異なる期間における環境管理計画の体制を**Figure 1.3-1**に示す。

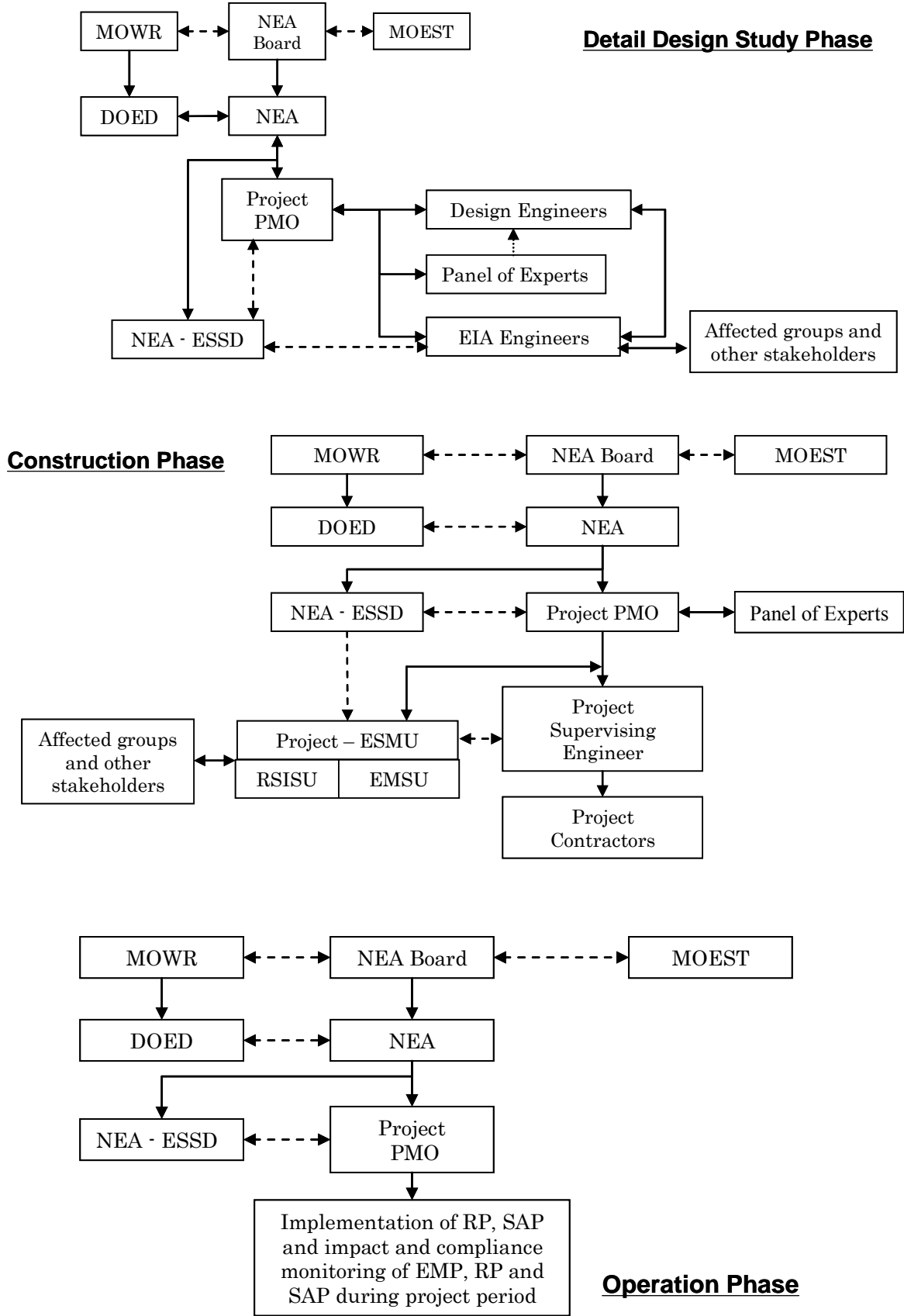


Figure 1.3-1 Environmental Management Plan Structure

1.4 プロジェクト環境管理事務所

ネパールの” Environmental Protection Rules”に、プロジェクトの環境管理は事業者の責任の下で行うことが規定されている。本プロジェクトでは、NEA と NEA のプロジェクト環境管理事務所が環境管理の責任を負うことになる。NEA には、プロジェクトの環境全般に関する計画や実施、運営を管轄する環境部がある。しかしプロジェクトの環境管理をすべて実施するには、環境部の人的資源が限られていることから非常に難しい。

補足EIA調査で提言した環境影響軽減策や改善策を着実に実施、モニタリング、評価し、さらにプロジェクトの改善に役立つフィードバックや意見を聴取するために、関係者を対象に情報普及を行うことが重要である。これらの業務を行うには、プロジェクトの管理事務所内に環境社会モニタリング・ユニットを設置するべきである。他の類似案件、実施中の水力案件でも同様に、こうした別組織を設置している。この環境社会モニタリング・ユニットの中に、2つのサブユニット—住民移転・社会アクション実施・サブユニットと環境モニタリング・サブユニットを設置すべきである。前者は、過去の類似案件の経験を持つNEAの職員が配置されることを想定しており、住民移転計画と社会アクション計画の実施を担うユニットである。後者は、過去の水力発電プロジェクトで環境モニタリングの業務経験をもつコンサルタントが配置されるべきで、少なくとも土木工事が開始される8ヵ月前にはユニットを設置すべきである。環境モニタリング・サブユニットはプロジェクトマネージャーの下で直接業務を担うが、プロジェクトの監督エンジニアとも緊密に連携調整していく責任を負う。住民移転・社会アクション実施サブユニットは、NEAの環境部や地元のVDC、郡開発委員会、NGOやCBO、影響を受ける関係機関や関係者、電力開発局、水資源省、環境科学技術省などと調整していくことが望まれる (Figure 1.4-1)。

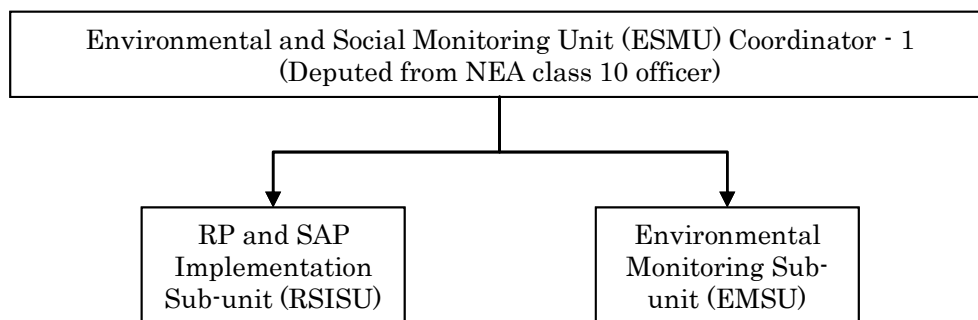


Figure 1.4-1 Organization Framework of ESMU

1.5 環境社会モニタリング・ユニットの業務管理費

環境社会モニタリング・ユニットの事務所は、土木工事が行われるエンジニアのキャンプ内に設置されるべきである。このユニットの業務管理費は、住民移転・社会アクション実施・サブユニットの職員のほとんどが、NEAから配置されることを想定して積算した。つまり追加のプロジェクトコストはこのサブユニットには必要ないが、環境モニタリング・サブユニットのコンサルタントの費用が必要となる。Table 1.5-1、1.5-2、1.5-3の表に業務管理費の明細を記し、Table 1.5-4にすべての費用をまとめて示す。

Table 1.5-1 Manpower Remuneration

SN	Position	Numbers	Period (yr)	Project Allowance/month (NRs.)	Total NRs. Million
1.	ESMU - Section chief (Environmental Management – Team Leader consultant)	1	5.66	90,000	6.11
2.	Environmental Engineer (ESMU)	2	5.66	60,000	4.08
3.	Sociologist (ESMU)	2	5.66	60,000	4.08
4.	Part time consultant (socio-economist/ Terrestrial ecologist/ Aquatic ecologist)		3.33	60,000	2.40
5.	Office runner (ESMU)	2	5.66	10,000	0.68
Total					17.34

Table 1.5-2 Support Facilities

SN	Particulars	Unit	Cost	Total NRs. (Million)
1.	Computers and printers	10 sets	150,000.00/unit	1.50
2.	4 wheel drive vehicles	5 nos	3,000,000.00/no	15.00
3.	Furniture		Lump sum	0.00
4.	Other equipment (camera, tape recorders, power point projector, pH meter, turbidity meter, flow meter, photocopier etc.)		Lump sum	0.00
5.	Office consumables	5.66 years	40,000/month	2.72
6.	Telephone and electricity	5.66 years	15,000/month	1.02
7.	Vehicle operation including Driver, Fuel and O &M (4 vehicles)	5.66 years	45,000/month/vehicle	12.23
Total				32.47

Table 1.5-3 Information Dissemination and Feedback

SN	Particulars	Years	NRs./yr	Cost NRs. (Million)
1.	Information through internet and web page	5.66	75,000	0.42
2.	Information dissemination through FM	5.66	100,000	0.57
3.	Regular stakeholder meetings in the project area	5.66	125,000	0.71
Total				1.70

Table 1.5-4 Summary of Administrative and Management Costs for ESMU

SN	Particulars	NRs. Million
1.	Consultant Remuneration	17.34
2.	Support facilities	32.47
3.	Information Dissemination and Feedback	1.70
Grand Total		51.51

1.6 環境モニタリングプログラム

環境モニタリングを以下の要領で実施する。

- 提案された影響緩和策や改善策を環境管理計画に具体化する
- 既存の環境基準に従ったパラメーターを用いて定期的なモニタリングを実施する
- 環境管理計画の有効性を判定し他の緩和策に対する提案を行う

放置すれば、重大な結果をもたらすと考えられる影響に対する緩和策・改善策に基づいて、モニタリング計画を策定する。主要なパラメーターを含んだ環境モニタリング計画を、**Table 1.6-1**に示す。この計画は、建設工事前と建設中、さらに運転期間も対象としている。EIA調査で収集されたベースライン情報は、計画の実施状況を判定する指標となる。

Table 1.6-1 Environmental Monitoring Plan

Project Phase	Method and Scope	Parameter	Location	Frequency	Responsibility	Cost (NR)
1. Pre-Construction/ Construction Period						
A. Physical Environment						
<ul style="list-style-type: none"> ▪ Land acquisition ▪ Vegetation clearing/tree cutting ▪ Excavation works ▪ Foundation works 	<ul style="list-style-type: none"> ▪ Measurement of ambient air quality 	<ul style="list-style-type: none"> ▪ Dust (TSP/PM10) 	<ul style="list-style-type: none"> ▪ Jhaputar and Damauli (close to the District Public Health Office) 	Three times a year in dry season (Nov., Feb., and May). Baseline data shall be taken before construction in dry season (April/May)	Contractor	NRs 5.3 million (lump sum including air, water, noise, spoil management, land erosion, etc.)
	<ul style="list-style-type: none"> ▪ Compliance of mitigation measures for air pollution 	<ol style="list-style-type: none"> a) Gravelling of road and its maintenance b) Control on vehicle speed c) Watering of roads d) Careful handling the contaminant or dumping of dusty materials e) Covering of exposed areas and site restoration f) Provision of dust mask to drivers and workers 	<ol style="list-style-type: none"> a) Along the construction road b) Along the construction road c) Along the construction road d) Temporary waste stock facility and disposal site e) Excavated area f) Construction sites 	<ol style="list-style-type: none"> a) Once a three months b) Once a day c) Once a day d) Once a week e) Once a week f) Once a week 	Contractor	Part of contractor's contract
	<ul style="list-style-type: none"> ▪ Water sampling and analysis 	<ul style="list-style-type: none"> ▪ Flow velocity, discharge, water temperature, pH, conductivity, total suspended solids (TSS), total phosphorous (T-P), Total Kjeldahl Nitrogen (TKN), ammonia (NH₃), nitrate, nitrite, dissolved oxygen (DO), and BOD₅ 	<ol style="list-style-type: none"> 1) upstream of the reservoir, 2) reservoir area (close to dam site), 3) confluence with the Madi River, 4) immediate downstream of the tailrace outlet 	4 times a year in 4 seasons (November, March, June, and September)	Contractor/EMSU-PM O-NEA	Included in the lump sum cost mentioned in air quality (dust) measurement.

Project Phase	Method and Scope	Parameter	Location	Frequency	Responsibility	Cost (NR)
	<ul style="list-style-type: none"> ▪ Compliance of mitigation measures for water pollution 	<ul style="list-style-type: none"> a) Adequacy and operation of water supply and sanitation facilities at engineers camps, construction camps and construction sites b) Collection of solid waste and safe disposal practices at engineers camps, construction camps and construction sites c) Awareness program on health and sanitation d) Prohibition on open defecation and solid waste disposal e) Storage facilities for fuel, lubricants, spent oils, and toxic chemicals f) Treatment facilities for waste water of batching plant, aggregate washing and tunnel seepages and its effective operation g) Water quality test for discharge of treated wastewater from batching plant aggregate washing plant, and tunnel discharges h) Disposal of construction spoils only in designated areas 	<ul style="list-style-type: none"> a) Engineers camps, construction camps and construction sites b) Engineers camps, construction camps and construction sites c) All over the construction site d) All over the construction site e) Storage facilities f) Treatment facilities g) Batching plant aggregate washing plant, and tunnel discharges h) All over the construction site 	<ul style="list-style-type: none"> a) Before project and every 3 month b) Once a week c) Every six month d) Once a week e) Before project and every 3 month f) Before project and every 3 month g) Once a three months h) Once a day 	Contractor	Part of contractor's contract
	<ul style="list-style-type: none"> ▪ Measurement of noise level 	<ul style="list-style-type: none"> ▪ Noise level 	<ul style="list-style-type: none"> ▪ Jhaputar and Damauli (close to District Public Health Office), and Beltar (near the school) 	<ul style="list-style-type: none"> ▪ Twice a year <p>Baseline data shall be taken before the construction.</p>	Contractor/ EMSU-PMO-NEA	Included in the lump sum cost mentioned in air quality (dust) measurement.

Project Phase	Method and Scope	Parameter	Location	Frequency	Responsibility	Cost (NR)
	<ul style="list-style-type: none"> ▪ Compliance of mitigation measures for noise 	<ul style="list-style-type: none"> a) Placement of noise arresting equipment b) Correct fitting of silencers, mufflers and acoustic shields c) Maintenance of plant and equipment d) Blasting restriction provisions as negotiated e) Blasting design and follow ups 	<ul style="list-style-type: none"> a) Construction site near the residential area b) Construction vehicles and machineries c) All over the construction sites d) Blasting site e) Blasting site 	<ul style="list-style-type: none"> a) Once before construction b) Once a three months c) Once a three months d) Once a day e) Once a three months f) Once a week 	Contractor	Part of contractor's contract
	<ul style="list-style-type: none"> ▪ Compliance of mitigation measures for land instability and erosion 	<ul style="list-style-type: none"> a) Vegetation clearance only to required limits b) Excavation works only to required limit by the design c) Side casting of excavated earth d) Management of spoil in the designated area e) Maintenance of toe protection structure, and drainage structure at spoil disposal; and sedimentation tank at batching yard, spoil disposal area and tunnel discharge areas f) Civil and bio-engineering protection works and their maintenance (including side drains) at access roads 	<ul style="list-style-type: none"> a) Along the project boundary such as FSL 415m area for the reservoir, dam site, and project facility sites. b) All over the construction site c) All over the construction site d) All over the construction site e) Batching yard, spoil disposal area and tunnel discharge areas f) Along the access roads 	<ul style="list-style-type: none"> a) Once a month b) Once a week c) Once a day d) Once a day e) Once a month f) Once a month 	Contractor	Part of contractor's contract
B. Biological Environment						
<ul style="list-style-type: none"> ▪ Land acquisition ▪ Vegetation clearing/tree cutting ▪ Excavation works ▪ Foundation works 	<ul style="list-style-type: none"> ▪ Compliance of mitigation measures for illegal tree cutting and poaching through frequent patrol activity 	<ul style="list-style-type: none"> ▪ Identification of illegal tree cutting and poaching 	<ul style="list-style-type: none"> ▪ All over the construction site and adjacent area 	Frequent and at random patrol	Contractor	Part of contractor's contract
	<ul style="list-style-type: none"> ▪ Habitat loss around the project sites 	<ul style="list-style-type: none"> ▪ Number of habitat loss identified before construction 	<ul style="list-style-type: none"> ▪ All over the construction site and adjacent area 	Every four months	Contractor/ EMSU-PMO-NEA	NRs 1 million

Project Phase	Method and Scope	Parameter	Location	Frequency	Responsibility	Cost (NR)
	<ul style="list-style-type: none"> Species occurrence around project sites 	<ul style="list-style-type: none"> Number of wildlife species 	<ul style="list-style-type: none"> All over the construction site and adjacent area 	Every four months	Contractor/ EMSU-PMO-NEA	
	<ul style="list-style-type: none"> Construction disturbances around project sites 	<ul style="list-style-type: none"> Damage to habitat and/or death of wildlife due to construction activity 	<ul style="list-style-type: none"> All over the construction site and adjacent area 	Once a week	Contractor/ EMSU-PMO-NEA	
	<ul style="list-style-type: none"> Mitigation measures compliance for wildlife conservation 	<ul style="list-style-type: none"> Implementation of the proposed measures based on designated schedule 	<ul style="list-style-type: none"> All over the construction site and adjacent area 	Every four months	Contractor/ EMSU-PMO-NEA	
	<ul style="list-style-type: none"> Aquatic life and ecology survey (fish, phytoplankton, zooplankton and aquatic insects) 	<ul style="list-style-type: none"> Identification of aquatic species 	<ul style="list-style-type: none"> 7 baseline stations 	Every six months (dry season and wet season) for 5 years	Contractor/ EMSU-PMO-NEA	NRs 1 million
	<ul style="list-style-type: none"> Observation of compliance of contractual mitigation clauses 	<ul style="list-style-type: none"> Adequate implementation of the mitigation measures 	<ul style="list-style-type: none"> At the designated location of the measures 	Every three months	Contractor	Part of contractor's contract

Project Phase	Method and Scope	Parameter	Location	Frequency	Responsibility	Cost (NR)
2. Operation and Maintenance Period						
A. Physical Environment						
<ul style="list-style-type: none"> ▪ Operation and maintenance of dam 	<ul style="list-style-type: none"> ▪ Water sampling and analysis (except reservoir area) 	<ul style="list-style-type: none"> ▪ Flow velocity, discharge, water temperature, pH, conductivity, total suspended solids (TSS), total phosphorous (T-P), Total Kjeldahl Nitrogen (TKN), ammonia (NH₃), nitrate, nitrite, dissolved oxygen (DO), and BOD₅ 	<ol style="list-style-type: none"> 1) Upstream of the reservoir, 2) Confluence with the Madi River, 3) Immediate downstream of the tailrace outlet 	5 times a year in 4 seasons (November, March, beginning of June before the sediment flushing operation, end of July after the sediment flushing operation, and September)	EMSU-PMO-NEA	NRs 3 million for 20 years
	<ul style="list-style-type: none"> ▪ Water sampling and analysis (reservoir area: close to the dam site) 	<ol style="list-style-type: none"> a) Water temperature, turbidity, DO b) pH, BOD/COD, SS, coliform counts, chlorophyll a, Pheophytin, inorganic nitrogen (I-N), inorganic phosphorus (I-P) c) Ingredient of bottom sediment d) Phytoplankton e) Heavy metals, hazardous substances, carcinogenic substance 	<ol style="list-style-type: none"> a) 0.1 m from the water surface, 0.5 m from the water surface, 1 m interval from the water surface to the bottom b) Surface layer (0.5 m from the water surface) Middle layer (half of the water depth) Bottom layer (1 m above from the bottom) c) First surface layer of the sediment d) Surface layer of water e) Surface layer of water 	<ol style="list-style-type: none"> a) Once a month b) Once a month c) Twice a year (End of May just before the sediment flushing operation, and November after stabilizing the bottom condition) d) Once a month e) Twice a year in dry season and rainy season) 	EMSU-PMO-NEA	Included in the above.
	<ul style="list-style-type: none"> ▪ Monitoring of riverbed sedimentation and erosion 	<ul style="list-style-type: none"> ▪ Riverbed sedimentation and erosion 	<ul style="list-style-type: none"> ▪ Several designated locations in the downstream riverbed 	Once a year in dry season	EMSU-PMO-NEA	NRs 2 million for 20 years

Project Phase	Method and Scope	Parameter	Location	Frequency	Responsibility	Cost (NR)	
B. Biological Environment							
<ul style="list-style-type: none"> ▪ Operation and maintenance of dam 	<ul style="list-style-type: none"> ▪ Transect survey for wildlife 	<ul style="list-style-type: none"> ▪ Wildlife species and population, habitat condition 	<ul style="list-style-type: none"> ▪ All over the construction site and adjacent area 	Every 3 years for 20 years	EMSU-PMO-NEA	NRs 1.2 million	
	<ul style="list-style-type: none"> ▪ Aquatic ecology survey for impact analysis 	<ul style="list-style-type: none"> ▪ Species composition 	<ul style="list-style-type: none"> ▪ 7 baseline stations 	<ul style="list-style-type: none"> ▪ 7 baseline stations 	Every six months after 2 years of the project operation, Once a year for 10 years	EMSU-PMO-NEA	NRs 3 million
	<ul style="list-style-type: none"> ▪ Compliance of mitigation measures for aquatic lives 	<ul style="list-style-type: none"> a) Compliance to release of environmental flows at Seti b) Compliance to restriction of fishing activities below tailrace c) Compliance to fish stocking, fish release in the reservoir and downstream area 	<ul style="list-style-type: none"> a) Dam site b) Downstream area of the tailrace c) reservoir and downstream area 	<ul style="list-style-type: none"> a) Dam site b) Downstream area of the tailrace c) reservoir and downstream area 	<ul style="list-style-type: none"> a) Daily b) Daily c) Once a year for project life 	EMSU-PMO-NEA	Part of project operation cost

1.7 記録と是正措置

環境管理計画を順守するためにも、建設業者は、建設期間中の環境影響軽減策や改善策の実施、モニタリング状況について毎日記録をつけて保持する必要がある。環境モニタリング・サブユニットは、建設期間中、監督エンジニアと共にモニタリング業務を行い、隔月のモニタリング報告書を作成する。同サブユニットも、建設業者に対して提言した是正措置や業務の遂行状況の記録をとる必要がある。同サブユニットが住民移転・社会アクション実施・サブユニットと協力して作成した隔月のモニタリング報告書は、プロジェクトマネージャーの承認後に、コメントや提言を得るために関係者に配布する。環境社会モニタリング・ユニットは、プロジェクトの建設が完了してから3ヵ月以内に最終環境モニタリング報告書を取りまとめ、プロジェクトに提出する必要がある。プロジェクトは、フィードバックを得るために関係者に回覧し、将来のプロジェクトに活用できるよう、環境管理業務のデータベースを提供することが求められている。

1.8 環境監査

“Environmental Protection Rules”の規定によると、環境科学技術省がプロジェクトの運用2年後に、環境監査の報告書を準備しなければならない。この監査は、環境社会モニタリング・ユニットや監督エンジニア、有識者で構成される専門家委員会が、現地踏査の結果や回収されたデータを用いて作成した一連のモニタリング報告書をもとに行われる。プロジェクトの監査報告書の中では、提案されていた環境面の要求に対してどの程度プロジェクトが対応できているかが最終評価されるほか、環境軽減策・改善策や制度開発の有効性の検証、さらにはプロジェクト活動によって予期せぬ影響がもたらされていなかどうかなどが評価、議論される。監査は環境科学技術省の業務であるが、十分な予算措置がなされていないことが多いため、事業者は監査費用としておよそ35万ルピーをあらかじめ確保したほうがよいだろう。

1.9 環境管理費の要約

Table 1.9-1とTable 1.9-2に建設前、建設期、運転期に必要な環境管理費を提示する。またTable 1.9-3に、プロジェクトの環境管理費の総額を示す。

Table 1.9-1 Environmental Costs in Pre-construction and Construction Phase

Physical Environment	
Cost for Clearing the Vegetation in the Reservoir	43.10
Monitoring for Air, Water, Noise, Vibrations & Spoil Management at Works Areas	5.32
Watershed Management Programs for 10 Years*	111.50
Mitigation Measures for Eutrophication	63.6
Grand Total (million NRs)	223.52
Biological Environment	
Cost for Clearing the Vegetation in Reservoir	3.72
Support to Kaligandaki A Hatchery for 5 Years	73.5
Capture & Release of Wildlife including 2 Reptile Species	0.5
Fish Monitoring during the Construction Phase	1
Grand Total (million NRs)	78.72
Compensation and Rehabilitation	
Cost Estimation for the Private Land	999.51
Cost Estimation for the Structures	33.972
Cost Estimates for Agriculture Production Equivalent to One Year Production	0.663
Other Rehabilitation Compensation to Relocate	90.88
Transportation Allowance to affected Structure Owners Other than the Affected Residential Structure Owners	0.47
Grand Total (million NRs)	1125.5
Social Action Plan	
Replacement of Affected Infrastructures by the Reservoir	85.5
Community's Initiative Support Program	52.13
Skill Enhancement and employment	10.14
Agricultural Development Programs	27.51
Community/Public Health and Education Enhancement Programs at the Project Construction sites	9.66
Community/Public Health and Education Enhancement Programs at the Reservoir affected VDCs	6.27
Women Development Program	13.03
Watershed Management Programs	12.31
Rural Electrification Programs	19.55
Total (million NRs)	236.10

Table 1.9-2 Environmental Costs in Operation Phase

Physical Environment	
Measures for Downstream Effects	3.8
Monitoring of Water Quality in Reservoir & Surrounds for 20 Years X 2 Times / Year	3.0
Monitoring of Reservoir & River Bed Sedimentation and Erosion for 20 Years X Once / Year	2.0
Grand Total (million NRs)	8.8
Biological Environment	
Compensation to Dept of Forestry for Trees, Community Forests & to Private Tree Owners	287.8
Annual Release of Purchased Carp fry & extras – 20 years	80
Fisheries Extension Program for Reservoir Area	10
Wildlife Monitor in the Reservoir Area	0.5
Monitoring of Wildlife for 10 Years	1.2
Fish Monitoring for 10 Years	3.0
Grand Total (million NRs)	382.5
Socio-economic Environment	
Monitoring of affected people and communities for 10 years	1.80
Grand Total (million NRs)	1.80

Table 1.9-3 Administrative and Management Cost

Administrative and Management Cost	
Consultant Remuneration	17.34
Support facilities	32.47
Information Dissemination and Feedback	1.70
Grand Total (million NRs)	51.51

Table 1.9-4 Summary of Environmental Cost

Summary of Environmental Cost		
1	Physical Environmental Cost	224
2	Biological Environmental Cost	461
3	Cost for Compensation and Rehabilitation	1,126
4	Social Action Plan	236
5.	Socio-Economic Environment	2
6	Administrative and Management Cost	52
Grand Total (million NRs)		2,101